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CONCEPTUAL DESIGN FOR URBAN STREET RECONSTRUCTION USING THE SHARED SPACE APPROACH

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Abstract

Shared space is an innovative approach to urban design aimed at improving the safety and functionality of traffic areas by integrating different users of the space. This paper investigates the potential application of the shared space concept to Hallerova Aleja Street in Varaždin, a key thoroughfare due to its proximity to educational institutions and high pedestrian traffic. The objective of this research is to assess the expected effects of implementing the shared space approach on traffic safety and user experience in an urban setting. Specifically, the research aims to predict how the removal of traditional traffic elements and the encouragement of direct communication between drivers and pedestrians might influence vehicle speed, pedestrian safety, and levels of noise and pollution. The research is based on a combination of simulations, predictive models, and surveys. Traffic flow and simulations are used to forecast changes in traffic conditions following the implementation of the shared space approach. Predictive risk analysis models evaluate potential impacts on pedestrian safety. It is anticipated that the implementation of the shared space solution will reduce vehicle speeds, enhance pedestrian safety, and decrease levels of noise and air pollution. Predictive models suggest a reduction in the number of traffic accidents and an increase in perceived safety among pedestrians. The research indicates that the application of the shared space concept has significant potential to improve the safety and functionality of urban streets. Predicted outcomes suggest reduced vehicle speeds, enhanced pedestrian safety, and improved environmental conditions.

Key words: *shared space, traffic safety, urban reconstruction, traffic calming.*

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1. Introduction

For most of the 20th century, it was thought that increasing traffic safety was achieved by separating vehicles from other road users. Thus, the cobblestones became concrete or asphalt, traffic signals were set up, pedestrian paths were built and pedestrian crossings were marked as part of the pavement surface intended for pedestrians crossing the pavement. Intersections were considered too complex and were regulated by traffic lights. Probably no city in the world, not a single street, is inconceivable without traffic signs warning traffic participants of the danger that threatens them on a particular road or part of that road, making them aware of the restrictions, prohibitions and obligations that traffic participants must adhere to and provide the necessary information for a safe and uninterrupted flow of traffic (Cvitković, 2022).

Walking with company and presence of high level pedestrian traffic flow in a street can increase the road safety level. Jacobsen (2003) concluded that doubling the pedestrian volume results to 32% reduction of traffic crashes with injuries. This can be explained because drivers are aware of pedestrians' presence and adapt their driving behavior. Higher vehicle speeds increase both the likelihood of a pedestrian being struck by a car and the severity of injury (Rosen and Sander, 2009).

However, the authorities of some small European cities decided to conduct a survey and removed all traffic signs from the roads. The city of Drachten in the Netherlands, the German city of Bomte and others were included in such research. About eight accidents had occurred in Drachten a year earlier, and after the removal of traffic signs, their number was zero. It is important to note that up to 50 traffic accidents occurred in Bomte in a year, but after the traffic signs were removed, all problems were solved. There is only one street sign in the city, informing pedestrians and cyclists, who have to share the road with drivers. Traffic regulation is thus reduced to mutual negotiation and respect for all users. Although it sounds like a framework for creating complete traffic chaos, the model has proven successful. Without traffic lights, drivers slowed down and became more considerate of other city traffic participants. Pedestrians feel safer and life is slowly returning to the centers of some small European cities, which can be seen in economic indicators.

Pedestrians are 1.5 times more likely than passenger vehicle occupants to be killed in a car crash on each trip (Beck et al., 2007). In 2016, 5.320 pedestrians were killed in road accidents in the EU (excluding Lithuania and Slovakia), which is 21% of all road fatalities. During the decade 2007-2016, in the European Union, pedestrian fatalities were reduced by 36%, while the total number of fatalities was reduced by almost 41%. Child pedestrians are unprotected users of the road vulnerable from the speeding vehicles and powerless of making mature judgments to minimize their risk of harm from traffic. While modifying the environment can enhance the safety for child pedestrians (Morris, Wang, & Lilja, 2001).

Modern experimented with simple designs and landscaping which emphasised the 'distinctive history and context' of the village by deliberately

removing or downgrading usual street elements such as signs, road markings, chicanes and road humps. Oudehaske was the first time Monderman tried to “make a village more like a village” (Engwicht, 2006) and even he was surprised when speeds on the street dropped by 40% (conventional 'traffic calming' was achieving reductions closer to 10%) (Hamilton-Baillie, 2008a).

1.1 Description of the current situation and traffic counting methods

A pedestrian must use the sidewalk or another surface designated for pedestrian movement, or a surface adjacent to the road suitable for walking. If there are no pedestrian paths, pedestrians must walk along the edge of the road in single file, without obstructing vehicle traffic. On roads outside urban areas, a pedestrian is required to walk along the left edge of the road in the direction of traffic. Exceptionally, a pedestrian may walk on the right edge of the road outside urban areas only when this is safer for them. Furthermore, a review of Google Street shows a large number of pedestrians walking on the road. The presence of pedestrians on the roadway is particularly high during the hours of school start and end times, as shown in the photos below (Cvitković, 2022).

Figure 1: Google street view photos from Haller Avenue, Varazdin.

Determining traffic flows is one of the most important pieces of information in traffic planning. The intensity and structure of traffic flows on the road network within the coverage area, as well as transit traffic through Hallerova Avenue, were determined using license plate counting on vehicles.

Traffic flows that were not directly surveyed were obtained through approximation and interpolation methods. Traffic counting established the

relationships in traffic flow within the coverage area, providing an overview of internal traffic movement.

2. Results and analysis of traffic data

Since traffic was measured during peak and off-peak hours, the resulting traffic picture serves as a basis for planning traffic under different conditions. The obtained traffic data, along with demographic information and elements of gross domestic product (GDP) growth, can serve as key elements in preparing a traffic forecast.

Traffic counting at the intersection of Hallerova Avenue and Vrazova Street was conducted during a characteristic day of the week. To facilitate determining the intensity of traffic flows, each group of vehicles was weighted with a specific coefficient and converted to a single unit called "PCU" (Passenger Car Unit). The coefficients were as follows: passenger cars 1, heavy vehicles 1.5, buses 2, motorcycles 0.5, and bicycles 0.3.

Pedestrian flows were also counted separately and highlighted in graphical representations.

Traffic counting was conducted between 6:00 AM and 6:00 PM. To accurately determine the characteristics of the analyzed flows and oscillations within an hour, each hour was divided into 15-minute intervals. All counts are presented in the following appendices.

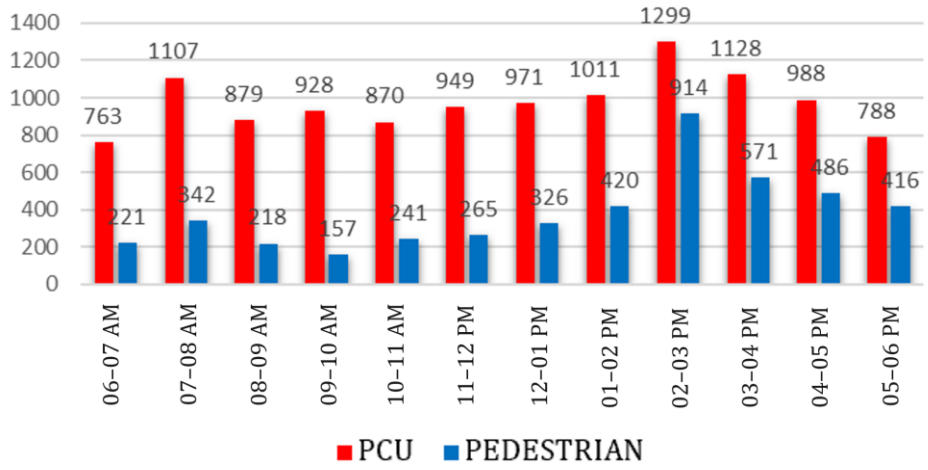

Figure 2: Hourly Intersection Load – PCU and Pedestrians

The highest hourly load at the Hallerova Avenue – Vrazova Street intersection was recorded between 2:00 PM and 3:00 PM, amounting to 1,299 PCU, while the pedestrian flow also peaked during this hour with 914 pedestrians passing through the intersection.

The lowest hourly load was recorded during the morning interval from 6:00 AM to 7:00 AM, with 763 PCU passing through the intersection, while the lowest pedestrian load was recorded between 9:00 AM and 10:00 AM, with 157 pedestrians.

These data are essential for easily verifying the modal split and flow distribution. Simulations have shown that the new flow redistribution will not significantly impact increased congestion in this traffic flow.

Traffic Counting - Vehicle License Plate Recording Method involves recording vehicle license plates that pass through a specific area. In the case of this study, counters were placed at the entrances to Hallerova Avenue from Vrazova Street and Gustav Krklec Street, and they recorded the license plates of vehicles entering and exiting Hallerova Avenue during the period from 6:00 AM to 4:00 PM. To accurately determine the characteristics of the analyzed flows and the oscillations within an hour, each hour was divided into 15-minute intervals. Since the objective of this study is to calm traffic in the area and create a "shared space" street, this counting was necessary to determine the number of vehicles that will be "redistributed" to other streets and intersections after the reconstruction of the street, thus discouraging simple transit through the street. Other vehicles that have a purpose to stay in the area for a certain period during the day will be able to move through the street without hindrance, following the rules that will be defined during the reconstruction.

Table 1 show the distribution of vehicles performing transit through the area versus vehicles that remain within the mentioned area.

Table 1: Distribution of Vehicles Performing Transit Through the Area Versus Vehicles Remaining Within the Area

TIME	Entry/Exit	Transit	TOTAL
6:00 AM - 7:00 AM	177	111	288
7:00 AM - 8:00 AM	338	157	495
8:00 AM - 9:00 AM	176	118	294
9:00 AM - 10:00 AM	216	86	302
10:00 AM - 11:00 AM	160	200	360
11:00 AM - 12:00 PM	106	234	340
12:00 PM - 01:00 PM	231	194	425
01:00 PM - 02:00 PM	298	179	477
02:00 PM - 03:00 PM	289	234	523
03:00 PM - 04:00 PM	203	247	450

Based on the obtained data, it can be concluded that transit vehicles make up an average of 44% of the vehicles passing through Hallerova Avenue daily. Given that approximately 10% of these numbers are registrations from other cities (ČK, DA, ZG, and even foreign registrations), it can be inferred that these cars do not use transit through Hallerova Avenue on a daily basis but were only present on that particular day. Therefore, it is likely that the actual percentage is closer to 35% of the total number.

Traffic flow simulation has shown that a certain number of vehicles will redistribute across other parts of the traffic network, and over time, drivers will self-select alternative routes that best suit their daily routines. In this way, Hallerova Avenue will, as expected, become less congested, providing more opportunities for the "new" users of this space, namely pedestrians and cyclists.

3. Designing inclusive areas for pedestrians, cyclists, and vehicles through shared space principles

Shared urban spaces represent a paradigm shift in urban planning, one that focuses on reducing the barriers between different users of the streets—pedestrians, cyclists, and vehicles—thus fostering an environment of shared responsibility. Designing such spaces requires a careful balance between functionality, safety, and aesthetic value, ensuring that all users coexist harmoniously.

A key consideration in shared urban spaces is promoting direct interaction between users without the reliance on traditional regulatory infrastructure like traffic lights and signs. Removing these elements encourages individuals—drivers, cyclists, and pedestrians alike—to make eye contact and negotiate right-of-way in real time. This not only enhances safety by fostering attentiveness but also adds to the overall user experience by cultivating a sense of mutual respect and shared community.

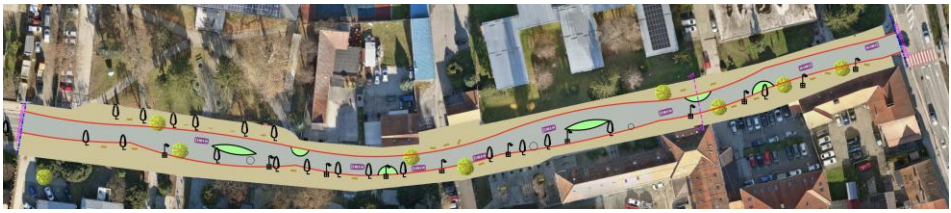

Figure 3: Situation with representation of the construction solution

In designing inclusive areas, urban planners must provide the necessary infrastructure that caters to the needs of all users. For pedestrians, this means creating comfortable walking paths, adequate resting places, and ensuring accessibility for people with disabilities. Benches, green areas, and resting zones enhance the experience for pedestrians, transforming streets from merely transit zones to places for leisure and community activities.

For cyclists, integrating safe and direct cycling routes within shared space is essential. Bike racks, dedicated lanes, and clear signals are crucial for maintaining a smooth flow of cycling traffic without conflicting with pedestrian or vehicular paths. Shared spaces should encourage cycling as a practical and sustainable means of transport, offering clear paths that blend seamlessly with pedestrian areas while maintaining a level of safety.

Vehicles, although not the primary focus of shared spaces, must still be accommodated thoughtfully. Traffic calming measures such as narrowing lanes, adding speed humps, and utilizing textured surfaces help reduce vehicle speeds and create a safer environment for all. The design should subtly signal to drivers that the space is not solely for them but shared with more vulnerable users, thereby promoting slower and more cautious driving behavior.

Additionally, landscaping and urban furniture play vital roles in defining the character and functionality of shared spaces. Trees, plants, and well-designed street furniture not only improve aesthetics but also serve as natural separators that guide users through the space. Strategic placement of elements like trash bins, tables, and seating arrangements can subtly direct the flow of movement and indicate areas for rest and socializing.

Urban planners must also ensure flexibility in the design to accommodate varying levels of traffic and different types of activities. During school hours, for example, streets near educational institutions might need to prioritize pedestrian movement, whereas in the evenings, they may serve a more mixed-use purpose. Proper lighting, clear pathways, and adaptable street furniture arrangements are all crucial in making these spaces versatile and welcoming at different times of the day.

After project approval, the next step is the coordination between urban planners, architects, and local authorities to refine the shared space features to align with the community's specific needs. Continuous community engagement and feedback are vital to ensure that the shared spaces truly serve their intended purpose and evolve in response to user experiences.

Figure 4: Situation with representation of the construction solution

The figure 3 and 4 shows a conceptual rendering of Hallerova Aleja after its transformation into a shared space. The central roadway is composed of

cobblestone, and is flanked by green planting zones, urban furniture, and wide walking paths.

In the redesign of Hallerova Aleja, the use of urban elements such as benches, trees, and planting zones is crucial for enhancing the functionality and appeal of the area. The benches provide resting spots, encouraging pedestrians to spend time in the area, thus turning the street into a place of leisure and social interaction rather than just a transit route. The planting zones serve as natural dividers between different modes of transport—specifically creating separation between vehicles, pedestrians, and cyclists without using rigid barriers. This soft boundary encourages drivers to lower their speed and be more attentive, fostering a safer environment.

Furthermore, the presence of cyclists and pedestrians moving freely without strict physical barriers promotes an environment of mutual awareness and respect among all road users. This design encourages direct interaction and negotiation between users, reducing the reliance on traditional traffic control devices like lights and signage. By relying on human-scale design and fostering informal communication, the redesigned Hallerova Aleja aims to reduce vehicle speed and prioritize the needs of non-motorized users, ultimately enhancing both safety and user experience.

The image illustrates how shared space principles can be applied effectively to a key thoroughfare in Varaždin, balancing the needs of different users and contributing to the overall aesthetic and environmental quality of the street. This holistic approach not only aims at improving safety but also at revitalizing the urban environment, making it more attractive for residents and visitors alike.

4. Conclusions

The implementation of shared urban spaces represents a significant step forward in fostering a more inclusive, safe, and user-friendly urban environment. By removing traditional barriers and encouraging direct interaction between different users of the street, shared space designs not only enhance safety but also create vibrant community spaces that prioritize the needs of pedestrians and cyclists. The integration of urban furniture, landscaping, and thoughtfully planned infrastructure helps in creating a balanced environment where all users, including vehicles, can coexist harmoniously.

Through careful planning, community involvement, and a flexible approach to urban design, shared spaces can transform streets into more than just transit routes—they become places for social interaction, leisure, and community building. The findings of this research suggest that shared space principles have the potential to significantly improve traffic safety, reduce vehicle speeds, and enhance the overall quality of life in urban areas. Moreover, shared spaces can contribute to environmental sustainability by reducing emissions through decreased vehicle use and promoting walking and cycling as primary modes of transport.

Community engagement plays a pivotal role in the success of shared urban spaces. It is crucial to involve residents, local businesses, and other stakeholders throughout the planning and implementation phases to ensure that the design meets the specific needs of the community.

Adaptability is another key factor in the long-term success of shared spaces. Urban environments are dynamic, and the needs of their users can change over time. Designing spaces that can be easily modified or repurposed to accommodate evolving demands is essential. This flexibility can be achieved through modular urban furniture, adaptable landscaping, and periodic assessments of how the space is being used.

The shared space concept also fosters social cohesion by creating environments where people from different backgrounds can come together and interact. By prioritizing human-scale design elements, shared spaces encourage face-to-face communication and reduce the dominance of vehicles, making urban areas more welcoming and accessible to everyone, including children, the elderly, and people with disabilities.

Moving forward, continuous engagement with stakeholders and adaptability in design will be crucial in ensuring the long-term success and acceptance of shared urban spaces. Policymakers, urban planners, and local communities must work together to refine these spaces, learning from both successes and challenges to create urban environments that are truly inclusive, safe, and vibrant for all users.

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