SUSTAINABLE TRANSPORT STRATEGIES FOR ENHANCING THE RESILIENCE OF HISTORIC URBAN AREAS

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Annotation: Historic cities face unique challenges in reconciling rapid motorization with the preservation of spatial identity and pedestrian-oriented urban fabric. This study examines the impact of uncontrolled vehicular traffic and inadequate pedestrian infrastructure on safety and historic urban structure in Samarkand District, Uzbekistan. Using field observations, analysis of road-traffic accident (RTA) statistics, and comparative international data, the research identifies critical bottlenecks and proposes sustainable transport solutions that respect the historic morphology of the district. Recommendations include designated stopping zones, regulated pedestrian crossings, underground passages in high-density areas, road widening to six lanes in congested sections, and physical separation of opposing traffic flows. Implementation of these measures can significantly reduce RTAs involving pedestrians while maintaining the human-scale character of the historic city.

Keywords: *sustainable transport, road safety, pedestrian mobility, historic urban structure, Samarkand, road-traffic accidents*

Introduction

The exponential growth of motorization in the 21st century has dramatically transformed urban environments worldwide. While vehicles provide unprecedented mobility, their uncontrolled proliferation in historic cities threatens both human life and the spatial integrity of centuries-old urban fabric (Tolley, 2017). In many

developing and transition economies, the absence of adequate parking, unregulated stopping practices, and insufficient pedestrian infrastructure exacerbate congestion and road-traffic accidents (RTAs), particularly in densely built historic districts where narrow streets were never designed for modern traffic volumes.

Uzbekistan, like many post-Soviet states, has experienced rapid motorization since the early 2000s. The Law of the Republic of Uzbekistan "On Automobile Roads" (29 June 2007, No. 467) established the legal framework for road safety and infrastructure development, yet implementation gaps remain evident at the local level. Samarkand District, containing numerous protected historic zones and a major bazaar area, exemplifies these contradictions: high pedestrian flows coexist with chaotic vehicular movement, resulting in frequent RTAs and degradation of the traditional urban landscape. [1] [2]

This paper investigates the role of sustainable transport interventions in preserving the historic urban structure of Samarkand District by prioritizing pedestrian safety, rationalizing vehicular flows, and introducing context-sensitive infrastructure solutions. [3] [4] [5]

Figure 1[1]

[1] https://www.sketchbubble.com/en/presentation-sustainable-urban-mobility.html

The integration of smart technologies, pedestrian-friendly planning, and sustainable transport models are central to the proposed approach. Ultimately, this research contributes to the broader discourse on how cities can evolve and adapt their mobility systems in a way that respects the past while addressing the demands of the present and future. [6] [7] [8] [9] [10]

Methods

Study Area

The research focuses on central streets and the bazaar district of Samarkand District (administrative unit within Samarkand city), characterized by narrow historic roadways (typically 9–14 m wide), high pedestrian intensity (up to 5,000–6,000 ped/h in peak hours), and heavy mixed traffic including route taxis and private vehicles.

Data Collection

- Direct field observations (2023–2024) of driver behavior, stopping practices, pedestrian crossing patterns, and conflict points.
- Measurement of selected pedestrian flow parameters (speed, density) using timed video recording at five representative locations.
- Analysis of national and international RTA statistics (WHO, 2018; national reports 2015–2023).
- Comparative analysis of road fatality rates normalized per 100,000 population and per motorization level across countries.

Analytical Approach

Pedestrian movement was characterized using three primary indicators: volume (ped/h), speed (km/h), and density (ped/m²). International benchmarks (China, Russia, Japan, UK, USA, etc.) provided context for evaluating Uzbekistan's performance.

Results

Pedestrian Movement Characteristics

Observed average pedestrian speeds ranged from 1.8 to 5.7 km/h, with minimum values of 0.7–0.8 km/h for elderly persons and women with children, and maximum values reaching 10 km/h among young adults. Morning peak speeds were 25–30 % higher than the daily average, while evening speeds were 15–20 % lower. Peak pedestrian volumes in central streets reached 5,000–6,000 ped/h, whereas local residential streets recorded only 50–150 ped/h. [7] [9] [10] [11]

Global Comparative Road Fatality Rates

Table 1 presents absolute and normalized road fatality figures for selected countries (latest available data).

Table 1. Road traffic deaths in selected countries

Country	Annual deaths (thousands)	Deaths per 100,000 population
China	98.74	7.56
India	94.97	8.79
USA	43.44	14.69
Russia	34.00	23.70
Brazil	34.00	18.24
Japan	6.87	5.39
United Kingdom	3.20	5.29

Countries with lower motorization levels (e.g., China, India) exhibited paradoxically lower death rates per capita than highly motorized Russia, highlighting the critical role of road discipline and infrastructure quality over mere vehicle ownership.

Local Conflict Points in Samarkand District

Field observations revealed five major problem categories:

1. Arbitrary stopping and parking along curbs (violating marking 1.4).
2. Route taxis and buses picking up/dropping passengers outside designated stops.
3. Absence or poor visibility of marked pedestrian crossings, leading to random crossing behavior.
4. Extreme congestion in the bazaar area due to insufficient road width.
5. Drivers crossing continuous center lines (1.3) or driving against traffic in narrow streets. [3] [12]

These practices directly contribute to pedestrian–vehicle conflicts and undermine the legibility and aesthetic coherence of the historic urban fabric.

Discussion

The results confirm that uncontrolled motorization in historic districts generates a vicious cycle: illegal stopping reduces effective carriageway width → congestion increases → drivers and pedestrians take higher risks → RTAs rise → public space quality deteriorates. This cycle is particularly damaging in cities like Samarkand, where the traditional orthogonal bazaar layout and human-scale street sections constitute intangible cultural heritage.

Comparative analysis demonstrates that countries achieving the lowest fatality rates (Japan 5.39, UK 5.29 per 100,000) combine strict enforcement, high-quality pedestrian infrastructure, and physical traffic calming. Uzbekistan's improving national trends (declining injuries over recent years) are attributable to centralized coordination under the Road Safety Council at the Cabinet of Ministers, yet local-level implementation remains the weakest link.

Proposed interventions for Samarkand District are fully compatible with heritage preservation requirements because they rely primarily on regulatory enforcement and minimal, reversible physical changes:

1. Strict enforcement of "No Stopping" zones (marking 1.4) and creation of dedicated bus/taxi bays (5.12, 1.17).

2. Systematic installation of marked zebra crossings (5.16.1–5.16.2) with signage and, in the bazaar zone, construction of grade-separated underpasses to eliminate surface conflicts without widening historic streets.

3. Widening of the main bazaar thoroughfare to six lanes (total width 24 m) with generous landscaped medians and tree planting—creating a grand boulevard that respects Central Asian urban tradition while accommodating modern flows.

4. Replacement of painted axial lines (1.3) with low-profile barrier fencing in multi-lane sections to prevent head-on collisions and lane drifting.

5. Designation and enforcement of official taxi ranks to eliminate kerbside haggling.

These measures collectively shift the district toward a sustainable transport paradigm: predictable vehicular movement at moderate speeds, absolute pedestrian priority in historic cores, and visual enhancement through greenery and consistent signage.

Conclusion

Preserving the historic urban structure of Samarkand District is inseparable from establishing a safe, sustainable transport system. The proposed package of regulatory, marking, and moderate infrastructural interventions can reduce pedestrian–vehicle conflicts by an estimated 60–80 % (based on international experience with similar measures) while enhancing rather than compromising the city's cultural identity. Immediate political will and inter-agency coordination are required to translate these technically feasible solutions into reality.

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