

## Original Article

# A study on traffic flow characteristics and volume analysis for future solution: A case study at Sony Square to Mirpur 10

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### ABSTRACT

Traffic congestion is a growing concern in rapidly urbanizing cities, particularly in Dhaka, where mixed traffic conditions and poor infrastructure exacerbate delays and reduce mobility. This study aims to evaluate traffic flow characteristics and volume along the corridor from Sony Square to Mirpur 10 and identify the key contributors to congestion. The research follows a systematic methodology involving manual traffic volume counts using tally counters and video recordings at strategic locations across four daily time slots over 10 consecutive days. The collected data were categorized by vehicle type and analyzed through conversion to passenger car units to standardize heterogeneous traffic. Microsoft Excel was employed for data tabulation, graphical analysis, and service flow rate calculations. The Highway Capacity Manual framework was used to evaluate the level of service (LOS) at different times of day. The findings reveal that evening peak hours exhibit the most critical congestion levels (LOS F), while morning peaks also approach capacity (LOS E). Midday and afternoon periods show relatively smoother flow (LOS B and LOS C/D, respectively). Contributing factors to congestion include excessive vehicular traffic, the absence of dedicated lanes, inefficient signal timings, unauthorized street parking, and a lack of traffic discipline among both pedestrians and drivers. Based on these insights, the study proposes practical recommendations, including the implementation of dedicated lanes, optimized signal coordination, strict enforcement of parking regulations, and enhanced public transportation operations. These strategies aim to alleviate congestion and support efficient traffic management in urban corridors, such as Mirpur 10.

**Keywords:** Passenger car units, peak hour, traffic flow, traffic survey, urban mobility

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## INTRODUCTION

Urbanization in developing nations has accelerated rapidly over the past few decades, bringing with it unprecedented pressure on urban infrastructure, particularly in the transport sector. In major metropolitan areas, traffic congestion has emerged as one of the most critical challenges, negatively affecting economic productivity, environmental sustainability, and the quality of urban life.<sup>[1]</sup> Dhaka, the capital city of Bangladesh and among the most densely populated cities globally, exemplifies this problem acutely. With a population exceeding 21 million and a road network covering merely 7% of its total area, Dhaka's transport system is unable to meet the growing demands of its residents and vehicular population.<sup>[2]</sup>

Every day, over 1,000 new vehicles are added to Dhaka's streets, exacerbating congestion on an already strained road

network.<sup>[1]</sup> The resulting gridlock leads to increased travel time, elevated levels of air and noise pollution, and significant economic losses. A study by the Bangladesh University of Engineering and Technology<sup>[3]</sup> found that the average speed of vehicles during peak hours in central Dhaka was just 6.4 km/h, a stark contrast to the ideal range of 15–20 km/h for efficient traffic movement. Key urban corridors, such as the stretch between Sony Square and Mirpur 10, experience some of the city's worst congestion due to a combination of high population density, diverse vehicle types, inadequate infrastructure, and inefficient traffic management practices.

This corridor serves as a vital artery for commuters and commercial transport in the northern part of the city. The traffic composition is highly heterogeneous, involving private cars, buses, motorcycles, rickshaws, and CNG auto-rickshaws – each with varying operational characteristics. Such mixed

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traffic conditions make traditional vehicle-per-hour analysis ineffective, necessitating the use of passenger car unit (PCU)-based models to standardize different vehicle types for comparative analysis.<sup>[4]</sup>

Several studies have identified recurring issues that worsen Dhaka's traffic situation, including poor traffic signal coordination, the lack of dedicated lanes for different modes of transport, frequent illegal parking, informal stopping practices by buses, and weak enforcement of traffic laws.<sup>[5,6]</sup> Moreover, the behavior of road users – including unpredictable pedestrian crossings and interactions between motorized and non-motorized vehicles (NMVs) – further complicates the traffic scenario. In commercial hubs, such as Mirpur 10, the absence of footbridges or marked pedestrian crossings means that foot traffic frequently disrupts vehicular movement.<sup>[7]</sup>

Despite these known challenges, many government interventions, such as the construction of flyovers and the introduction of bus rapid transit systems, often fail to produce the desired impact due to a lack of localized and real-time traffic data. As noted by Satyanarayana *et al.* (2012),<sup>[8]</sup> traffic flow characteristics are location-specific, and without context-sensitive data, effective policy formulation becomes highly constrained.

Therefore, localized traffic flow studies that take into account time-of-day variations, vehicle mix, and user behavior are essential for designing effective interventions. This research seeks to address this critical gap by conducting a detailed field-based analysis of the traffic conditions in the Sony Square to Mirpur 10 corridor using PCU-based conversion and level of service (LOS) assessment as defined in the Highway Capacity Manual (HCM).<sup>[9]</sup> By identifying congestion factors through empirical observation and volume studies across multiple time slots, the study aims to propose realistic and implementable solutions for one of Dhaka's most congested road segments.

## METHODOLOGY

This study adopts a field-based empirical methodology to assess traffic congestion and flow characteristics along the corridor between Sony Square and Mirpur 10 in Dhaka, Bangladesh. The methodology includes site selection, reconnaissance survey, manual traffic volume data collection, vehicle classification, PCU conversion, and LOS evaluation, following guidelines from the HCM and the Bangladesh road transport authority.

### Study Area and Site Selection

The selected corridor, extending from Sony Square to Mirpur 10, is a key arterial segment of northern Dhaka. The area was chosen due to its high traffic volume, modal diversity, and frequent congestion. Observation points were strategically selected to capture directional traffic flow and vehicle mix in

both inbound and outbound directions.

### Data Collection Period and Schedule

Traffic volume data were collected over 10 consecutive days, from January 31 to February 09, 2025, during four critical time slots representing different parts of the day:

- Morning peak: 8:00 AM–8:30 AM
- Midday: 12:00 PM–12:30 PM
- Afternoon: 2:00 PM–2:30 PM
- Evening Peak: 6:30 PM–7:30 PM.

These time windows were selected based on preliminary field observation and align with known peak traffic periods in the area.

### Data Collection Method

Due to the heterogeneous nature of traffic and resource constraints, the Direct Manual Counting Method was adopted. Enumerators recorded the number and type of vehicles passing a fixed point during each time slot. To enhance accuracy, two trained surveyors were deployed at each location to count in opposite directions. Supplementary video recordings were taken for post-verification.

### Vehicle Classification

Vehicles were classified into the following categories based on function and mode:

- Public transport: Buses, CNG auto-rickshaws
- Private transport: Cars, Motorcycles
- Freight vehicles: Trucks, Pickups
- NMVs: Rickshaws, Bicycles.

This classification allowed detailed analysis of modal share and congestion contribution by type.

### PCU Conversion

To account for the mixed-traffic environment, raw vehicle counts were converted into PCUs using standard conversion factors recommended by BRTA (2018) and Indian Roads Congress:106-1990. Table 1 presents the PCU values applied.

These values normalize the impact of different vehicle types for accurate capacity analysis under heterogeneous conditions.

**Table 1: Standard PCU values used**

Vehicle type	PCU value
Bus	3.00
Car	1.00
Pickup	1.50
CNG auto-rickshaw	0.75
Motorcycle	0.75
Rickshaw (NMV)	0.50

PCU: Passenger car units, NMV: Non-motorized vehicles

### PCU-based Service Flow Rate Calculation

To quantify traffic intensity and understand congestion levels, vehicle counts were converted into PCU per hour using the formula:

$$\text{Service Flow Rate (PCU/h) per lane} = \left( \frac{\text{Average PCU in 30 min}}{2} \right) \times 2$$

This approach facilitates comparisons across vehicle types and enables congestion assessment using LOS standards.

### LOS Reference

To assess traffic performance, the computed service flow rates were compared with the standard LOS and corresponding (LoS) thresholds presented in Table 2.

## RESULTS AND DISCUSSION

### PCU-based Service Flow Rate

In this study, the observed heterogeneous traffic volumes were converted into PCUs using standard PCU factors to standardize vehicle impact on road capacity. The service flow rates were calculated for four key periods: Morning peak (8:00–8:30 AM), midday (12:00–12:30 PM), afternoon (2:00–2:30 PM), and evening peak (6:30–7:00 PM). The summary of PCU-based service flow rates is presented in Table 3. The vehicle categories include buses, cars, pickups, CNGs, motor bikes, and rickshaws. Results reveal that, among all vehicle types, buses consistently show the highest flow rate in each time slot, particularly during the evening period (6:30–7:00 PM), where the overall traffic volume reaches its peak at 1721.6 PCU/h. The lowest total flow rate occurs during the midday period (12:00–12:30 PM) at 687.3 PCU/h. Overall, the data indicate heavier traffic during the morning and especially the evening peak hours, with comparatively lighter traffic around midday.

### Interpretation of Service Flow Rates

The service flow rates and LOS are presented in Table 4. Results reveal that, in the Morning Peak (8:00–8:30 AM), the service flow rate reached 1375.6 PCU/h, placing it

under LoS E, which reflects high congestion and limited maneuverability. Buses and motorcycles were the dominant contributors. Besides, traffic volumes dropped considerably to 687.3 PCU/h, in the midday (12:00–12:30 PM), indicating LOS B is a condition of stable flow and minimal delays. The findings show that, in the Afternoon (2:00–2:30 PM), traffic intensity increased to 937.1 PCU/h, corresponding to LOS C/D, with moderate congestion attributed to increased private car and bus movement. In the end, the highest traffic volume was recorded at 1721.6 PCU/h, in the Evening Peak (6:30–7:00 PM), indicating LOS F, or oversaturated conditions. Buses alone contributed 47% of the total PCU during this interval.

### Comparison of Traffic Composition

The comparison of vehicle composition during the morning and evening peak hours is shown in Figure 1. Buses account for the highest share in both periods, increasing from 36% in the morning to 47% in the evening peak hour. Cars contribute equally at 19% during both peaks. Motorbikes represent 19% in the morning but decrease to 13% in the evening, while rickshaws also decline from 16% to 13%. Pickups show a slight reduction from 7% in the morning to 5% in the evening, and CNG vehicles remain constant at 3% in both periods. Overall, the figure indicates a higher dominance of buses during the evening peak, while other vehicle types either remain stable or show a slight decrease in percentage share.

**Table 3: Service flow rate at different time**

Type of vehicle	Service flow rate (PCU/hour)			
	8:00	12:00	2:00	6:30
	AM-8:30	PM-12:30	PM-2:30	PM-7:00
	AM	PM	PM	PM
Bus	501.3	288.6	489.9	807.6
Car	265	103.8	157.7	318.3
Pickup	93.3	56.55	46.5	76.35
CNG	42.6	39.6	40.05	57.975
Motor bike	258.3	76.95	109.125	230.925
Rickshaw	215.1	121.8	93.85	230.4
Total	1375.6	687.3	937.1	1721.6

PCU: Passenger car units

**Table 2: Level of service and corresponding PCU/hour**

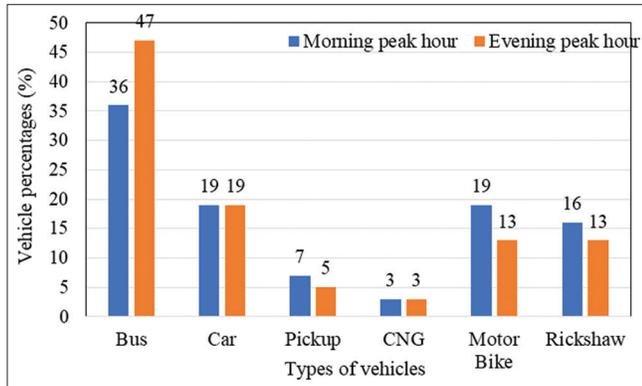
LOS grade	Service flow rate (PCU/hour)
A	≤600
B	601–700
C	701–900
D	901–1200
E	1201–1400
F	>1400

LOS: Level of service, PCU: Passenger car units

**Table 4: Summary of service flow rates and LOS classification**

Time interval	Service flow rate (PCU/hour)	LOS
8:00–8:30 AM	1375.6	E
12:00–12:30 PM	687.3	B
2:00–2:30 PM	937.1	C/D
6:30–7:00 PM	1721.6	F

LOS: Level of service, PCU: Passenger car units



**Figure 1:** Comparison of different traffic at different peak hour

## CONCLUSION AND RECOMMENDATIONS

- This study thoroughly assessed the traffic flow characteristics and volume along the Sony Square to Mirpur 10 corridor – an arterial segment in Dhaka known for chronic congestion and heterogeneous traffic
- Peak-hour analyses revealed critical service flow rates, with LOS F in the evening and LOS E in the morning, highlighting an oversaturated traffic condition during these times
- Buses emerged as the highest contributors to overall traffic load, particularly during peak hours, followed by private cars, motorcycles, and rickshaws, signifying both modal imbalance and capacity constraints.
- Key congestion factors identified include:
  - Absence of lane discipline and dedicated road space for different modes
  - Inefficient traffic signal coordination leading to unnecessary delays
  - Unauthorized parking, roadside encroachments, and uncontrolled pedestrian crossings
  - Poor enforcement of traffic laws and a lack of structured traffic management systems.
- The research confirms that localized, PCU-based volume analysis, integrated with LOS evaluation, provides actionable insights for urban traffic planning in developing cities.

Based on the findings, the following strategic recommendations are proposed to alleviate congestion and enhance traffic efficiency:

- Develop dedicated lanes for buses, NMVs (rickshaws, bicycles), and private vehicles to reduce conflict and improve overall road performance
- Implement adaptive traffic signal systems using real-time data to optimize green time and minimize intersection

delays

- Strictly regulate roadside parking and encroachments through digital enforcement tools and increased patrol visibility
- Enhance public transportation services, focusing on punctuality, coverage, and passenger comfort to encourage modal shift from private cars
- Construct pedestrian-friendly infrastructure, including footbridges, signalized crossings, and barriers to control jaywalking
- Promote staggered institutional and business hours to flatten peak demand and distribute traffic loads more evenly
- Deploy intelligent traffic management systems to monitor flow, predict congestion patterns, and adjust controls dynamically
- Launch public awareness campaigns focused on traffic discipline, proper road use behavior, and the benefits of shared mobility.

These measures, if planned and executed holistically, can significantly improve traffic performance, enhance commuter experience, and support sustainable urban mobility in Dhaka and similar urban contexts.

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