CAPACITY AND PERFORMANCE ANALYSIS OF A FOUR-LEG TRAFFIC INTERSECTION IN VISSIM 2025 USING WIEDEMANN 74

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Introduction

Background on Traffic Microsimulation:

The increasing complexity of urban traffic networks demands sophisticated tools for analysis and planning. Traditional analytical methods often fall short in accurately modeling the dynamic, stochastic, and interactive behavior of vehicles and drivers in complex scenarios like signalized intersections. Traffic microsimulation has emerged as a powerful tool to overcome these limitations. It is a computational modeling technique that represents the movement of individual vehicles based on car-following, lane-changing, and gap-acceptance logic. By simulating the behavior of each entity (vehicles, pedestrians) second-by-second, microsimulation software like PTV VISSIM provides a virtual laboratory for engineers. This allows for the detailed evaluation of traffic operations, assessment of intersection capacity, performance measurement (e.g., delay, queue length), and testing of various improvement strategies such as signal timing optimization and geometric redesign before costly physical implementation.

The Wiedemann 74 Model:

The Wiedemann 74 model, developed by Reiter Wiedemann in 1974, represents a psychophysical car-following approach that simulates driver behavior based on perceptual thresholds. Unlike purely mathematical models, it incorporates human factors and perception limitations, making it particularly suitable for simulating realistic traffic behavior in complex urban environments. The model is widely implemented in VISSIM and has become a standard for microscopic traffic simulation, especially in heterogeneous traffic conditions like those found in Dhaka.

The Wiedemann 74 model incorporates three fundamental parameters that significantly influence simulated traffic behavior:

Average Standstill Distance (m):

- Represents the minimum desired distance between stationary vehicles (typically 1.5-2.5 meters)
- Affects queue formation and discharge rates at intersections
- Influences the minimum spacing during congested conditions

Additive Part of Safety Distance:

- Defines an additional safety margin added to the standing distance during movement
- Typically ranges between 0.5-3.0 meters depending on driver’s behavior
- Affects following behavior at low to medium speeds

Multiplicative Part of Safety Distance:

- A multiplier that determines sensitivity to relative speed changes
- Usually it ranges from 1.5-4.0, with higher values indicating more cautious driving

- Most influential parameter on capacity and traffic flow stability

Problem Statement:

The accuracy and reliability of any traffic microsimulation model are profoundly dependent on the calibration of its underlying behavioral parameters. The Wiedemann 74 car-following model, widely used in VISSIM for simulating urban and extra-urban traffic, is governed by several key parameters, including Average Standstill Distance (m), Additive Part of Safety Distance and Multiplicative Part of Safety Distance. A significant challenge exists because the default values for these parameters, provided within VISSIM, are often generic and may not reflect the unique and local driving behaviors specific to a particular region, such as Bangladesh. Utilizing uncalibrated default values can lead to models that produce unrealistic capacity estimates, inaccurate performance measures. Therefore, a systematic investigation into the sensitivity of intersection capacity to variations in these critical Wiedemann 74 parameters is essential to ensure the development of valid and reliable simulation models for local traffic conditions.

Study Objective:

1. To design and develop a comprehensive VISSIM 2025 model of a four-leg intersection that accurately represents Dhaka's heterogeneous traffic composition, including private cars, buses, motorcycles, and CNG.
2. To incorporate local traffic characteristics into the Wiedemann 74 car-following model through systematic parameter adjustment and calibration.
3. To analyze the sensitivity of intersection capacity to variations in three key Wiedemann 74 parameters: average standstill distance (m), additive part of safety distance, and multiplicative part of safety distance
4. To identify patterns in traffic performance under different simulations setting.

Methodology

Site Selection Criteria:

1. A standard four-leg signalized intersection commonly found in urban Dhaka
2. Significant presence of mixed vehicle types (cars, buses, rickshaws, CNGs)
3. Experiencing recurrent congestion with potential for improvement through simulation analysis

Description of the Selected Site:

The Bijoy Sarani intersection is a signalized four-leg junction situated along the Bijoy Sarani Road in the Tejgaon thana of Dhaka, Bangladesh. This major street connects Farmgate to the Tejgaon Airport area, linking key points such as Sony Rangs Building, Khamarbari, and Rokeya Sarani intersection. The junction handles traffic from four approaches: from Farmgate (southbound), Tejgaon (industrial corridor), Jahangir Gate (near the cantonment), and Urojahaj Mor (Metrorail). This intersection connects Farmgate area, Mohakhali Flyover , elevated expressway and Bijoy Sarani Metro Station and shows a high traffic volume. The intersection has four dedicated left-turn lanes, making it ideal for standard simulation. Its traffic composition is highly heterogeneous, including buses, cars, Truck, motorcycles and CNGs, which makes it a representative site for urban traffic study.

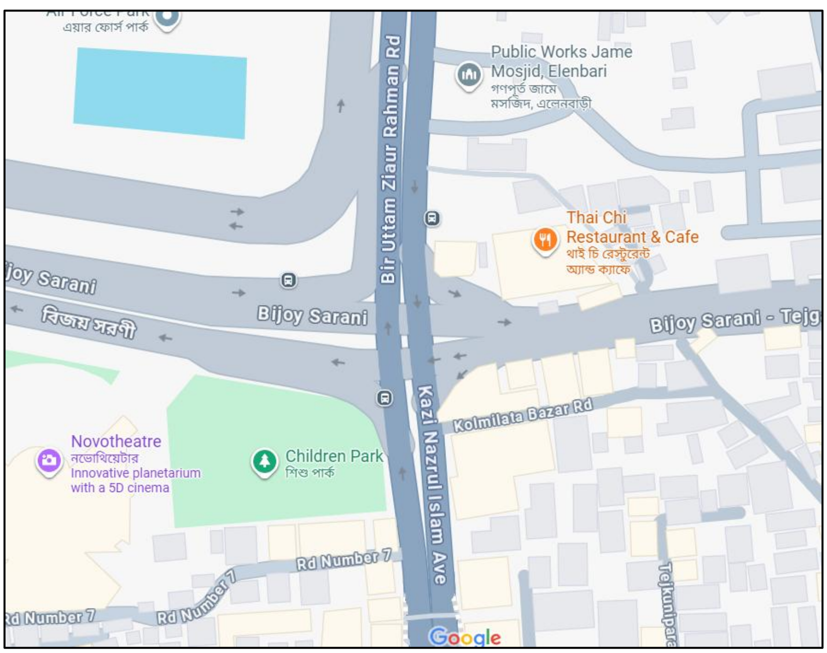


Figure: Bijoy Sarani Intersection

Data Requirements:

For modeling and capacity analysis the following data is required:

1) Traffic Volume Characteristics: Total vehicles come from each approach and movement (through, left-turn, right-turn) count. Vehicle composition (cars, motorcycles, tracks, buses, CNG) for each approach with share percentage.
2) Lane Configuration: Details of lane number and lane width for each approach. Exclusive turning lane and sharing lane details.
3) Signal Timing: Details of cycle length and phase sequence with green time allocation of each movement.

Data Collection Methodology:

The primary method for data collection is manual counting with tally sheets, video recording, photographic documentation or RHD survey. For our simplicity the data is assumed:

Table 1: Flow (Veh/hr.) details for approaches

Approach name	Flow (Veh/hr)
From Farmget	1700
From Urojahaj Mor	2150
From Jahangir gate	1950
From Tejgaon	1700

Traffic Volume Characteristics:

Here is the different Vehicle Percentage and turning percentage for our four approaches:

Table 2: Vehicle composition (%) at different approach

Vehicle	From Farmgate	From Tejgaon	From Jahangir Gate	From Urojahaj Mor
Car (60 km/hr.)	36	31	36	35
Truck (50 km/hr.)	10	16	11	11
Bus (50 km/hr.)	17	18	13	14
Bike (40 km/hr.)	21	23	21	17
CNG (30km/hr.)	17	12	19	23

Table 3: Vehicle Percentage (%) at different turn

Turn	From Farmgate	From Tejgaon	From Jahangir Gate	From Urojahaj Mor
Dedicated Left Turn	18	26	19	18
Through	31	32	22	31
Right	29	17	32	29
Left	23	24	26	23

Signal Design:

The signal design followed established methodologies for urban four-leg intersections, incorporating Webster's method for cycle length optimization based on critical lane volumes and saturation flows. A four-phase plan was adopted. Passenger Car Units (PCU) use typical Dhaka PCE values: Car=1.0, Truck=3.0, Bus=2.5, CNG=0.8, Bike=0.5.

Table 4: Signal Design and Timing

Approach Name	**y**
Farmgate Approach	0.292944026
Tejgaon Approach	0.296129776
Jahangir Gate Approach	0.35347586
Novo theater Approach	0.369609138
Y	1.3121588
Y > 1. So, Webster method is not applicable	
Phase Number (without All-Red)	4
Amber (sec)	3
Lost Time per Cycle (sec)	2
L (sec)	20
All red (sec)	2
Cycle Time, C (sec)	120
Total Green Time (sec)	98
Farmgate Approach Green Time (sec)	24
Tejgaon Approach Green Time (sec)	24
Jahangir Gate Approach Green Time (sec)	28
Urojahaj Mor Approach Green Time (sec)	30

Software and Tools: VISSIM 2025:

This study was carried out using the **student version of PTV VISSIM 2025**, a microscopic, behavior-based traffic simulation platform. Despite the limitations compared to the professional license (such as restricted network size and reduced simulation duration), the student version provided sufficient functionality for analyzing the selected site.

Key features of VISSIM 2025 that were utilized in this project include:

- Heterogeneous vehicle classes: Representation of multiple vehicle types (e.g., cars, buses, trucks, motorcycles) to capture mixed traffic flow.
- Custom vehicle compositions: Adjustment of traffic composition percentages to reflect real-world mode share and fleet mix.
- Complex intersection geometries: Ability to model irregular approaches, turning lanes, and dedicated movements for realistic intersection layouts.

Model Development:

The Bijoy Sarani Intersection is coded in the PTV VISSIM as four leg intersection add then add Dedicated left turn. These four legs have dedicated left turn, through, right turn, and left turn. As the student version cannot support code approach more than 1km, this limitation is considered while coding the intersection.

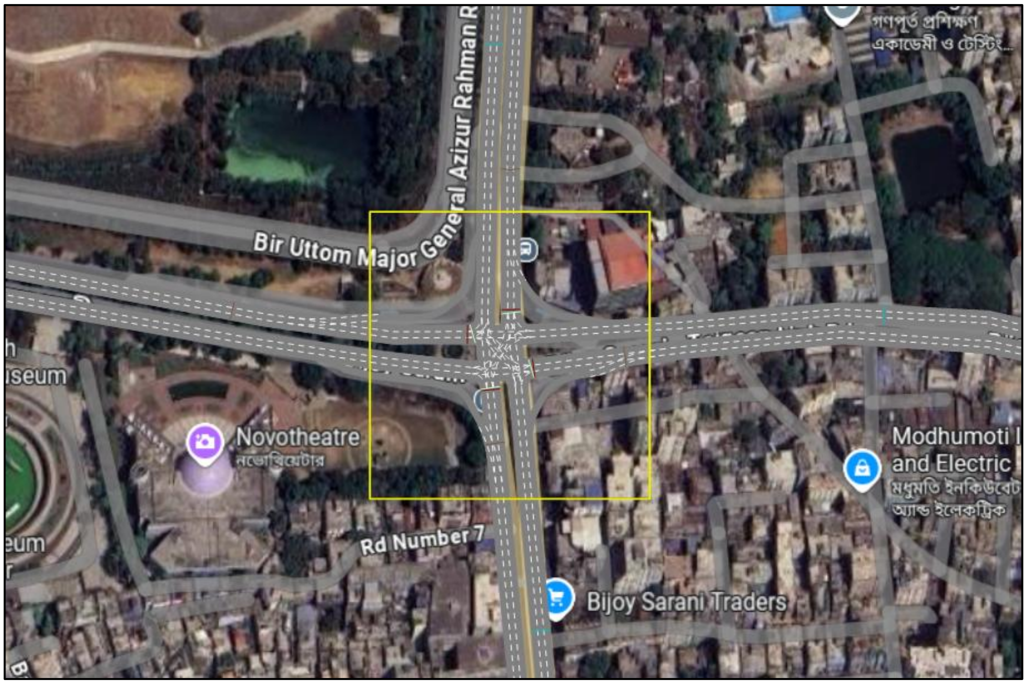


Figure: Coding at Vissim of Bijoy Sarani Intersection

PTV Vissim student version don't have local vehicle (CNG) in default vehicle type. But it supports adding custom vehicle 3D Model (PTV Group, n.d.-a). To incorporate heterogeneous traffic and replicate field condition, local vehicles CNG's 3D model is imported at vissim.

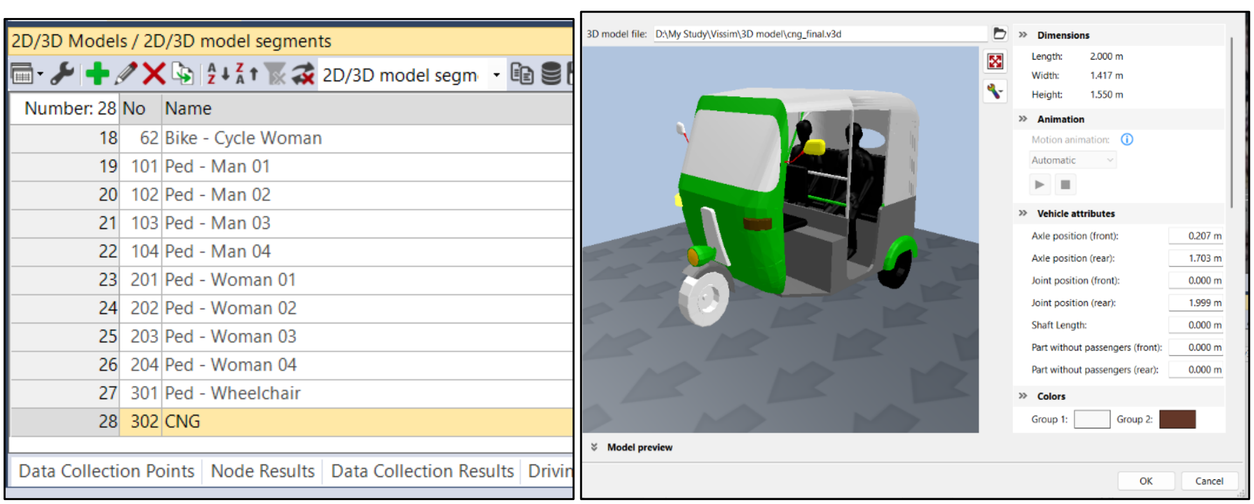


Figure: Importing CNG in PTV Vissim

To replicate the actual traffic conditions, vehicle composition was assigned separately for each approach based on observed data. The proportions of cars, buses, trucks, motorcycles and CNG to reflect heterogeneous mix. In addition, desired speed ranges were set according to vehicle type. This ensured that both the traffic mix and driving behavior were realistically represented in the simulation. The vehicle volume for each approach is added from the hourly basis data.

Relative flows

Number: 4	No	Name
1	1	From Novo Theatre
2	2	From Jahangir Gate
3	3	From Farmgate
4	4	From From Tejgaon

Number: 5	VehType	DesSpeedDistr	RelFlow
1	100: Car	60: 60 km/h	44.000
2	190: LGV	50: 50 km/h	22.000
3	300: Bus	50: 50 km/h	26.000
4	610: Bike Man	40: 40 km/h	32.000
5	630: CNG	30: 30 km/h	17.000

Figure: Vehicle composition

Vehicle Inputs / Vehicle volumes by time interval

Vehicle volumes by

Number: 4	No	Name	Link	Volume(0-MAX)	VehComp(0-MAX)
1	1		1: From Farmget	1700.0	3: From Farmgate
2	2		3: From Urojahaj Mor	2150.0	1: From Novo Theatre
3	3		5: From Jahangir gate	1950.0	2: From Jahangir Gate
4	4		7: From Tejgaon	1700.0	4: S

Figure: Vehicle Volume

There are different turning movements. So, the conflict area is coded and optimized with correct right of way assign. Route decisions are coded for each approach as there are different turning movements (left, through, right).

4	VehRoutDec	No	Name	Formula	DestLink	De
1	2: From Farmget	1			4: From Urojahaj Mor	
2	2: From Farmget	2			6: From Jahangir gate	
3	2: From Farmget	3			8: From Tejgaon	
4	2: From Farmget	4			4: From Urojahaj Mor	

Figure: Vehicle Route Decision

Figure: Conflict Area Coding

A four-phase signal system with a 120-second cycle length was implemented, derived from analyzed vehicle data. Each phase follows a standardized sequence of Green, Amber, and Red intervals. The effective green times for all phases were calculated and assigned based on field-collected traffic volume and saturation flow data.

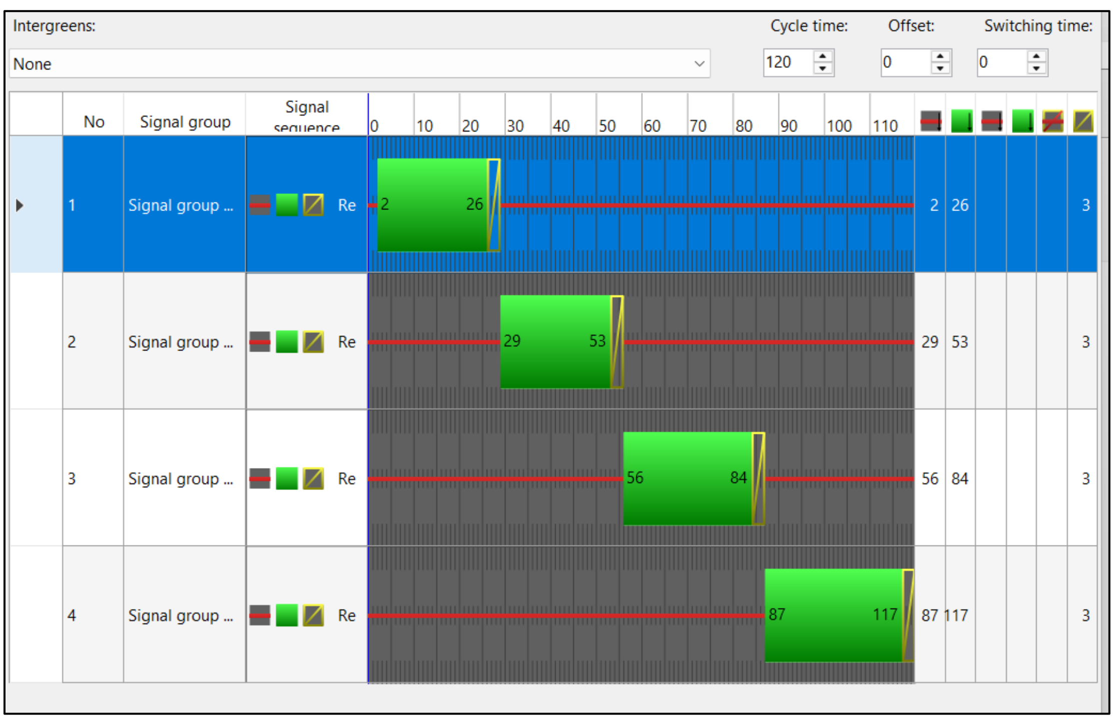


Figure: signal time

To better match Dhaka's real traffic, where vehicles do not strictly follow lanes, the simulation was adjusted. The "lane change behavior" setting was set to "any", allowing vehicles to move freely within the available road space. This helps replicate the non-lane-based and flexible driving style common in the city.

No	Name	NumInteractObj	StandDistIsFix	StandDist	CarFollowModType
1	Urban (motorized)	4	☐	0.50	Wiedemann 74
2	Right-side rule (motorized)	2	☐	0.50	Wiedemann 99
3	Freeway (free lane selection)	2	☐	0.50	Wiedemann 99
4	Footpath (no interaction)	2	☐	0.50	No interaction
5	Cycle-Track (free overtaking)	2	☐	0.50	Wiedemann 99
6	ACC free lane selection	4	☐	0.50	Adaptive Cruise Control (ACC)

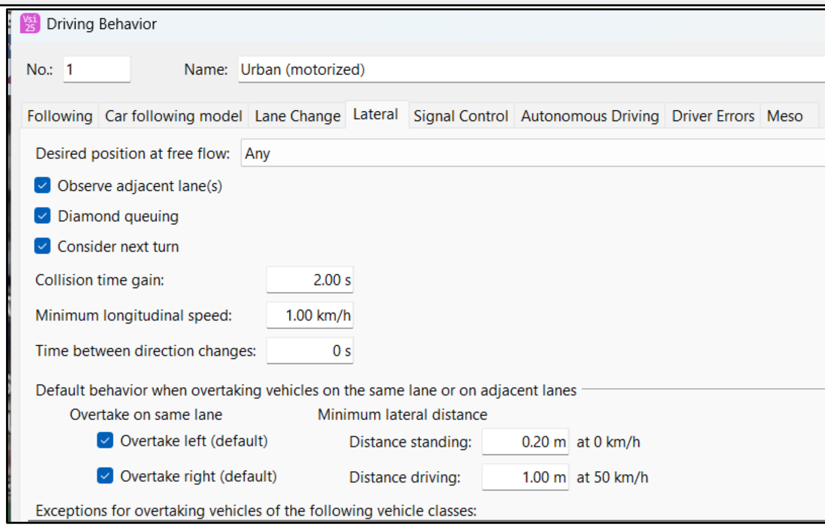


Figure: Non-Lane Base Driving Behavior setting

To measure traffic flow and delays, data collection points were placed in the middle of each road leading to the intersection. Nodes were also set at the intersection itself to track vehicle movements. The evaluation settings were configured to record key outputs like capacity, delay, and travel time.

Number: 12	No	Name	Lane	Pos
1	1	From Urojahaj Mor	3 - 3	330.809
2	2	From Urojahaj Mor	3 - 2	330.525
3	3	From Urojahaj Mor	3 - 1	330.275
4	4	From Farmgate	1 - 3	276.838
5	5	From Farmgate	1 - 2	277.093
6	6	From Farmgate	1 - 1	277.287
7	7	From Tejgaon	7 - 1	386.145
8	8	From Tejgaon	7 - 2	385.654
9	9	From Tejgaon	7 - 3	385.871
10	10	From Jahangir gate	5 - 1	190.974
11	11	From Jahangir gate	5 - 2	191.415
12	12	From Jahangir gate	5 - 3	190.831

Figure: Data collection point

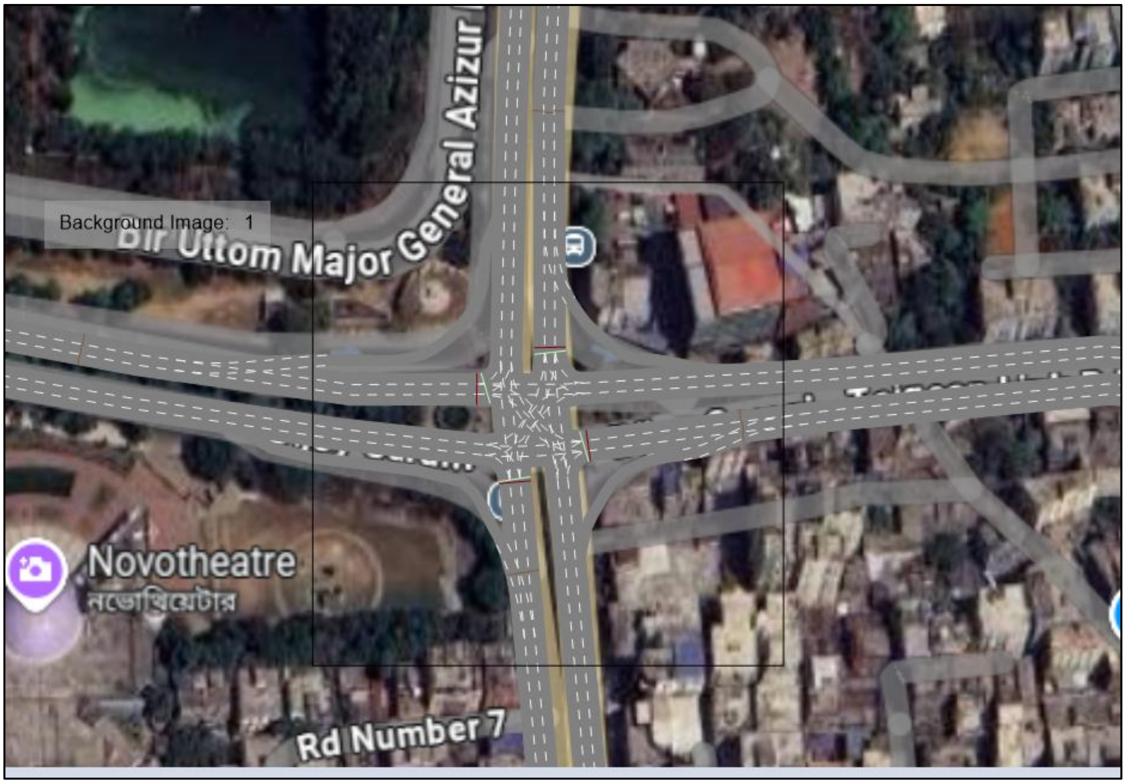


Figure: Node assign

Results and Analysis

The baseline model was calibrated using default Wiedemann 74 parameters (Average standstill distance (m) = 2, Additive part of safety distance = 2, Multiplicative part of safety distance = 3). Under these conditions, the intersection demonstrated a total capacity of 8,400 veh/hr. during peak hours, with approach-specific capacities ranging from 1,680 to 2,400 veh/hr. In this simulation parameter values vary in different ranges (Average standstill distance is 1 to 3 m, Additive part of safety distance is 0.4 to 4.4 and Multiplicative part of safety distance is 1 to 5). Three parameters were varied individually while keeping others constant. The simulation timestep is 30sec. For data analysis and filtering, python programming is used. A python script is used to find the maximum veh per 30s of each link in per simulation (see appendix).

Effect of Varying Average Standstill Distance (1-3 m):

For each parameter, the simulation runs 21 times. Then the data is collected in csv format and filter using python programming (see appendix). Table 5 shows the final result.

Table 5: Capacity of Approaches when Average Standstill Distance vary 1 to 3

				Capacity (Veh/hr.)			
SIMRUN	Average Standstill Distance (m)	Additive part of safety distance	Multiplicative part of safety distance	From Farmgate	From Tejgaon	From Jahangir Gate	From Urojahaj Mor
1	1	2	3	2280	1320	2640	2880
2	1.1	2	3	2280	1800	3000	2520
3	1.2	2	3	1680	1320	2640	2880
4	1.3	2	3	2040	1560	2760	2520
5	1.4	2	3	2280	1320	2760	2520
6	1.5	2	3	1920	1680	2400	2520
7	1.6	2	3	2280	1680	2520	2520
8	1.7	2	3	1560	1200	2400	2520
9	1.8	2	3	1680	1440	2640	2520
10	1.9	2	3	1800	1560	2040	2520
11	2	2	3	2040	1440	2640	2400
12	2.1	2	3	1920	1680	2160	2520
13	2.2	2	3	2040	1680	2400	2640
14	2.3	2	3	2040	1200	2400	2640
15	2.4	2	3	2160	1440	2280	2280
16	2.5	2	3	1680	1320	2280	2520
17	2.6	2	3	1800	1440	2640	2760
18	2.7	2	3	1680	1320	2400	2520
19	2.8	2	3	1920	1440	2280	2640
20	2.9	2	3	1680	1560	2280	2280
21	3	2	3	1920	1440	2520	2520

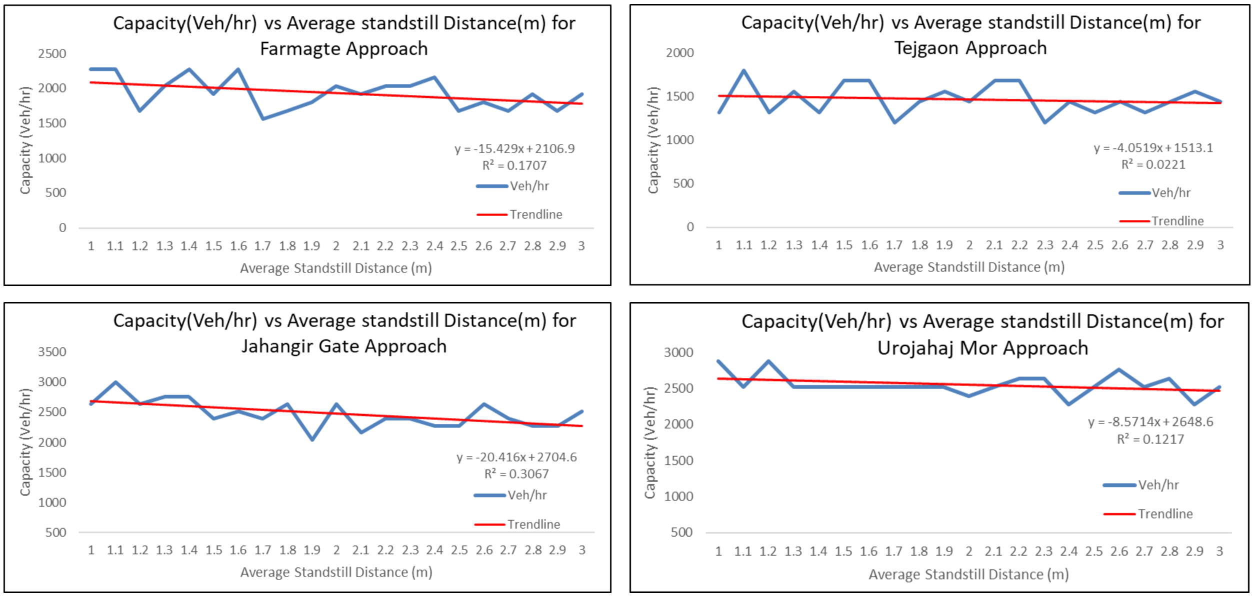


Figure: Capacities (veh/h) of all four approach for changes of average standstill distance

Changes were observed from the trendline:

As the average standstill distance increased, fluctuations in capacity were observed across all four approaches of the Bijoy Sarani intersection. For example, at the Tejgaon approach, capacity initially increased from 1320 veh/h (standstill distance = 1.0 m) to a peak of 1800 veh/h (1.1 m), before dropping back to 1320 veh/h (1.4 m) and later stabilizing around 1440–1680 veh/h for higher distances. Similarly, at the Farmgate approach, capacity showed variations between 1680 veh/h and 2280 veh/h, with no consistent increasing or decreasing pattern, though moderate reductions were noticeable beyond a standstill distance of 2.5 m. At the Jahangir Gate approach, capacity ranged between 2040–3000 veh/h, reaching its highest level at 1.1 m standstill distance (3000 veh/h), after which the values generally fluctuated downward. Finally, the Urojahaj Mor approach recorded comparatively stable capacities, remaining close to 2520–2880 veh/h across the range, with only minor reductions at higher standstill distances.

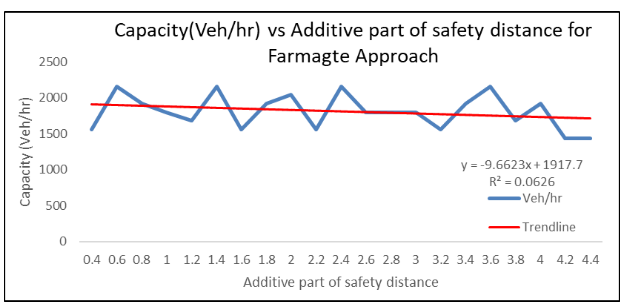
Overall, it shows a downward trend, but the results suggest that capacity does not decrease strictly linearly with increasing standstill distance. Higher standstill distances generally limit capacity by widening vehicle gaps and reducing discharge flow. This effect is particularly evident at Jahangir Gate and Tejgaon approaches, which showed more pronounced declines compared to the relatively stable Urojahaj Mor approach.

Effect of Varying Additive Part of Safety Distance (0.4 - 4):

For each parameter, the simulation runs 21 times. Then the data is collected in csv format and filter using python programming (see appendix). Table 6 shows the final result.

Table 6: Capacity of Approaches when Additive Part of Safety Distance vary 0.4 to 4

				Capacity (Veh/hr.)			
SIMRUN	Additive part of safety distance	Average Standstill Distance (m)	Multiplicative part of safety distance	From Farmgate	From Tejgaon	From Jahangir Gate	From Urojahaj Mor
1	0.4	2	3	1560	1440	2640	2520
2	0.6	2	3	2160	1560	2400	2520
3	0.8	2	3	1920	1320	2760	2400
4	1	2	3	1800	1680	2520	2880
5	1.2	2	3	1680	1440	2400	2400
6	1.4	2	3	2160	1440	2400	2520
7	1.6	2	3	1560	1560	2400	2400
8	1.8	2	3	1920	1440	2520	2640
9	2	2	3	2040	1440	2640	2400
10	2.2	2	3	1560	1320	2520	2520
11	2.4	2	3	2160	1440	2280	2520
12	2.6	2	3	1800	1920	2520	2520
13	2.8	2	3	1800	1320	2400	2520
14	3	2	3	1800	1920	2400	2520
15	3.2	2	3	1560	1200	2400	2520
16	3.4	2	3	1920	1200	2520	2520
17	3.6	2	3	2160	1440	2640	2520
18	3.8	2	3	1680	1440	2520	2520
19	4	2	3	1920	1320	2520	2400
20	4.2	2	3	1440	1320	2280	2520
21	4.4	2	3	1440	1560	2400	2280



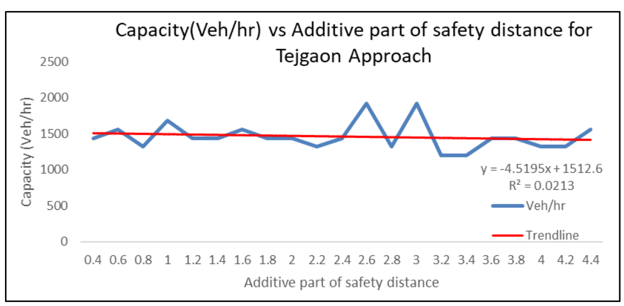
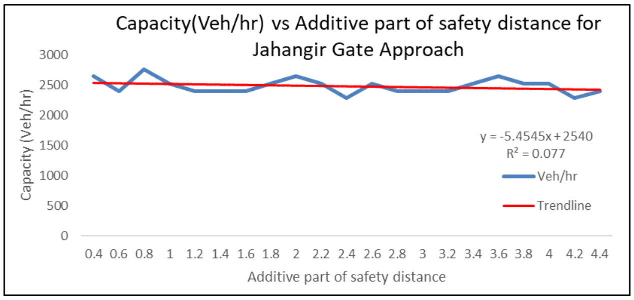


Figure: Capacities (veh/h) of all four approach for changes of Additive Part of Safety



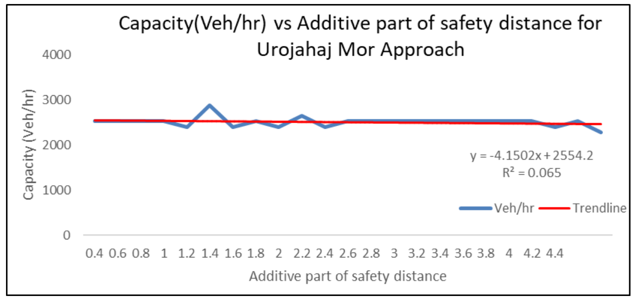


Figure: Capacities (veh/h) of all four approach for changes of Additive Part of Safety

Changes were observed from the trendline:

The impact of increasing the additive part of safety distance on intersection capacity showed noticeable fluctuations across all approaches. At the Farmgate approach, capacity ranged between 1440–2160 veh/h. The highest value (2160 veh/h) was observed at 0.6 m and 1.4 m, but capacity declined to as low as 1440 veh/h at 4.2 m and 4.4 m, indicating that larger additive distances generally reduced efficiency. For the Tejgaon approach, capacity varied between 1200–1920 veh/h. A peak of 1920 veh/h occurred at 2.6 m and 3.0 m, while the lowest (1200 veh/h) was seen at 3.2 m and 3.4 m. This suggests an irregular pattern, but overall capacity tended to decline when additive distances exceeded 3.0 m. At the Jahangir Gate approach, capacity remained comparatively high, between 2280–2760 veh/h, with the maximum capacity recorded at 0.8 m (2760 veh/h). Beyond this point, capacities stabilized around 2400–2640 veh/h, showing only moderate reductions even at higher additive values. The Urojahaj Mor approach demonstrated the most stable performance, ranging from 2280–2880 veh/h. The highest capacity occurred at 1.0 m (2880 veh/h), while only minor decreases were observed at higher values.

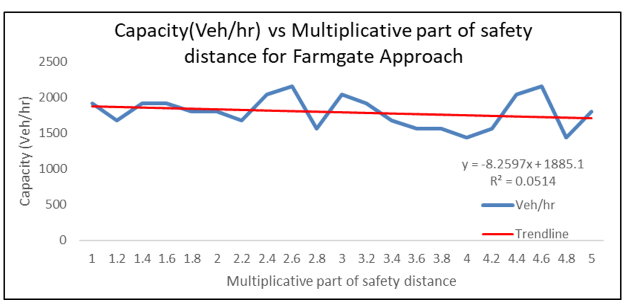
Overall, it shows a downward trend. The results indicate that smaller additive safety distances improve capacity,

Effect of Varying Multiplicative Part of Safety Distance (1 - 5):

For each parameter, the simulation runs 21 times. Then the data is collected in csv format and filter using python programming (see appendix). Table 7 shows the final result.

Table 7: Capacity of Approaches when Multiplicative Part of Safety Distance 1 to 5

				Capacity (Veh/hr.)			
SIMRUN	Multiplicative part of safety distance	Additive part of safety distance	Average Standstill Distance (m)	From Farmgate	From Tejgaon	From Jahangir Gate	From Urojahaj Mor
1	1	2	2	1920	1440	2520	2400
2	1.2	2	2	1680	1560	2400	2640
3	1.4	2	2	1920	1560	2400	2640
4	1.6	2	2	1920	1560	2520	2760
5	1.8	2	2	1800	1440	2280	2520
6	2	2	2	1800	1440	2520	2400
7	2.2	2	2	1680	1320	2280	2760
8	2.4	2	2	2040	1200	2400	2520
9	2.6	2	2	2160	1440	2640	2640
10	2.8	2	2	1560	1320	2520	2400
11	3	2	2	2040	1440	2640	2400
12	3.2	2	2	1920	1440	2280	2520
13	3.4	2	2	1680	1320	2520	2400
14	3.6	2	2	1560	1440	2640	2280
15	3.8	2	2	1560	1320	2160	2880
16	4	2	2	1440	1320	2280	2640
17	4.2	2	2	1560	1200	2280	2880
18	4.4	2	2	2040	1560	2400	2280
19	4.6	2	2	2160	1560	2400	2400
20	4.8	2	2	1440	1440	2520	2520
21	5	2	2	1800	1440	2760	2760



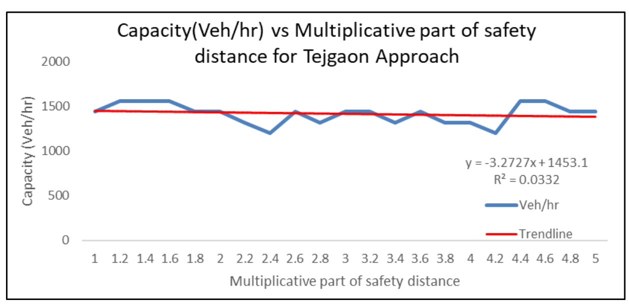
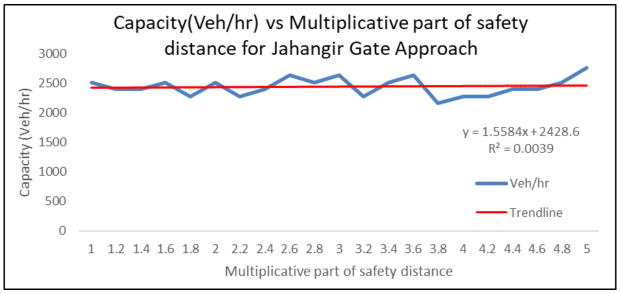


Figure: Capacities (veh/h) of all four approach for changes of Multiplicative Part of Safety



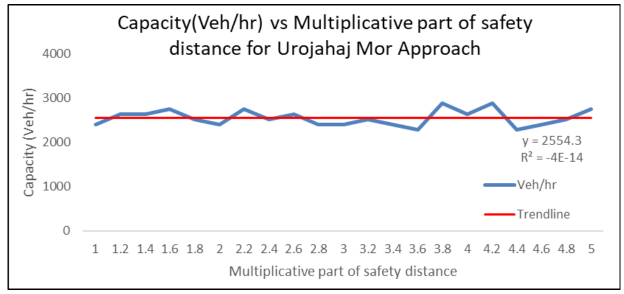


Figure: Capacities (veh/h) of all four approach for changes of Multiplicative Part of Safety

Changes were observed from the trendline

Changes in the multiplicative part of safety distance produced noticeable variations across approaches. At Farmgate, capacity ranged from 1440–2160 veh/h, with lower values at higher multiplicative factors, showing that wider following gaps reduced flow. The Tejgaon approach was more sensitive, varying between 1200–1560 veh/h, and generally staying at the lower end. For Jahangir Gate, capacity remained relatively high (2160–2760 veh/h), with the peak at 5.0 m, suggesting greater resilience. The Urojahaj Mor approach showed the most stable and strongest performance (2280–2880 veh/h), even improving at moderate to high multiplicative values.

Overall, the results indicate that while Farmgate and Tejgaon lose capacity with higher multiplicative factors, Jahangir Gate and Urojahaj Mor maintain strong performance, highlighting different sensitivity levels across approaches.

Discussion:

The simulation results demonstrate that intersection capacity is significantly affected by the three key car-following parameters (multiplicative part of safety distance, additive part of safety distance, and average standstill distance). Among these, the multiplicative part had the strongest impact, with higher values generally lowering capacity due to increased headways. The additive part and standstill distance influenced capacity more subtly, mainly affecting close-following conditions and queue discharge. Variation across the four approaches indicates that site-specific factors, such as approach geometry and traffic composition, also interact with driver behavior parameters. Overall, the findings highlight the sensitivity of capacity estimation to car-following parameters and underline the importance of careful calibration in replicating Dhaka's heterogeneous traffic environment.

Limitations and Recommendations

This study has certain limitations that should be acknowledged. The analysis is restricted to a single site (Bijoy Sarani intersection), and therefore the findings may not be directly generalizable to all intersections in Dhaka. Traffic signal phasing and pedestrian behavior were not modeled in detail due to their complexity. Additionally, only selected Wiedemann 74 parameters were varied, while other driver behavior parameters were kept constant. The traffic data used was approximate because of time and resource constraints, which may affect accuracy. Furthermore, the simulation does not incorporate weather conditions, road surface variations, or enforcement issues, all of which can influence real-world traffic capacity.

To improve simulation reliability and relevance for Dhaka traffic, it is recommended to increase the number of runs to 50–100 per parameter set with multiple random seeds, widen key parameter ranges to capture nonlinear effects, and extend the analysis to multiple intersection types and small networks to assess systemic interactions. Additionally, incorporating more parameters, lane-change and lateral behavior, and vehicle-type-specific setting will better reflect Dhaka's mixed traffic dynamics and help identify optimal bounds for practical traffic management.

References:

PTV Group. (n.d.-a). *PTV VISSIM-3D vehicle models*. PTV Group. https://us-resources.ptvgroup.com/en-us/ptv-support/ptv-vissim-3d-vehicle-models

Appendices

Appendix A: Python Script

Max value for Average Standstill distance:

```
import pandas as pd
# Read the file
df = pd.read_csv("/content/Vissim Project_Data Collection Results_Average
Standstill distance.csv")
# Give names to Approach
detector_map = {
    1: "From Farmgate",
    2: "From Tejgaon",
    3: "From Jahangir Gate",
    4: "From Urojahaj Mor"
}
# Add new column
df["EntryPoint"] = df["DATACOLLECTIONMEASUREMENT"].map(detector_map)

# Change VEHS column to numbers (if empty make it 0)
df["VEHS"] = pd.to_numeric(df["VEHS"], errors="coerce").fillna(0)

# Make an empty list for the final table
rows = []

# Go through each SIMRUN
for sim in sorted(df["SIMRUN"].unique()):
    # Take only this SIMRUN's data
    temp = df[df["SIMRUN"] == sim]
    # Find max value for each Approach
    farm = temp[temp["EntryPoint"] == "From Farmgate"]["VEHS"].max()
    tej  = temp[temp["EntryPoint"] == "From Tejgaon"]["VEHS"].max()
    jah  = temp[temp["EntryPoint"] == "From Jahangir Gate"]["VEHS"].max()
    uro  = temp[temp["EntryPoint"] == "From Urojahaj Mor"]["VEHS"].max()

    rows.append([sim, farm, tej, jah, uro])

# Make a result DataFrame
result = pd.DataFrame(rows, columns=["SIMRUN", "From Farmgate", "From
Tejgaon", "From Jahangir Gate", "From Urojahaj Mor"])

# Save to Excel
result.to_excel("Average standstill distance vary.xlsx", index=False)
print(result)
```

Max value for Additive Part of safety distance:

```
import pandas as pd
# Read the file
df = pd.read_csv("/content/Vissim Project_Data Collection Results_Additive
Part of safety distance.csv")
# Give names to Approach
detector_map = {
    1: "From Farmgate",
    2: "From Tejgaon",
    3: "From Jahangir Gate",
    4: "From Urojahaj Mor"
}
# Add new column
df["EntryPoint"] = df["DATACOLLECTIONMEASUREMENT"].map(detector_map)
# Change VEHS column to numbers (if empty make it 0)
df["VEHS"] = pd.to_numeric(df["VEHS"], errors="coerce").fillna(0)

# Make an empty list for the final table
rows = []

# Go through each SIMRUN
for sim in sorted(df["SIMRUN"].unique()):
    # Take only this SIMRUN’s data
    temp = df[df["SIMRUN"] == sim]
    # Find max value for each Approach
    farm = temp[temp["EntryPoint"] == "From Farmgate"]["VEHS"].max()
    tej  = temp[temp["EntryPoint"] == "From Tejgaon"]["VEHS"].max()
    jah  = temp[temp["EntryPoint"] == "From Jahangir Gate"]["VEHS"].max()
    uro  = temp[temp["EntryPoint"] == "From Urojahaj Mor"]["VEHS"].max()

    rows.append([sim, farm, tej, jah, uro])

# Make a Result DataFrame from the list
result = pd.DataFrame(rows, columns=["SIMRUN", "From Farmgate", "From
Tejgaon", "From Jahangir Gate", "From Urojahaj Mor"])

# Save to Excel
result.to_excel("Additive part of safety distance vary.xlsx", index=False)

print(result)
```

Max Value for Multiplicative part of safety distance:

```
import pandas as pd
# Read the file
df = pd.read_csv("/content/Vissim Project_Data Collection
Results_Multiplicative part of safety distance.csv")
# Give names to Approach
detector_map = {
    1: "From Farmgate",
    2: "From Tejgaon",
    3: "From Jahangir Gate",
    4: "From Urojahaj Mor"
}

# Add new column for Approach
df["EntryPoint"] = df["DATACOLLECTIONMEASUREMENT"].map(detector_map)

# Change VEHS column to numbers (if empty make it 0)
df["VEHS"] = pd.to_numeric(df["VEHS"], errors="coerce").fillna(0)

# Make an empty list for the final table
rows = []

# Go through each SIMRUN
for sim in sorted(df["SIMRUN"].unique()):
    # Take only this SIMRUN’s data
    temp = df[df["SIMRUN"] == sim]
    # Find max value
    farm = temp[temp["EntryPoint"] == "From Farmgate"]["VEHS"].max()
    tej  = temp[temp["EntryPoint"] == "From Tejgaon"]["VEHS"].max()
    jah  = temp[temp["EntryPoint"] == "From Jahangir Gate"]["VEHS"].max()
    uro  = temp[temp["EntryPoint"] == "From Urojahaj Mor"]["VEHS"].max()
    rows.append([sim, farm, tej, jah, uro])

# Make a Result DataFrame
result = pd.DataFrame(rows, columns=["SIMRUN", "From Farmgate", "From
Tejgaon", "From Jahangir Gate", "From Urojahaj Mor"])

# Save to Excel
result.to_excel("Multiplicative part of safety distance vary.xlsx",
index=False)

print(result)
```

Appendix B: Data from Vissim

Max flow data

	Veh/30 s			
Additive part of safety distance	From Farmgate	From Tejgaon	From Jahangir Gate	From Urojahaj Mor
0.4	13	12	22	21
0.6	18	13	20	21
0.8	16	11	23	20
1	15	14	21	24
1.2	14	12	20	20
1.4	18	12	20	21
1.6	13	13	20	20
1.8	16	12	21	22
2	17	12	22	20
2.2	13	11	21	21
2.4	18	12	19	21
2.6	15	16	21	21
2.8	15	11	20	21
3	15	16	20	21
3.2	13	10	20	21
3.4	16	10	21	21
3.6	18	12	22	21
3.8	14	12	21	21
4	16	11	21	20
4.2	12	11	19	21
4.4	12	13	20	19

SIMRUN		Veh/30 s			
	Multiplicative part of safety distance	From Farmgate	From Tejgaon	From Jahangir Gate	From Urojahaj Mor
1	1	16	12	21	20
2	1.2	14	13	20	22
3	1.4	16	13	20	22
4	1.6	16	13	21	23
5	1.8	15	12	19	21
6	2	15	12	21	20
7	2.2	14	11	19	23
8	2.4	17	10	20	21
9	2.6	18	12	22	22
10	2.8	13	11	21	20

11	3	17	12	22	20
12	3.2	16	12	19	21
13	3.4	14	11	21	20
14	3.6	13	12	22	19
15	3.8	13	11	18	24
16	4	12	11	19	22
17	4.2	13	10	19	24
18	4.4	17	13	20	19
19	4.6	18	13	20	20
20	4.8	12	12	21	21
21	5	15	12	23	23

SIMRUN		Veh/30 s			
	Average Standstill Distance (m)	From Farmgate	From Tejgaon	From Jahangir Gate	From Urojahaj Mor
1	1	19	11	22	24
2	1.1	19	15	25	21
3	1.2	14	11	22	24
4	1.3	17	13	23	21
5	1.4	19	11	23	21
6	1.5	16	14	20	21
7	1.6	19	14	21	21
8	1.7	13	10	20	21
9	1.8	14	12	22	21
10	1.9	15	13	17	21
11	2	17	12	22	20
12	2.1	16	14	18	21
13	2.2	17	14	20	22
14	2.3	17	10	20	22
15	2.4	18	12	19	19
16	2.5	14	11	19	21
17	2.6	15	12	22	23
18	2.7	14	11	20	21
19	2.8	16	12	19	22
20	2.9	14	13	19	19
21	3	16	12	21	21