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POSSIBILITIES AND THE EFFECTS OF INTRODUCING SUPERBLOCKS IN ZAGREB LOWER TOWN

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Abstract

This paper investigates the spatial and technical possibilities for transforming the Croatian capital Zagreb Lower Town street network according to the principle of superblocks. Superblock is an innovative intervention in the use of urban areas, the goal of which is to restore space for residents' recreation, reduce motorised traffic, promote sustainable mobility and an active lifestyle, ensure the greening of the area, and thereby reduce the effects of climate change, all while improving the functioning of the entire transport system. The initial analysis based on the publicly available literature, spatial and statistical data, and regulations showed that the Lower Town area could be divided into 15 superblocks, of which the potential of one specific superblock was analysed in detail. Based on the collected data on traffic and infrastructure, an analysis of the current state of the pedestrian and motor system was performed. The quality of the chosen superblock transport network was evaluated, and a proposal was made to transform it by implementing eight measures. Based on the re-evaluated results following the implementation of the proposed measures, it was concluded that small interventions in the superblock infrastructure, i.e. modifications of transport corridors that do not require extensive construction works, can provide an environment that would improve the quality of the entire transport system.

Keywords: Zagreb, superblock, urban transport systems, transport infrastructure, measures, quality analysis

1 Introduction

Any city that wants to be competitive in an intensive process of economic globalisation must emphasise its flexibility in meeting the welfare, commercial and transport needs of its inhabitants [1]. The urban transport system should be adapted to all population groups while ensuring the necessary safety for all users, with a focus on pedestrians and cyclists as the most vulnerable groups [2]. However, as historic city centres are often characterised by dense development and narrow traffic corridors, mobility in these areas is low, especially for pedestrians and cyclists. The historic Lower Town area in Croatia's capital Zagreb, with residential and commercial buildings and infrastructure dating from the beginning of the 20th century, is no exception.
The complex traffic situation in Lower Town (presented in more detail in Section 2) has been analysed in urban planning studies and documents [3-6]. They all have proposed the following measures for transport system improvements: integration of the street network, integration of public traffic, construction of garage parking spaces, development of traffic monitoring and management system, improvement of bicycle and pedestrian infrastructure, and introduction of new pedestrian zones.

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However, the main problem in implementing these measures is that the Lower Town central area is protected due to its historical architecture. This means that introducing new structures and infrastructures is strictly controlled and must be minimal. Therefore, the superblock model has been proposed to improve mobility in the Lower Town in the recently created urban mobility development Program [7]. According to [8-10], it's expected that the application of the superblock model could lead to a reduction in car traffic within the superblock, but also on the peripheral main streets. This would result in less congestion thanks to fewer turns into the superblock. The design of the superblock could reduce the amount of space dedicated to cars, allowing the use of alternative modes of transport and the development of public open and green spaces, which would improve the quality of life and sustainability. This paper presents the main findings of the Master thesis [11] that examined the potential of (re)organising the transport system of the Lower Town based on the superblock model. Additionally, to test if the abovementioned benefits of introducing superblocks could be achieved in local conditions, an analysis of the quality of the existing infrastructure and traffic conditions was carried out for one potential superblock bordering the planned underground garage containing 800 parking lots.
Based on the results of the analysis, several measures for the conversion of superblock transport corridors freed from on-street parking were proposed. The following premises guided the measures proposal: (1) achieving sustainable mobility, where cycling and walking play the dominant role, (2) achieving urban greening as an effective mitigation option for climate change, and (3) performing small interventions, i.e. those that will not require extensive construction works. Finally, the effect of the proposed measures on spatial and traffic conditions within one superblock was analysed.

2 Lower Town superblocks proposal

According to [12], Lower Town's 3 square kilometres (0.5% of the total city area) is inhabited by 5% of the city population, and the average population density is 8 times higher than in the rest of the city (Fig. 1.a). Although the area is predominantly mixed in use (residential and commercial, Fig. 1.b), it includes the narrowest city centre where most of the public and cultural life is concentrated (Fig. 1.c).
Lower Town has an extensive public transport network, especially tram network (Fig 2.a). The transport system is largely determined by the location of the railway and the Central Railway Station at Lower Town's southern border (Fig. 2.a). The main problem of public transport is the lack of its integration, low travelling speed along shared corridors, and low number of urban and suburban rail lines operating well below the designed capacity [7, 13].
According to [7], 70% of car traffic is transiting through the Lower Town along its two main arteries - longitudinal parallel three-lane one-way streets with coordinated traffic lights ("green waves"), and two transverse multi-lane one-way streets. The rest of the traffic uses a fragmented minor street network (Fig. 2.b). Traffic congestion problems often occur, especially in the central part of Lower Town where the public and private vehicles crawl at speeds of 10-20 km/h during the morning and afternoon peak hours.
In addition to car traffic, the network is occupied by stationary and parked vehicles. 8,000 on-street parking spaces encourage car use and reduce the space for pedestrians and cyclists.
A 10-ha pedestrian zone around the central town square consists of several interconnected squares, streets, and passages (Fig 2.b). The rest of the pedestrian infrastructure consists of raised pavements, most of which are too narrow for the intense pedestrian traffic. The main lack of cycling infrastructure is its discontinuity, a lack of a clear vision for its implementation, and the fact that it is mostly established at the expense of pedestrians, on pavements, which creates unsafe traffic conditions for both (Fig. 2.c).

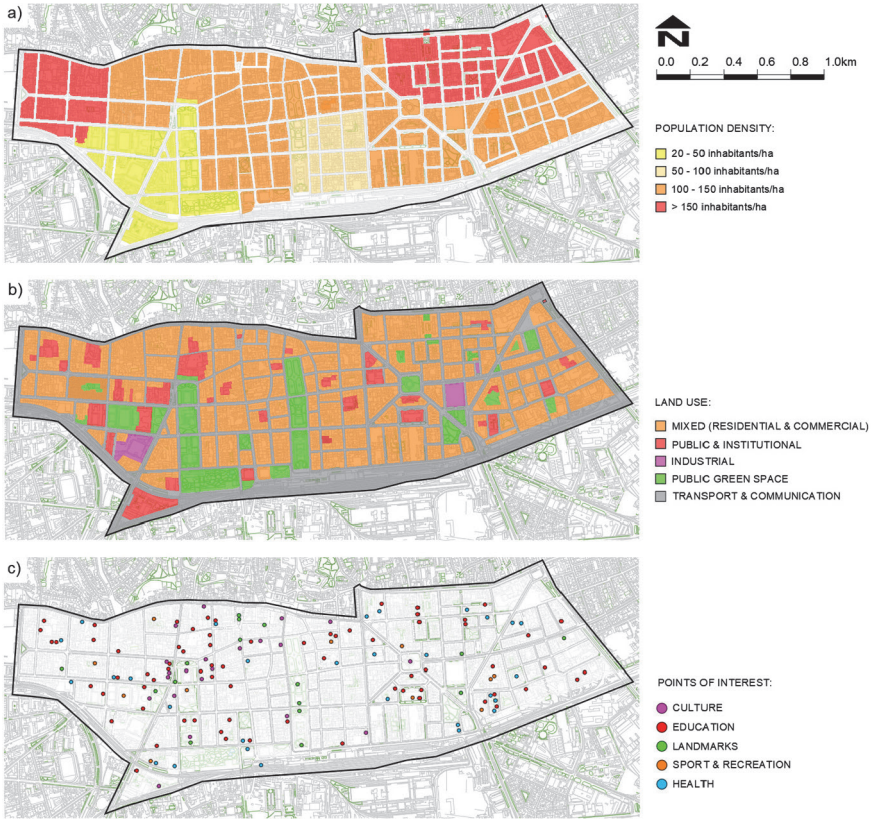

Figure 1 Lower Town spatial characteristics

The analysis showed that the Lower Town area can be divided into 15 superblocks (Fig. 3.) The approach taken to form superblocks involved the following criteria: (1) the dimensions of the planned superblocks are approximately 500 by 500 meters (enabling easy access to the facilities inside the superblock by walking or cycling), (2) each superblock is bordered, at least on one side, by the main street with public city transport, and (3) the remaining streets bordering the superblock are those with higher traffic intensity. A more detailed analysis of the superblock highlighted in Fig.3. is presented in Section 3.

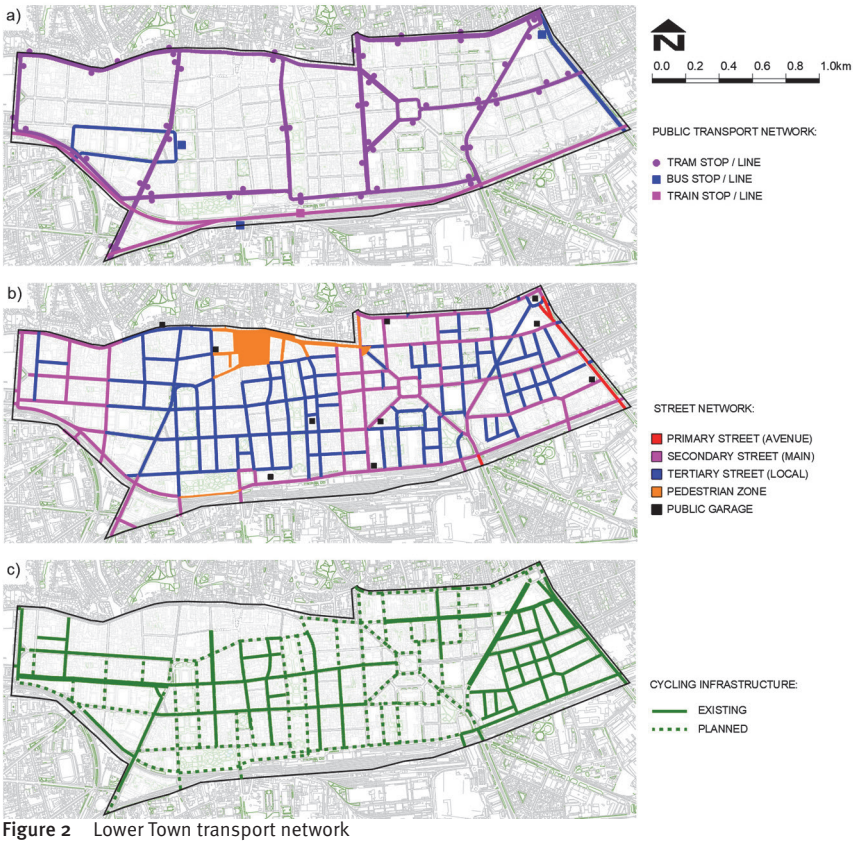

Figure 2 Lower Town transport network

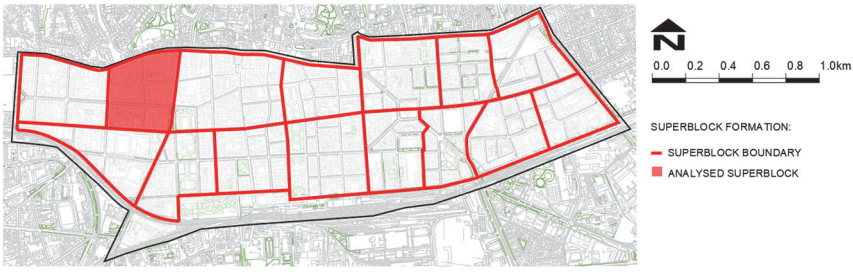

Figure 3 Proposed Lower Town superblock formation

3 Superblock analysis

The highlighted superblock in Fig. 3 borders a planned underground garage with 800 parking spaces on its south side. This garage will allow the elimination of most of the 450 on-street parking spaces within the superblock. The question posed in this investigation is: can the newly available street space be used to improve the sustainability and quality of life within the superblock with some small infrastructure interventions once the garage is operational? To answer this question, the quality of the existing infrastructure and traffic conditions for motor vehicles and pedestrians were analysed along the transport corridors within the superblock.

Characteristics of the current transport infrastructure were gathered through field investigations and cadastral and orthophoto maps. Data on existing motor and pedestrian traffic was obtained from traffic surveys conducted in October 2021 and 2022.
The level of service (LOS) for pedestrian and motor traffic was calculated at 7 signalized intersections within the superblock using the Highway Capacity Manual 4th edition methodology. LOS was based on the average delay experienced by a motorist expressed as seconds per personal car (s/pc) and pedestrian expressed as seconds per pedestrian (s/p). The pedestrian LOS was also evaluated based on crossing time-space expressed as available space per pedestrian at crossing (m^2/p). Since the analysis of the existing infrastructure showed that pavements mostly do not meet the minimum width prescribed by the valid regulations and spatial documents, the third LOS measure for pedestrians (pedestrian area requirements at street corners) was not considered.
After analysing the LOS results shown in Fig. 4, eight measures were proposed for converting superblock transport corridors that are freed from on-street parking. The proposed measures include: (1) introducing a speed limit of 30 km/h within the superblock, (2) restricting heavy traffic within the superblock, (3) abolishing most on-street parking spaces (except for spaces designated for persons with reduced mobility, delivery, and emergency vehicles), (4) introducing green infrastructure such as treelines, rain gardens, and bioswales, (5) expanding pedestrian crossings to a minimum width of 500 cm, (6) introducing curb extensions at intersections, (7) abolishing bicycle lanes on sidewalks and crossings, and (8) introducing a two-way bicycle lane and bicycle parking lots along the main W-E superblock street. Changes in lane utilization, the motor vehicles' trajectories, and the traffic lights cycle phases were not considered to ensure the functionality of the Lower Town "green waves". Also, only measure (5) was introduced along the bordering streets of the superblock, which are served by the tram public transport system. This is due to the risk of harming the already low quality of tram traffic along these sections. After the reconfiguration of the corridors and traffic conditions, the LOS evaluation was carried out again. A comparison of the LOS results showed that introducing the proposed measures improves the LOS for all users (Fig. 4).

Figure 4 LOS evaluation results at 7 signalized superblock intersections before and after the garage construction and proposed 8 measures implementation

The introduction of the proposed measures could reduce the overall average delay for motorized street users along the superblock by 40%. A significant reduction in delay (by 80 s/pc and 20 s/pc) could be achieved at the two S-E intersections (Fig. 4.a). Today, the poor LOS on these 3-lane approaches is caused by oversaturation of the central lane. It is a consequence of drivers' desire to avoid interference by both properly parked and improperly stopped vehicles. The evaluation assumed that the construction of the underground garage would eliminate this problem, contributing to an even distribution of the traffic on the lanes. Given that the traffic light phases were not changed, the average control delay experienced by pedestrians remained the same (Fig. 4.b), averaging 17 s/p. On the other hand, the expansion of the pedestrian crossing width and the introduction of curb extensions enhanced the available space per pedestrian at crossings (Fig. 4.c), on average by 30%.
Today, 58% of superblock transport areas are dedicated to motor vehicles, whether moving or stationary. Reduction of on-street parking areas by 92% could enable the reconfiguration of 19% of the corridor area to green and pedestrian infrastructure, corresponding to an increase in pedestrian areas by 19% and green areas by 88%. Fig. 5 shows the planned rededication of the superblock transport corridors area. The values in brackets show the share of rededicated areas in the total transport corridors area.

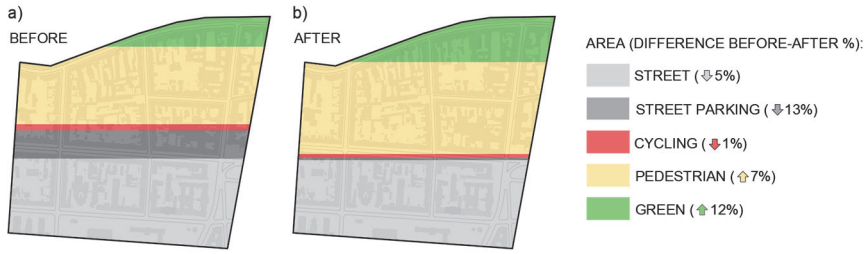

Figure 5 Superblock transport corridors use before and after the garage construction and proposed 8 measures implementation i.e. area rededication

4 Conclusions

In the last century, wide lanes for traffic and little space for people became the norm in most parts of the world, dividing cities, slowing economic growth, and causing dangerous traffic jams. Every time they invest in transport infrastructure, cities have a choice: should they focus on the car, leading to a sprawling, high-quality street network and the isolation of city centres, or should they grow sustainably by promoting denser and more compact neighbourhoods with better transport links? This new approach to the street (re)design, centred on people and green spaces, has been proposed in recent years by Zagreb urban planners through the introduction of superblocks in the city's Lower Town and explored in this paper.
The analysis of the spatial, social, and transport characteristics carried out showed that the area of the Lower Town could be divided into 15 superblocks. It also showed that a more efficient formation of superblocks could be achieved if the railway corridor for international traffic, which stretches along the southern border of the Lower Town, wouldn't present a physical obstacle to transport integration with the southern urban areas. Another problem with the transport system in the Lower Town is the large number of on-street parking spaces that restrict both motorised and non-motorised mobility along the street network. This problem should be tackled soon by building several underground garages. However, the additional question to be answered by this investigation was how this newly available street space could be utilised to improve sustainability and quality of life in the Lower Town superblocks.

The investigation was performed by analysing the quality of the existing and planned infrastructure and traffic conditions for motor vehicles and pedestrians within one defined Lower Town superblock. The results of the investigation show that sustainable mobility and urban greening in the analysed superblock could be achieved through cost-effective, small interventions along transport corridors within the superblock, e.g. by introducing a 30 km/h speed limit and restricting heavy traffic, introducing green infrastructure, expanding pedestrian crossings, introducing curb extensions and separate cycle lanes.

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