# Application of GIS for Identification and Impact Evaluation of Road Side Friction Points on Urban Traffic Speeds

By

**A. Mohan Rao**

Senior Scientist
TES Division

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# Introduction

- Geographic Information System (GIS) over the years has emerged to be a very **efficient technology** platform.
- It has shows **great applications** in almost all the persisting fields including the transportation field.
- GIS is a technological field that incorporates geographical features with tabular data in order to **map, analyze, and assess real-world problems.**
- GIS can be used in the analysis of **traffic speed/ flow** monitoring and management along with traffic congestion studies.

# Introduction

Contd…

- Using the power of GIS we can identify various **friction locations** that impact the speed of the vehicle.
- GPS can help to **trace the vehicular speed** in practice
- The influencing factors that affect the speed of vehicles on the road, such as **width of road, geometry of the road, construction works, various land uses** etc.,.
- Mapping out these factors using **GIS capabilities** can help in the road **Capacity Estimation**.
- The various advantages of GIS make it an **attractive option** to be used to face the emerging traffic problems.

# Friction Points

- Friction factors are defined as all those actions related to the **activities taking place by the sides of the road and sometimes within the road**, which **interfere** with the traffic flow on the travelled way.

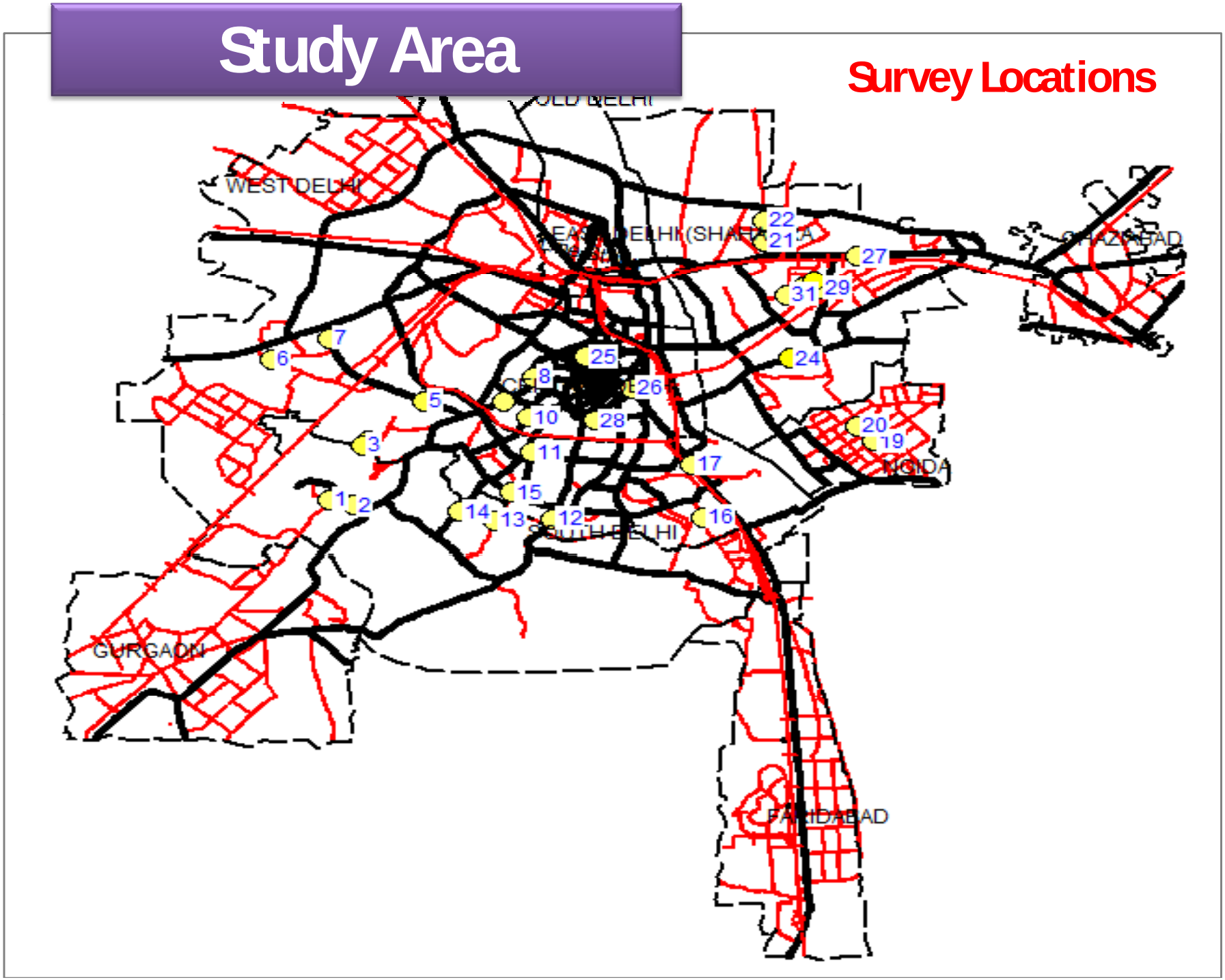
- They include but not limited to **pedestrians, bicycles, non-motorized vehicles, parked and stopping of vehicles, bus stops, petrol pumps on the side roads etc..**

# Objectives of the study

- To identify the roadside friction locations on urban arterials and sub-arterials in Delhi region.

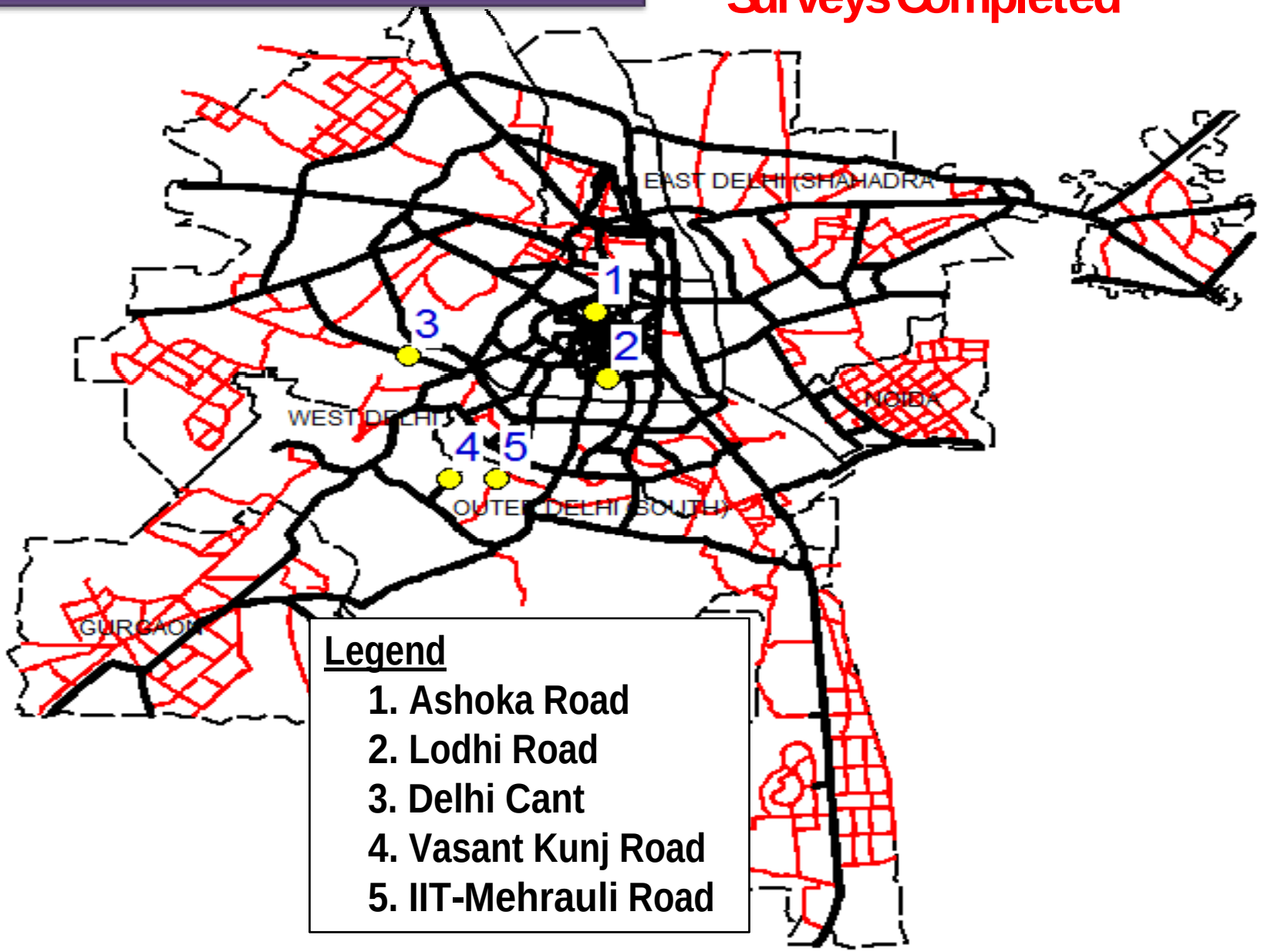
- To predict Impact of the friction points on traffic speed

# Study Area


Survey Locations
WEST DELHI
GURGAON
NOIDA
FARIDABAD
1
2
3
5
6
7
8
10
11
12
13
14
15
16
17
19
20
21
22
24
25
26
27
28
29
31

## Preliminary Survey Completed)

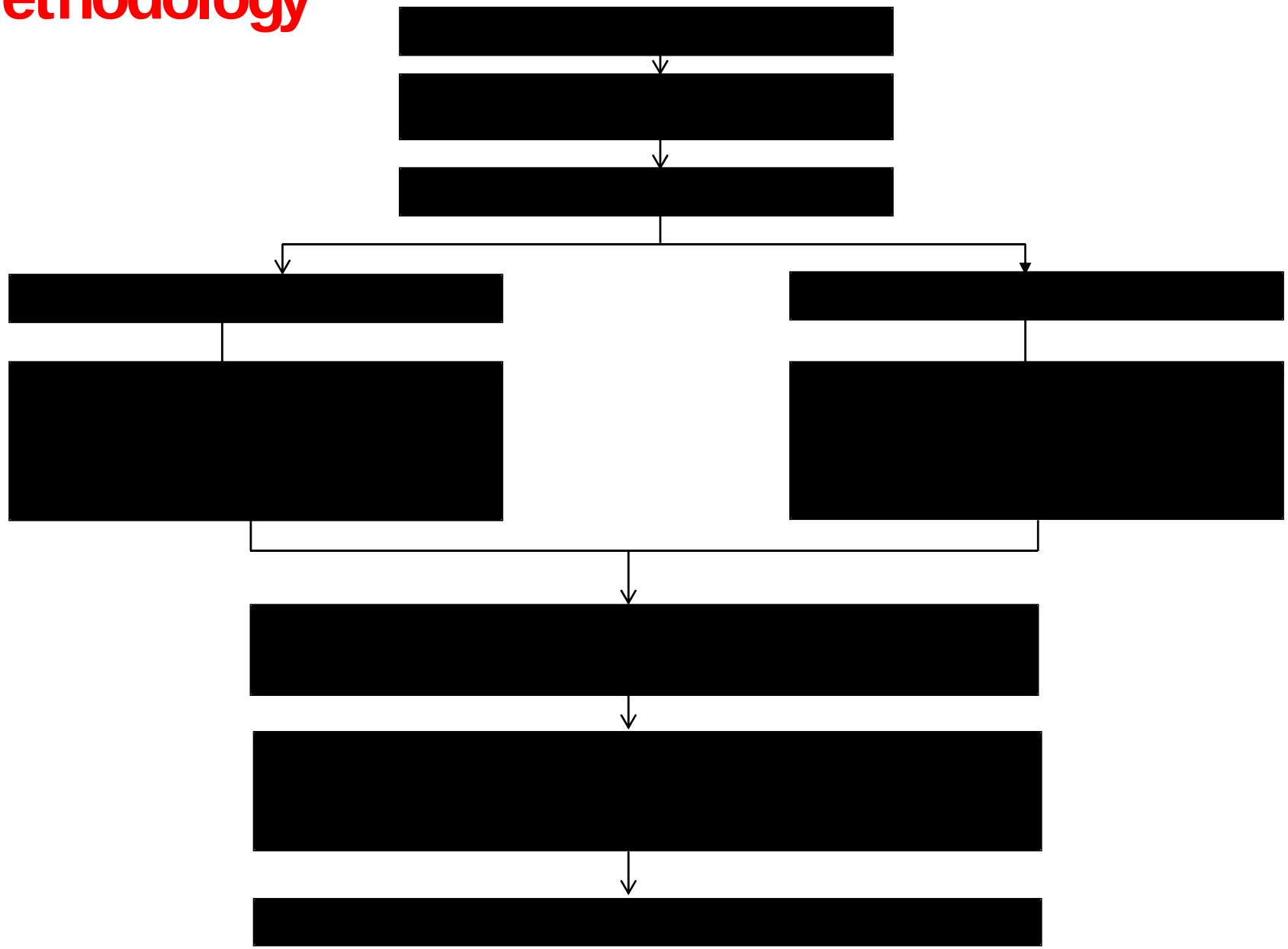
# Surveys Completed




**Legend**

1. Ashoka Road
2. Lodhi Road
3. Delhi Cant
4. Vasant Kunj Road
5. IIT-Mehrauli Road

# Methodology



# Data collection

## *Form: Road Geometry*

Indian Highway Capacity Manual

**Test Section Inventory Forr**

*(Please Tick the relevant)*

Road Class: **Urban Roads** Name of the City: _____

Name of the Road Segment_____ Class of the Road: Arterial / Sub-Arterial / Collector

Type of the Road Segment (Divided/ Undivided) _____ Length of the Road Segment (km)_____

Horizontal Curvature (Straight/Curved) _____ Gradient of Road_____

Width of the Road (for each direction of movement in case of divided road) _____

Type of Road (Bitumen/Concrete):_____Pavement Condition (In mm /Km): _____

Median Width (m)_____ Median Continuity (No Gaps/few gaps/frequent gaps)_____

Median Type: Raised / Depressed Footpath Width: (m)_____

Height of Footpath (cm) _____ Condition of Footpath (V. Good/Good/Average/Poor/V .Poor): _____
Shoulder Width (m) _____ Shoulder Type (Paved/unpaved) _____

Condition of Shoulder (V. Good/ Good/ Average/ Poor/ V .Poor): _____
Adjoining Land use (Commercial/Residential/Industrial/Institutional/Mixed/Others) _____
Type of Friction Point(s) on the Test Section

Surveyed by_____ Date: Day_____ Month _____Year_____
Checked by_____ Date: Day_____ Month _____Year_____

# Identification of Survey Locations

| Road No. | Class of the Road: Arterial / Sub-Arterial / Collector | Type of the Road Segment | Length of the Road Segment (km) | Horizontal Curvature | Gradient of Road | Width of the Road (for each direction of movement in case of divided road) (m) | Type of Road (Bitumen/ Concrete | Pavement Condition (In mm /Km) | Median Width (m) | Height of Median (cm) | Median Continuity (No Gaps/few gaps/frequent gaps) | Median Type | Footpath Width(m) | Height of Footpath (cm) | Condition of Footpath | Shoulder Width (m) | Shoulder Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | Divided | 1 | Straight | Nil | 9.2 | | Poor | 1.1 | 60 | | | 0 | 0 | | 3.3 | Paved |
| 2 | | Divided | 1.1 | No | Nil | 6.8 | | Good | 1.06 | 45 | Few Gaps (4) | Raised | 3.9 | 18 | Poor | 1.8 | Paved |
| 3 | | Undivided | 1 | No | Nil | 10.1 | | Good | | | | | 4.4 | 26 | Poor | 2 | Unpaved |
| 4 | | Divided | 1.5 | Straight | Nil | 12.9 | | Good | 1.2 | | No Gap | Raised | 2 | 18 | Good | 0.5 | Unpaved |
| 5 | | Undivided | 0.5 | Straight | | 14 | | Excellent | | | | | 1.7 | 20 | | | |
| 6 | | Divided | 0.6 | Straight | | 7 | | Excellent | 0.35 | 35 | | | 2 | 35 | Good | | |
| 7 | | Divided | 1.3 | Straight | | 8.1 | | Good | 1 | 70 | Few Gaps (3) | Raised | 2.4 | 32 | Poor | 5.4 | Paved |

| Road No. | Type of Friction Point(s) on the Test Section | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. of Access Points | Pedestrians walking | Stopping of IPT modes (on roadway or shoulder) | Stopping of NMT vehicles (on roadway or shoulder) | Absence of bus bays | Pedestrians crossing the road | At the mouth of the Flyover | Vehicles entering and leaving roadside premises | Parking on roadway or shoulder |
| 1 | 0 | No | 1 | 0 | | 1 | | | No |
| 2 | 2 | Yes | 2 | 2 | | 1 | | | Yes |
| 3 | 5 | No | 5 | 5 | | | | | Yes |
| 4 | | | | | | | | | |
| 5 | | Yes | 1 | 1 | | | | | Yes |
| 6 | | | | | | | | | |
| 7 | 1 | Yes | 4 | 4 | | | | | Yes |
| 8 | | Yes | 1 | 1 | | | 1 | | No |
| 9 | 2 | No | 3 | 3 | | | | | No |
| 10 | | | | | | | | | |
| 11 | 1 | No | 2 | 2 | | | | | No |
| 12 | 0 | yes | 1 | 1 | | | | | No |
| 13 | 0 | Yes | 1 | 1 | | | | | No |
| 14 | 1 | No | 1 | 1 | | | | | No |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | 0 | No | 2 | 2 | | | | | No |
| 18 | 2 | No | 1 | 1 | | 1 | | | yes |
| 19 | 3 | No | 3 | 3 | | | | | No |
| 20 | 4 | No | 4 | 4 | | | | | No |
| 21 | 2 | No | 1 | 1 | | | | | No |
| 22 | | | | | | | | | |
| 23 | 1 | No | 1 | 1 | | | | | No |
| 24 | | | | | | | | | |

# Ideal Section

**Parameters To be considered while selecting Ideal Test Sections in Urban Areas**

| S.No | Parameter | Value | Remarks |
|---|---|---|---|
| 1 | Type of Carriageway | As per facility | |
| 2 | Sight Distance | >300 m | 250 m to 300m |
| 3 | Terrain | Plain | Up to 15m/km |
| | | Rolling | 15 - 25 m/km |
| | | Hilly | > 25 m/km |
| 4 | Side Friction | Low | - |
| 5 | Road Side Land use | Negligible | - |
| 6 | Traffic Flow Split | 50/50 | As far as possible |
| 7 | Roughness | < 3 IRI | - |
| 8 | Traffic Control Devices | Good | Good Delineation using Signs, Road Markings and Lighting can be categorized as Good |
| 9 | Shoulders | 1.5 m to 2.0 m | If the width is available for Shoulder without marking can also be considered |

# 22. Palam Rd To Sadar Bazar (Delhi Cantt) Road


**Undivided Road**
**Width : 9.0m**

# 5. Ashoka Road


**Undivided Road**
**Width : 12.9m**


## Video and Spot Speed Surveys)


# GPS Speed Survey

# Database Preparation

## ➢ Spatial database preparation

- Delhi Maps
- Google Earth images
- GPS data
  - ✓ Performance Box data
  - ✓ NSV Data

## ➢ Non- spatial database preparation

- Speed Data

# Application of GIS for Friction points Identification

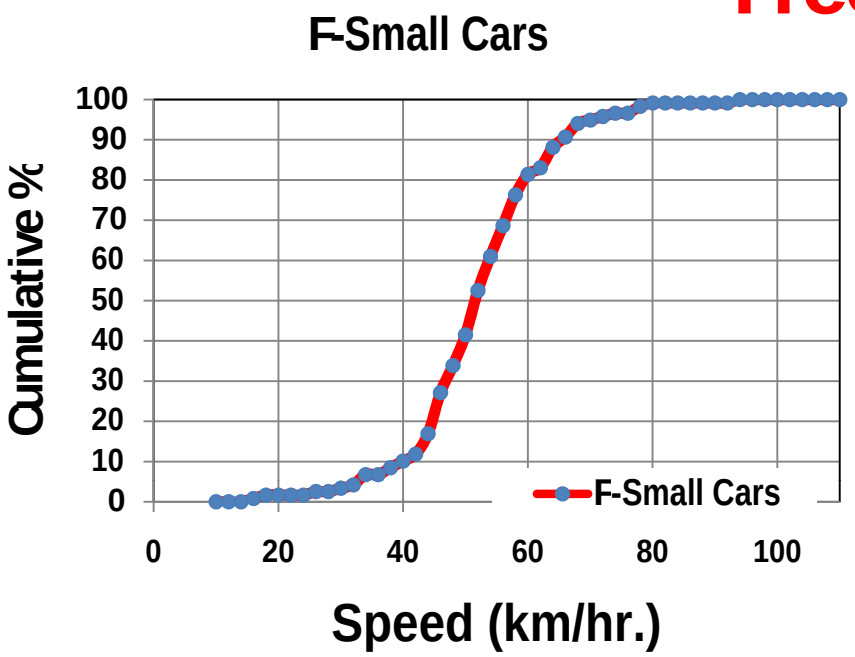


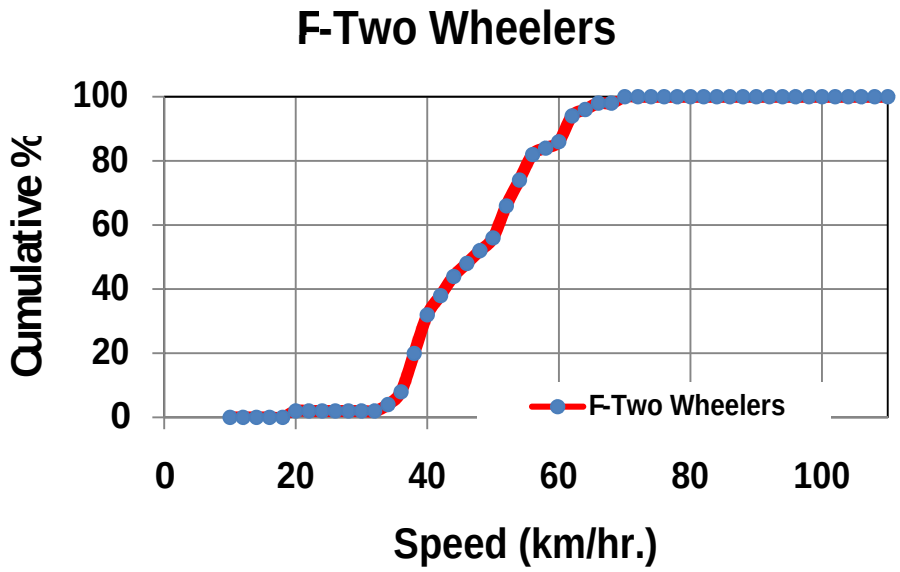


# Integration of GIS Map, Google Image and GPS Data

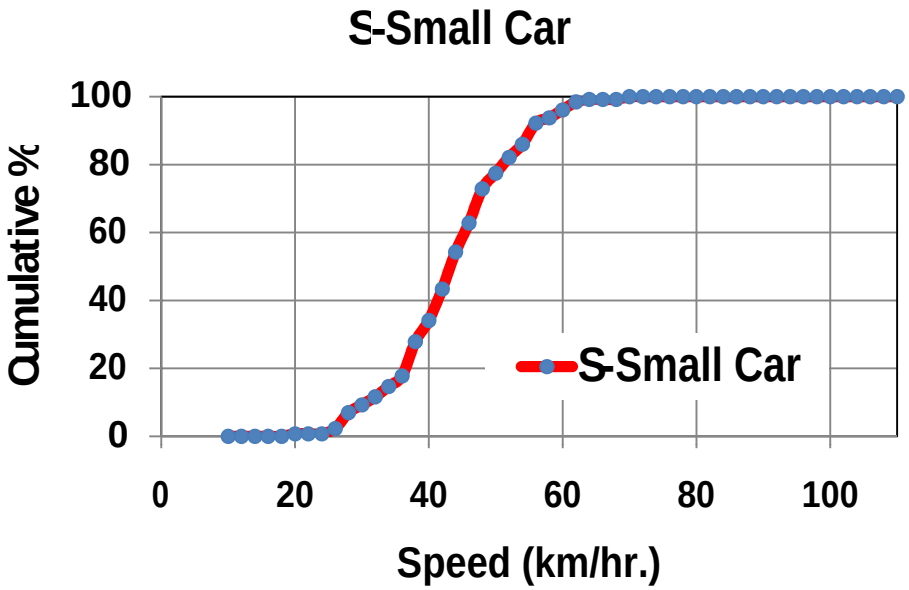
# Analysis of Data

# Free Speed (Lodhi Road)



# Stream Speed (Lodhi Road)



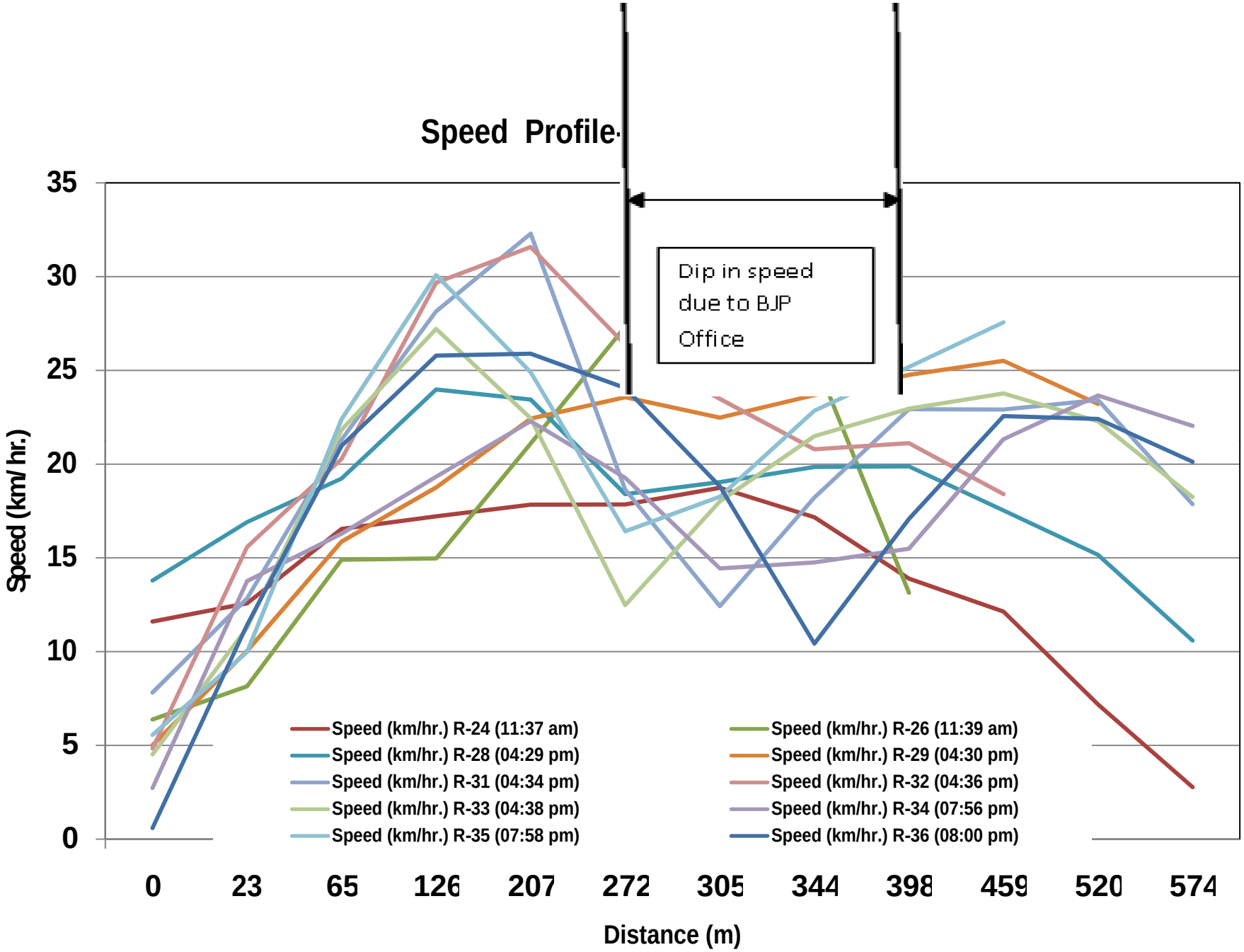

# Segment Properties

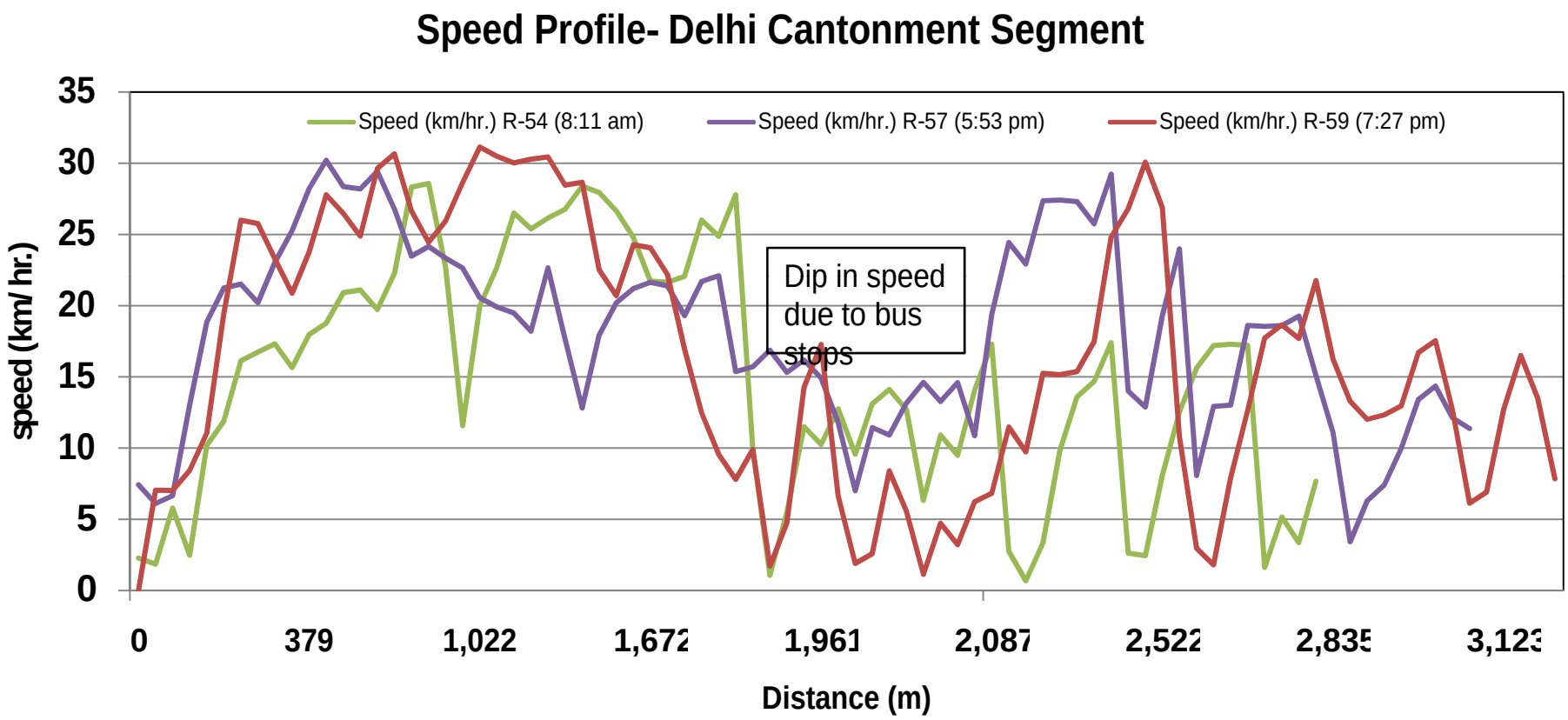
## Percentage difference between Free speed and stream speed

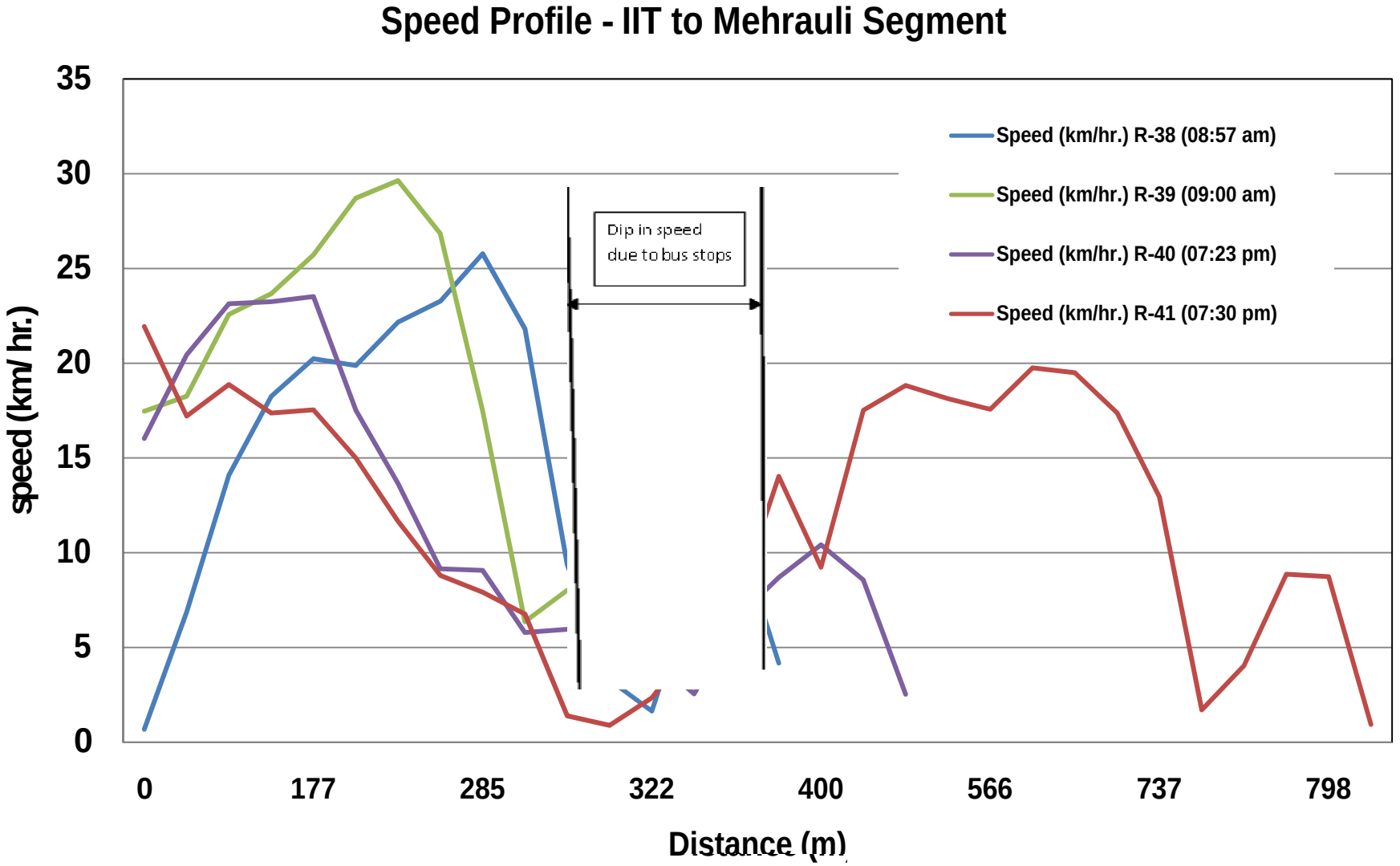
| LOCATIONS | AVERAGE SPEED (km/hr)- NSV Data | AVERAGE SPEED (km/hr)- Pbox Data | Number of Runs | % Difference between Free Speed and Stream Speed |
|---|---|---|---|---|
| Lodhi Road | 51.41 | 18.09 | (avg. of 12 runs) | **64.8** |
| Ashoka Road | 56.5 | 19.36 | (avg. of 15 runs) | **65.7** |
| Delhi Cantonment | 42.5 | 17.19 | (avg. of 8 runs) | **59.6** |
| IIT Delhi to Mehrauli | 51.25 | 15.75 | (avg. of 5 runs) | **69.3** |
| Munirka to Vasant Kunj | 60.4 | 22.38 | (avg. of 9 runs) | **62.9** |
| | | | **Average** | **64.5** |

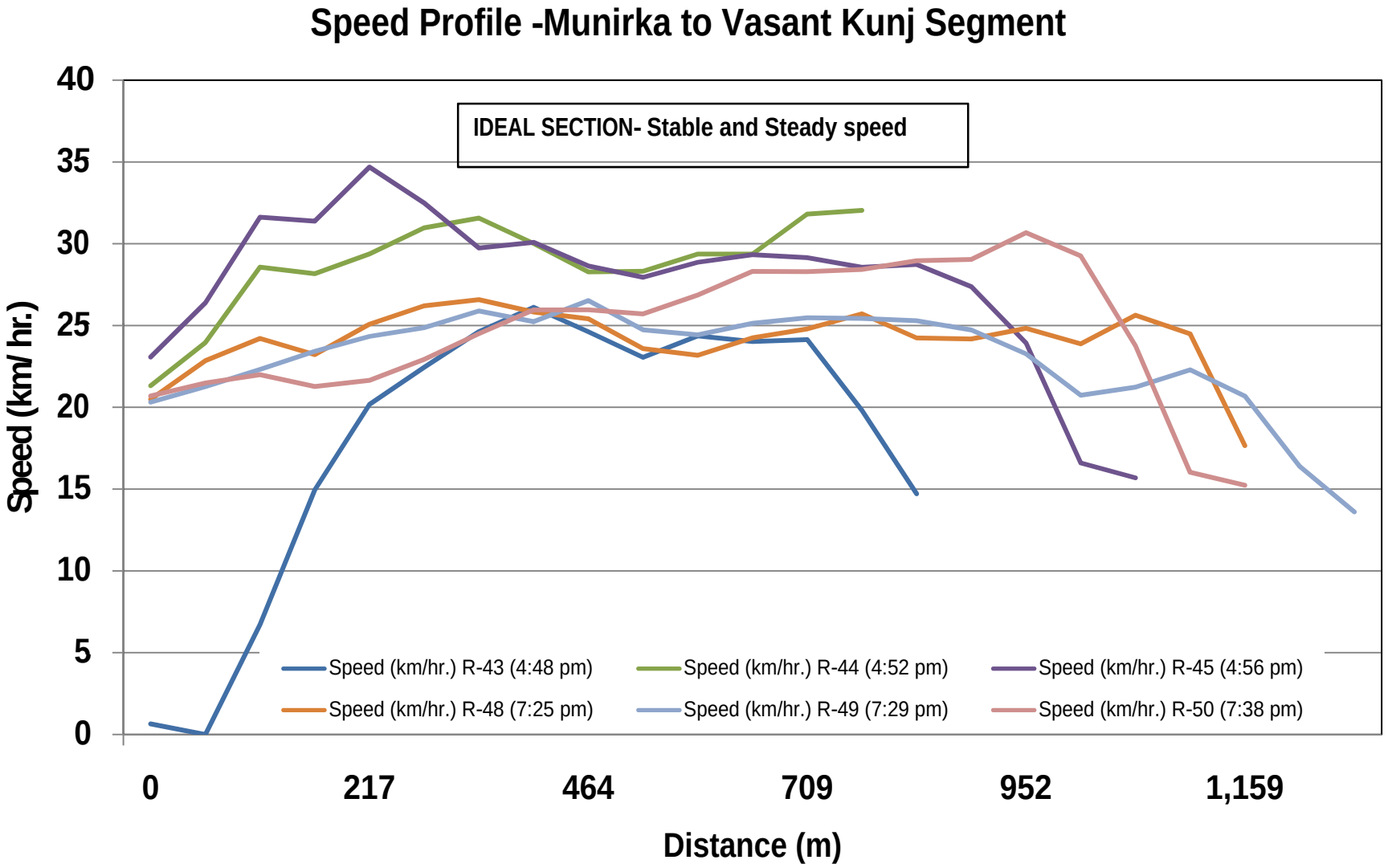
# Temporal Variation of Speed

| S.No. | Location Name | Distance | Time Periods | | | |
|---|---|---|---|---|---|---|
| | | | 7-9 am | 9-12 am | 4-6 pm | 6-8 pm |
| 1 | Lodhi Road | 0.50 km | NA | 18.83 | 16 | 16.81 |
| 2 | Ashoka Road | 0.54 km | 17.85 | 18.58 | 20.12 | 20.14 |
| 3 | IIT Delhi | 0.62 km | 16.9 | 20.43 | NA | 12.26 |
| 4 | Munirka | 2.24 km | NA | NA | 23.65 | 21.37 |
| 5 | Delhi Cantt | 3.20 km | 16.95 | NA | 18.59 | 16.63 |
| Average | | | **17.23** | **19.28** | **19.59** | **17.44** |


Speed Profile
Dip in speed due to BJP Office
Speed (km/ hr.)
35
30
25
20
15
10
5
0
0
23
65
126
207
272
305
344
398
459
520
574
Distance (m)
Speed (km/hr.) R-24 (11:37 am)
Speed (km/hr.) R-26 (11:39 am)
Speed (km/hr.) R-28 (04:29 pm)
Speed (km/hr.) R-29 (04:30 pm)
Speed (km/hr.) R-31 (04:34 pm)
Speed (km/hr.) R-32 (04:36 pm)
Speed (km/hr.) R-33 (04:38 pm)
Speed (km/hr.) R-34 (07:56 pm)
Speed (km/hr.) R-35 (07:58 pm)
Speed (km/hr.) R-36 (08:00 pm)


Speed Profile- Delhi Cantonment Segment
Speed (km/hr.) R-54 (8:11 am)
Speed (km/hr.) R-57 (5:53 pm)
Speed (km/hr.) R-59 (7:27 pm)
Dip in speed due to bus stops
speed (km/ hr.)
35
30
25
20
15
10
5
0
0
379
1,022
1,672
1,961
2,087
2,522
2,835
3,123
Distance (m)


Speed Profile - IIT to Mehrauli Segment
35
30
25
20
15
10
5
0
speed (km/ hr.)
0
177
285
322
400
566
737
798
Distance (m)
Dip in speed due to bus stops
Speed (km/hr.) R-38 (08:57 am)
Speed (km/hr.) R-39 (09:00 am)
Speed (km/hr.) R-40 (07:23 pm)
Speed (km/hr.) R-41 (07:30 pm)


Speed Profile -Munirka to Vasant Kunj Segment
IDEAL SECTION- Stable and Steady speed
Speed (km/ hr.)
40
35
30
25
20
15
10
5
0
0
217
464
709
952
1,159
Distance (m)
Speed (km/hr.) R-43 (4:48 pm)
Speed (km/hr.) R-44 (4:52 pm)
Speed (km/hr.) R-45 (4:56 pm)
Speed (km/hr.) R-48 (7:25 pm)
Speed (km/hr.) R-49 (7:29 pm)
Speed (km/hr.) R-50 (7:38 pm)

# Influence of Friction Points on Traffic Speed

| Site Locations | Speed reduction due to Parking of vehicles on the road sides. in Different Time Periods | | | |
|---|---|---|---|---|
| | 7 am - 9 am | 9am - 12 am | 4 pm - 6pm | 6 pm - 8pm |
| Lodhi Road | - | - | - | - |
| Ashoka road | - | 15.69% | 5.64% | **35.21%** |
| IIT Delhi | - | - | - | 6.69% |
| Munirka | - | - | - | - |
| Delhi Cantt | 9.64% | - | 24.43% | 15.17% |

| Site Locations | Speed reduction due to Pedestrians crossing the roads in Different Time Periods | | | |
|---|---|---|---|---|
| | 7 am - 9 am | 9am - 12 am | 4 pm - 6pm | 6 pm - 8pm |
| Lodhi Road | - | 40.94% | - | 17.02% |
| Ashoka road | 2.92% | 15.69% | 8.15% | 9.78% |
| IIT Delhi | 1.78% | - | - | **49.82%** |
| Munirka | - | - | - | - |
| Delhi Cantt | 23.50% | - | 30.45% | 48.08% |

| Site Locations | Speed reduction due to Bus Stop in Different Time Periods | | | |
|---|---|---|---|---|
| | 7 am - 9 am | 9am - 12 am | 4 pm - 6pm | 6 pm - 8pm |
| Lodhi Road | - | 26.27% | 4.05% | 48.37% |
| Ashoka road | - | - | - | - |
| IIT Delhi | **93.96%** | 78.54% | - | 90.30% |
| Munirka | - | - | 43.61% | 38.96% |
| Delhi Cantt | 59.50% | - | 43.42% | 48.08% |

# The Stream Speed difference W.R.T ideal section

| Test Locations | Results |
|---|---|
| Ashoka Road | **59.71%** |
| Lodhi Road | **52.13%** |
| Delhi Cantt | **64.36%** |
| IIT Delhi to Mehrauli | **77.19%** |
| **Munirka to Vasant Kunj** | **Ideal Section** |

# Thank You