Journal of Basic and Applied Engineering Research
p-ISSN: 2350-0077; e-ISSN: 2350-0255; Volume 3, Issue 3; January-March, 2016, pp. 263-270

http://www.krishisanskriti.org/Publication.html

# Assessing Capacity and Level of Service for Urban Corridors, a Case of Kukatpally (NH-9) & Puranapool (NH-7) Stretches

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**Abstract—***Hyderabad Metropolitan area is connected by three national highways, NH-7, NH-9 and NH-202 and five state highways. There are two urban corridors NH-7 and NH-9 which completely pass through this region. For the study, two different stretches of length 1km each have been selected in Kukatpally Y-junction, from NH-9 and Puranapool from NH-7 for the study. The purpose of the study is to assess the capacity and level of service and the effects of mixed traffic, surrounding land use, traffic signs & signals and road geometry of urban corridors on them after entering from the rural areas to the Peri-urban and core urban areas. Capacity and Level of service are two related terms. Capacity analysis tries to give a clear understanding of how much traffic a given transportation facility can accommodate. Level of service tries to answer how good the present traffic situation on a given facility is, the former gives a quantitative measure of a facility and the later gives a qualitative measure of traffic. Capacity and level of service varies with the type of facility, prevailing traffic and road conditions etc. For the study, field surveys such as traffic volume count and speed delay survey and measurement of the cross-sections of the roads has been carried out. The above data collected is used for Speed and volume analysis, land use analysis and comparative analysis have been done.*

*After the study of Kukatpally and Puranapool stretch, capacity is evaluated with respect to traffic conditions, road way characteristics and control conditions. LOS is analyzed based on the operational conditions, base conditions, and road way conditions. The results after assessing the capacity and LOS for both the corridors shows that the mixed traffic and surrounding land-use and road way conditions has great impact on the speed, volume and capacity and level of service of the highway corridors entering from rural to urban areas.*

## 1. INTRODUCTION

### 1.1 Background

Growing traffic congestion is inevitable in all large and growing metropolitan areas across the world. India being a developing country, the traffic in urban corridors is vastly heterogeneous, consists various kinds of vehicles with different operational characteristics. In current scenario no suitable methodology is available for determination of how rural highway traffic once entering into urban areas is affected by diverse traffic conditions. So there is dire need of assessing capacity and level of service for urban corridors.

In this context, present study is carried out to determine the capacity and level of service based on speed- flow behavior and performance of traffic flow using traffic flow theory for the prevailing mixed traffic conditions. The heterogeneous traffic when enters into the urban areas is highly affected by the mixed traffic, which in turn affects the quality and quantity of the traffic. For this study, urban corridors of length 1 km each are selected which completely pass through the city. The corridors having characteristics of the core urban area and Peri-urban area are selected, which affect the quality of traffic condition diversely. Two Un-interrupted traffic stretches are selected, first Stretch is access controlled 8 lane divided NH- 9 in the west Zone with predominant Educational and Industrial land uses in the Peri-urban area. Second stretch is access uncontrolled uninterrupted 4 lane divided NH-7 in the south zone with predominant commercial and residential land uses in the core urban area.

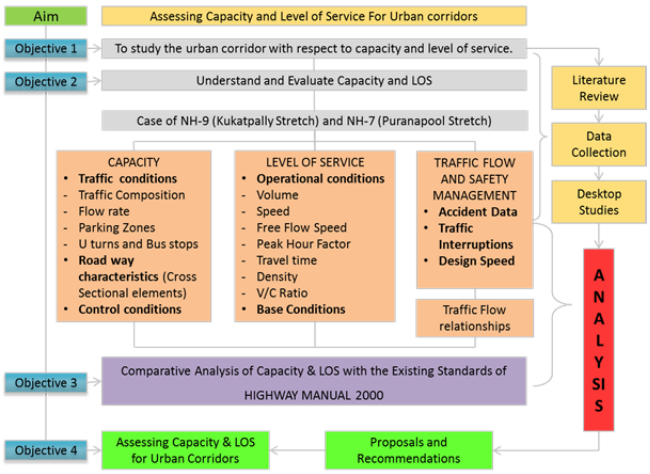
### 1.2 Aim

To study and assess capacity and Level of service for highway corridor passing through the urban area experiencing mixed traffic

### 1.3 Objective

- To study the urban corridor with respect to capacity and level of service.
- To study vehicular flow movement on the corridor.
- Traffic Flow Performance determination of the speed, density, flow and their relationships using traffic flow theory.
- Comparison of LOS for different Modes OF transport.
- Assessing the capacity and level of service for the urban corridors and providing safety measures.

### 1.4. Methodology




### 1.5 Traffic Field Study and Surveys

Traffic surveys are conducted to collect data on classified vehicular volume and speed on the selected urban corridors. Road Inventory surveys are conducted for gathering information regarding road geometry including carriage way, number of lanes, lane widths, median, U turns etc. On the basis of inventory surveys, detailed traffic surveys are planned. The surveys are conducted on normal working days during morning and evening peak as well as off peak hours, covering wide range of traffic conditions and flow behavior. Manual as well as videography technique are used for the traffic surveys.

Traffic volume: The traffic volume study is carried out for 12 hours in both the stretches on working days. The daily traffic volumes, peak hourly variation in traffic volume, vehicle composition are obtained from this survey. Vehicular Spot speed is measured by the Direct Timing Procedure between the two reference lines lying at 30m interval. For every 5 min interval, 30 vehicles of each mode are selected randomly from videography. The free flow speed study is also carried out in midnight 12.00 am to 1.00 am.

## 2. LITERATURE REVIEW

Capacity and Level of service are two related terms. Capacity analysis tries to give a clear understanding of how much traffic a given transportation facility can accommodate. Level of service tries to answer how good the present traffic situation on a given facility is. Thus it gives a qualitative measure of traffic, whereas capacity analysis gives a quantitative measure of a facility. Capacity and LOS varies with the type of facility, prevailing traffic and road conditions etc.

### 2.1 Capacity

Capacity is defined by the Highway Capacity Manual as the maximum hourly rate at which persons or vehicles can be reasonably accommodated on a uniform segment of a lane or roadway during a given time period under prevailing roadway, traffic and control conditions. It speaks about the physical amount of vehicles. It does not depend on the total number of vehicles demanding service. Capacity is the maximum flow rate that a facility can afford. While calculating the capacity the maximum flow rate is taken for the worst 15 minutes of the peak hours.

#### 2.1.1 Factors affecting capacity

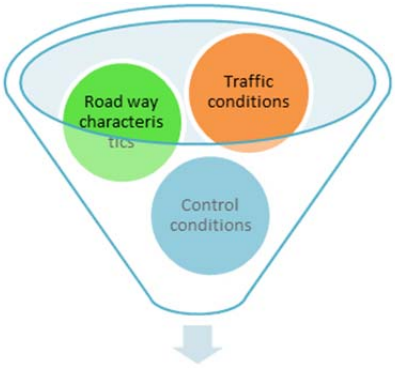



Fig 1: Factors affecting capcity

**Traffic conditions:** It refers to traffic composition on the road such as the presence of cars, trucks, buses etc. in the stream. It also includes peak hour characteristics, proportions of turning movements at intersections and U turns.

**Road way characteristics:** It discusses the geometric characteristics of the road. These include lane width, shoulder width, lane configuration, horizontal alignment and vertical alignment.

**Control conditions:** These primarily apply to surface facilities and often refer to the signals of intersection.

### 2.2 Level of service:

Level of service is defined based on the measure of effectiveness or (MOE). Typically three parameters are used under this and they are

- Speed
- travel time,
- Density and delay.

**The intention of LOS is to relate the traffic service quality to a given flow rate of traffic.** It is a term that designates a range of operating conditions on a particular type of facility. Highway capacity manual (HCM) 2000 provides some procedure to determine level of service. It divides the quality of traffic into six levels ranging from level A to level F. **Level 'A'** represents the best quality of traffic where the driver has the freedom to drive with free flow speed and **level 'F'** represents the worst quality of traffic.

### 2.2.1 LOS for different types of transportation facilities

Most important classification of transportation facilities from the engineering perspective is based on the continuity of flow which is of two types:

i. Uninterrupted flow

ii. Interrupted flow. .

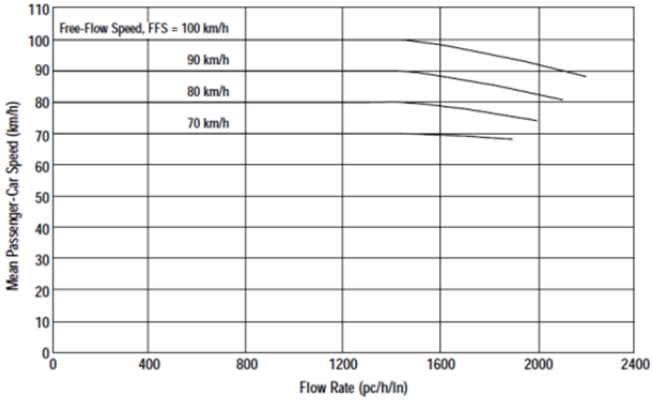
Uninterrupted flow is the flow of traffic in which there is no obstruction to the movement of vehicles along the road. Uninterrupted flow is possible in sections of rural and urban multilane highways between signalized intersections where signal spacing is sufficient to allow for uninterrupted flow.

### 2.2 Urban Arterial Streets Classification

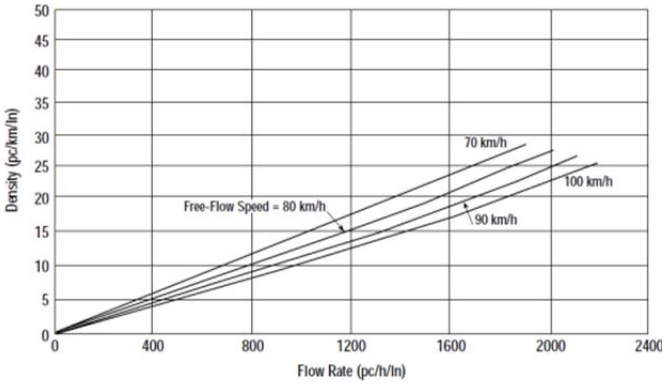
| Urban street Class | I | II | III | IV |
|---|---|---|---|---|
| Range of free flow speed | 90-70 km/hr | 70-55 km/hr | 55-50 km/hr | 55-40 km/hr |
| Typical FFS | 80 km/hr | 65 km/hr | 55 km/hr | 45 km/hr |
| LOS | Average Travel Speed (km/hr) | | | |
| A | >72 | >59 | >50 | >41 |
| B | >56-72 | >46-59 | >39-50 | >32-41 |
| C | >40-56 | >33-46 | >28-39 | >23-32 |
| D | >32-40 | >26-33 | >22-28 | >18-23 |
| E | >26-32 | >21-26 | >17-22 | >14-18 |
| F | < = 26 | < = 21 | < =17 | < = 14 |

### 2.3 Speed-Flow& Density-Flow relationships

As the exhibit shows, the capacity of a multilane highway under base conditions is 2,200 pc/h/ln for highways with an FFS of 100 km/h. For flow rates of 1,400 to 2,200 pc/h/ha, the speed on a multilane highway with an FFS of 100 km/h drops by 12 km/h. This shows that density varies continuously throughout the range of flow rates.




The capacity value of 2,200 pc/h/ln represents the maximum 15-min flow rate accommodated under base conditions for highways with an FFS of 100 km/h. Capacities on specific multilane highways may vary.




### 2.4 Referred to Desktop study on the important traffic corridor of Surat city known as `Gaurav Path'

## 3. HYDERABAD HIGHWAY CORRIDORS NH 7 & NH 9

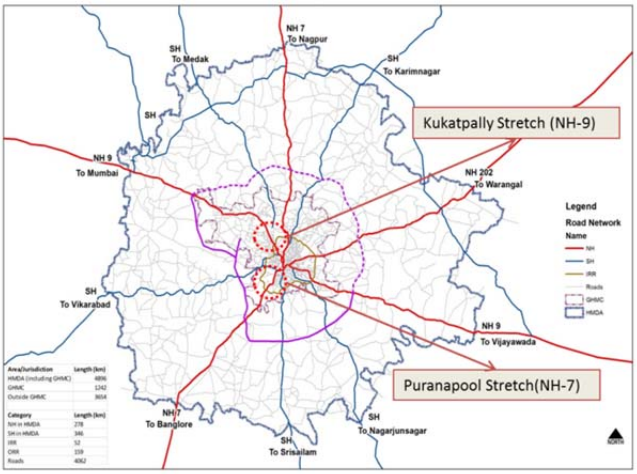



**Fig. 3. 1: Hyderabad road connectivity Map**

Hyderabad is well connected to many other locations in India, such as Bangalore, Mumbai, Delhi, Kolkata, Nagpur, Chennai, Pune, Vishakhapatnam and Vijayawada, either through direct or intermediate locations.

Hyderabad being the capital city of Telangana attracts huge volume of intercity and inter-regional passenger traffic and also handles freight logistics which generates enormous level of goods. Ensuring smooth flow of this cargo and passenger traffic through Hyderabad Region is of national importance. But this traffic when passing through the region experiences problems of congestion and poor service of urban corridors due to the increase in the personalized motor traffic. To study this subject of interest, two stretches are selected as the case study areas for the assessing the issues affecting the capacity and level of service.

### 3.1 Case Study stretch 1: NH-9 Kukatpally – Balaji nagar Road.

NH-9 is passing through Kukatpally, which is a major residential and commercial area and also consists of Balanagar industrial area. This stretch provides connectivity to hi-tech city (IT HUB), due to which high daily traffic is witnessed during the peak hours. Consequently, its proximity to Balangar industrial area is encouraging the heavy vehicular traffic in the day time also.

The stretch has predominantly industrial areas on the right side and with supporting commercial shops (service centres and mechanic shops for industrial vehicles) on the left. To the north of this stretch there is residential area with major public facilities like Govt Degree College, Chaitanya junior college and exhibition ground. These land uses are responsible for the existing pattern of the road network, intense vehicular traffic and the geometric characteristics of the road.

The access controlled uninterrupted stretch has capacity of 4800 PCU's/Hour for one direction with carriage way of 50m and average lane width of 3.9 m. The traffic is regulated by median in both directions and has two U turns of which one is mainly for the left turning traffic, where this road connects directly to Hitech city.

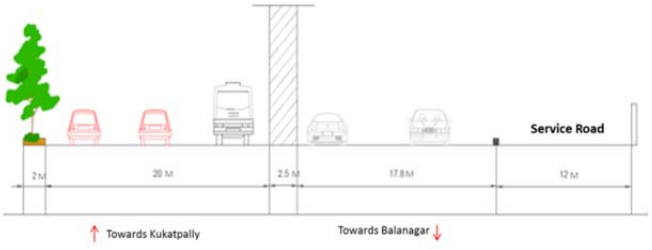



**Fig. 3.2: Cross section of the Kukatpally Stretch**

#### 3.1.1 Capacity

**Traffic conditions:** Traffic Composition: Here 65 % of the traffic is shared by Two wheelers (54 %) and Auto Rickshaws (22%).This shows the major share of the mixed traffic composition. capacity of the roads is increased to more than 1400 PCU/Hr/lane. 7 % of the heavy vehicles and 22 % of the buses are creating major traffic congestion during the peak hours due to Industrial, Commercial, educational land use along the stretch.

**Flow Rate:** It is above 1700 in the peak hours i.e. from 8.00 A.M to 10.00 A.M and 5.00 P.M to 8.00 P.M. which shows increase in the traffic flow and density. The speed of the traffic is affected by the density and if the flow rate increases then the speed also increases. In the peak hours the traffic flow is more than designed capacity which is causing congestion of traffic, affecting speed, time and flow of the traffic.

**Table 3.1: Service flow rate of Kukatpally stretch**

| Stretches | Towards Kukatpally | | Towards Balanagar | |
|---|---|---|---|---|
| Time | PCU/Hr | Flow rate | PCU/Hr | Flow rate |
| 8.00-9.00 | 7109 | 1777 | 6461 | 1615 |
| 9.00-10.00 | 6971 | 1743 | 5781 | 1445 |
| 11.00-12.00 | 5551 | 1388 | 4495 | 1124 |
| 12.00-1.00 | 5168 | 1292 | 4373 | 1093 |
| 2.00-3.00 | 4842 | 1210 | 4014 | 1003 |
| 5.00-6.00 | 4997 | 1249 | 4493 | 1123 |
| 6.00-7.00 | 6071 | 1518 | 5971 | 1493 |
| 7.00-8.00 | 6047 | 1512 | 6653 | 1663 |
| Total | 5877 | 1469 | 6807 | 1702 |

**Existing traffic scenario**

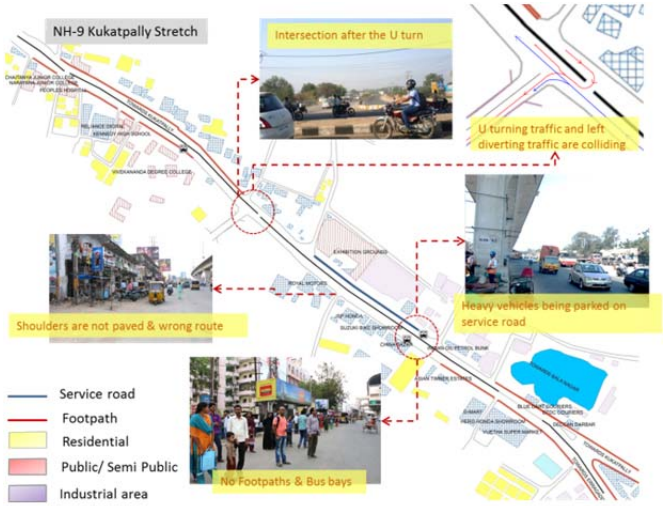



**Fig. 3. 3: Existing traffic Scenario of Kukatpally Stretch**

**U turns:** The vehicles which are taking U turn are interrupting the flow speed of traffic in both the directions. The narrow road width at the U turn and its close proximity to junction is creating major traffic congestion obstructing the speed, flow rate and capacity of the Roads.

**Bus stops:** There are no bus bays and bus shelters in these stretches. Buses are halting on the main four lane road obstructing the flow of traffic.

#### 3.1.2 Level of Service

Operational conditions: Speed of the vehicles is inversely proportional to V/c ratio because of which if the V/c ratio is increasing then the speed is also decreasing with respect to their PCU Values.

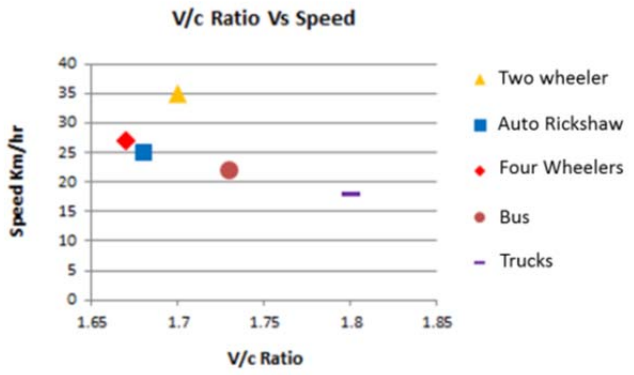



**Fig. 3. 4: V/C Ratio Vs Speed on Kukatpally Stretch**

Expected Speed is possible only if the V/c ratio is 1or less than 1 and LOS will be C which enables steady flow of the traffic.

**Table 3.2: LOS for different types of vehicles**

| Vehicles | FFS(Km/Hr) | AVG Speed (km/Hr) | LOS calculated |
|---|---|---|---|
| Two Wheeler | **70-90** | **35** | **D** |
| Auto Rickshaw | **45-60** | **25** | **F** |
| Car/Jeep/Taxi | **60-75** | **27** | **E** |
| Bus | **50-70** | **22** | **F** |
| Truck | **50-65** | **18** | **F** |
| NH- 9 | **60-80** | **27** | **E** |

- Travel time is very high during the peak morning hours (8.00 -11.00 AM) and evening peak hours (5.00 – 9.00 PM) Traffic, which increases the delay by minimum 3-4 minutes for heavy vehicles and buses to travel a stretch of 1 km and min 2-3 minutes for 2/3 and 4 wheelers.
- LOS for the stretch is 'E' which shows small increase in flow, may cause substantial increase in delay and further decreases in travel speed. Average travel speeds are about 40 % of FFS in this situation.
- Density of the vehicles is 35.21PCU/km/ln towards Kukatpally & 33.76 PCU/km/ln towards ZOO Park. It is very high due to slow flow rate and volume of the traffic. In the V/c vs speed graph speed is decreasing as the V/c Ratio is increasing and also the Level of service decreases from C to D and E varying based on their PCU values.

**Table 3.3: Peak Hour factor Calculations**

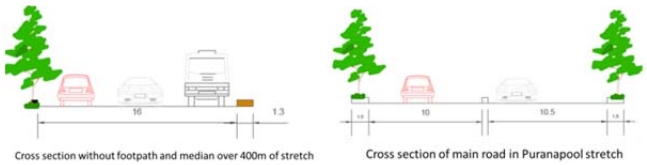
| Corridors stretches | Towards Kukatpally | Towards Balanagar |
|---|---|---|
| Average volume of peak hour | 7108 | 6807 |
| Volume of peak 15 minutes | 1794 | 1762 |
| Peak hour factor | 0.99 | 0.97 |

- Peak Hour Factor is between 0.97-0.99, it should be 0.95 for Urban Roads which shows the traffic at peak hours in the stretch is comparatively high.
- Fatal accidents are majorly because of the movement of the heavy vehicles, metro rail constructions and U- turns which are not removed at the night time.
- On street parking is prevalent in this stretch and dilapidated condition of foot paths make people walk along the roads which obstructs the traffic flow by reducing the carriage way. No clearance between the edges reduces the LOS of the road
- Bus bays are not provided in the two bus stops, which force the buses and auto rickshaws to stop on the roads and there by blocking the traffic flow.

### 3.2 Case Study Stretch 2: NH-7 Puranapool cross road – Bahdurpura Road

NH-7 from Nagpur to Bangalore passes through the old city of Hyderabad, where core area is distinct having narrow roads, encroachments of footpaths with small commercial shops and musi river on west of the road. The Puranapool stretch has majority commercial land use (4 petrol bunks, paid heavy vehicle parking area and mechanic shops) followed by public (Grave yards) and residential land uses. The stretch is just 2 km away from major landmarks of MG bus stand, Charminar and high court. Traffic congestion is mainly caused by buses and tourist vehicles.

This access uncontrolled uninterrupted stretch has capacity of 2400 PCU's/Hr for one direction of traffic. It has Carriage way width of 20m with 4 LANES and average lane width of 3.9 m. The traffic is divided by median on both the directions and has 1 U turn near the bus stops. The pathetic situation is that the 400 m road stretch is neither having median nor footpath on neither side.




#### 3.2.1 Capacity

**Traffic conditions:** In this stretch 76% of the traffic is shared by two wheelers (54 %) and Auto rickshaws (22%). This shows the major share of the mixed traffic composition. 4 % of the heavy vehicles and 10 % of the buses are creating major traffic

**Flow rate:** It rate is above 1400 in the peak hours i.e. from 8.00 A.M to 10.00 A.M and from 5.00 A.M to 8.00 P.M. which shows decrease in the traffic flow and speed of the vehicles and increase in the density of the vehicles leading to

severe traffic congestion all along the stretch due to lack of foot paths, medians, wide roads.

**Table 3.4: Service flow rate of Puranapool stretch**

| Stretches | Towards Kukatpally | | Towards Balanagar | |
|---|---|---|---|---|
| Time | PCU/Hr | Flow rate | PCU/Hr | Flow rate |
| 8.00-9.00 | 3656 | 914 | 3095 | 774 |
| 9.00-10.00 | 3304 | 826 | 2899 | 725 |
| 11.00-12.00 | 2659 | 665 | 2288 | 572 |
| 12.00-1.00 | 2446 | 611 | 2049 | 512 |
| 2.00-3.00 | 2139 | 535 | 2083 | 521 |
| 3.00-4.00 | 5431 | 608 | 2412 | 603 |
| 5.00-6.00 | 2904 | 726 | 3119 | 780 |
| 6.00-7.00 | 3335 | 834 | 3502 | 876 |
| 7.00-8.00 | 3616 | 904 | 3590 | 898 |
| Total | 26491 | 6623 | 25039 | 6260 |

U turning vehicles are interrupting the speed of traffic flow in both directions due to lack of median on the road and improper location of U turns. People and vehicles from the local streets are directly accessing the roads and causing impediment to the traffic flow.

**Bus stops:** There are No bus bays and bus shelters. The Buses are stopped on the two lane road blocking the traffic flow and passengers are occupying the foot paths and capacity of the road is being adversely affected.

**Parking Zones:** There are no Parking Zones along the Road, which are leading to on street illegal parking in the NO PARKING ZONES and thereby reducing the road occupancy of the vehicles.

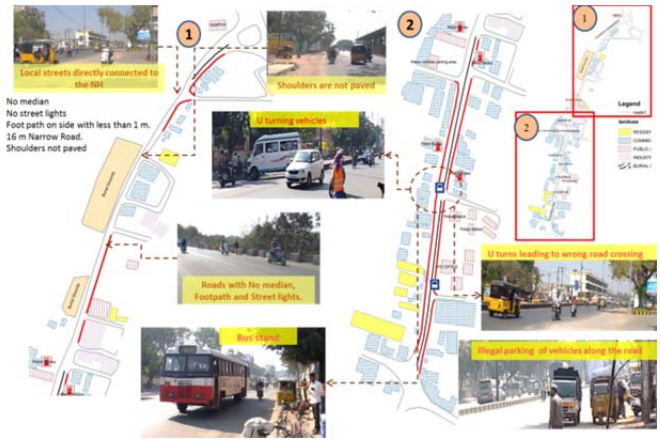



**Fig. 3.5: Existing Traffic scenario of Puranapool Stretch**

### 3.2.2 Level of service:

Operational conditions: LOS of this road is D where it experience significant delays and average travel speeds of 33% or less of the free-flow speed. Such operations may be caused by the combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections, and inappropriate signal timing.

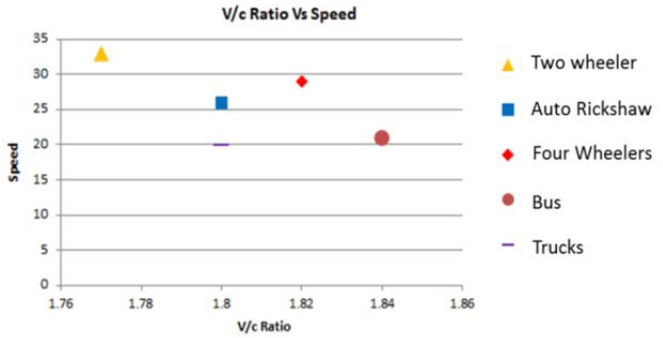



**Fig. 3.6: V/C ratio VS Speed on Puranapool Stretch**

**Table 3.5: LOS for different types of vehicles**

| Vehicles | FFS(Km/Hr) | AVG Speed (km/Hr) | Calculated LOS |
|---|---|---|---|
| 2Wheeler | 55-60 | 33 | C |
| Autos | 45-55 | 26 | C |
| Car/Taxi | 45-60 | 29 | C |
| Bus | 30-40 | 21 | D |
| Truck | 30-40 | 17 | E |
| NH-7 | 30-60 | 25 | D |

- **Free flow speeds** of the vehicles are decreasing when compared to the Multi lane highways. Two wheelers average speed is 33Km/Hr and its free flow speed is 55-60 km/hr. This might be due to lack of wide roads, medians, Street lights and proper traffic signs.
- The volume is very high with respect to the standards for a two lane road in one direction either in the morning or evening due to which the speed & flow rate of the vehicles is decreasing. Here the average maximum speed is 45 kmph for 2 wheelers, because of narrow roads, wrong route driving, U turning vehicles interrupting the flow, on street illegal parking and lack of Bus bays
- Travel time is very high during the peak hours (8.00 A.M -11.00 AM) and (5.00 A.M – 9.00 PM) of the Traffic, which increases the delay by minimum 3-4 minutes for heavy vehicles and buses and minimum of 2-3 minutes for two wheelers, Autos and 4 wheelers to travel a stretch of 1 km.

### 3.3 Comparative analysis for assessing the capacity and LOS in both the stretches

In this analysis the traffic conditions, road way characteristics and operation conditions, which affect the capacity and level of service of the roads are categorized based on their existing situation and actions to be taken. They are represented by using different colors. The situation of these indicators is assessed based on comparison with standards.

| Check list | | Parameters | NH-7 | NH-9 | Standards |
|---|---|---|---|---|---|
| CAPACITY | Traffic Conditions | Vehicle type Composition | 2W- 40 %, 3W-22%, 4W-10% BUS-10%, TRUCK-4% | 2W-49 %, 3W-17%, 4W-5%, BUS-22%, TRUCKS-7% | |
| | | Heavy Vehicles | 4% | 7% | <10% |
| | | Parking zones | No parking Zones but parked along the roads | Service road with Parking facility for heavy vehicles | Separate Parking Zones |
| | | Flow Rate | Towards Puranapool-914 during 8-9 AM, Towards Bahdurpura-897 during 7-8 PM | Towards Kukatpally-1777 during 8-9 AM, Towards Erragadda-1795 during 7-8 PM | Two lane highway ->1400 PCU/Hr/ln in 15 min and >2200 for mutli lane highwways. |
| | | Bus Stops | Existing but no shelter - no of bus stops (2) | existing but no shelter for two and one is having bus shelter | separate bus ways are requested |
| | | U turns | Two U-turns | Two U-Turns | in planned locations |
| | Road way Characteristics | Cross section of the road | 20 M and 16 M | 50 M | 20M-60 M |
| | | Lane Widths | 3.5 | 3.65 | 3.65 M |
| | | No of Lanes | 4 | 8 | |
| | | Shoulder Widths | 1-2 M | 1 M | 1.2 M |
| | | Median | available for 0.5km | Available | strictly required |
| | | Signage | No Signage | No Proper Signage | compulsory |
| | | Foot Path | No Foot path for 0.5 km and less than 1 M | Dilapitated Condition and Not Maintained | Min 1.2 M |
| | Control Conditions & Surface Condition | | Bad with half of roads damaged. | Bad Because of metro rail construction going on. | Good with no impedents |
| LEVEL OF SERVICE | Operational Conditions | Volume | Towards Puranapool-3656 during 8-9 AM and 2139 during 2-3 PM, Towards Bahdurpura-3590 during 7-8 PM and 2049 During 12-1 PM | Towards Kukatpally-7108 during 8-9 AM and 4841 during 2-3 PM, Towards Erragadda-6807 during 7-8 PM and 4013 During 2-3 PM | 800 PCU/Hr/Lane |
| | | Speed | 22 | 24 | 60-80 km/hr |
| | | Free Flow Speed | (30-60Km/Hr)-45 | (50-80Km/Hr)-65 Km/hr | 80-100 km/Hr |
| | | Peak Hour Factor | 0.97 towards Puranapool and 0.99 Towards Bahdurpura | 0.98 Towards Kukatpally and 0.97 Towards Erragadda | 0.92 For Urban Roads |
| | | Travel Time | 5 min | 4 min | less than 1 min |
| | | Traffic Interruptions | U-turning and Wrong route vehicles Because of the Existing Landuse | Pedestrians walking and Metro Works | well regualated withour any interruptions |
| | | Density | 27.3 PCU/he/km/ln | 30.7 PCU/hr/km/ln | less than 20 PCU/hr/km/ln for Urban streets |
| | | Volume/Capacity | 1.77 | 1.57 | 1 or < 1 |
| | Base Conditions | Lane Width | 3.65 | 3.65 | 3.65 |
| | | Clearance between the Edges | vehicles are parked and people are walking along the Roads | bad maintained Footpaths | Good Clearance |
| | | Free Flow Speed | 30-60 km/hr | 50-80 km/hr | 80-100 Km/Hr |
| | | No impedents | Bad Surface Condition of the Roads and Shoulders | bad maintained Footpaths and Metro Rail Work under Progress | |
| | | Type of Facility | Arterial Roads | Arterial Roads | Marked upto the standards |
| | | Development Environment | 3 Petrol Bunks, Commercial Landuse and Smashan Ghat | Industrial, Residential and Educational Buildings | |
| | | Shoulder Widths | 1-2 M | 1 M | 1.2 M |
| | | Lateral Clearances | Occupied Shoulders | Pedestrians walking and Metro Works | enforcement should be good |
| | | Design Speed | 60 Km/Hr | 80 Km/Hr | 60-80 Km/Hr |
| | | Turn Lanes | No | No | No |

### 3.3.1 Situations of Indicators depicted with colors:

| | |
|---|---|
| | services are very Bad and not upto the standards and needs an immediate improvement |
| | services are there but not properly maintained or under dilapidated condition |
| | services are upto the mark and according to the standards |

### 3.3.2 Parameters affecting capacity and LOS

| Capacity | LOS |
|---|---|
| Illegal on-street parking | Proper Street infrastructure |
| No Bus Bays | Volume |
| Un paved shoulders | Speed |
| No Medians | density |
| Traffic signage | Peak Hour factor |
| Proper U turns, | Travel time |
| Traffic composition | flow rate |
| Surface conditions | Free Flow Speed |
| Surrounding land use | Clearance on carriage way |
| Access to residential streets | Traffic interruptions |

### 3.3.3 Change in LOS based on the existing condition

| Level of service | Average travel Speed | Characteristics of traffic |
|---|---|---|
| LOS A | 90 % Of Free Flow Speed | Unimpeded to maneuver within the traffic stream |
| LOS B | 70 % Of Free Flow Speed | Maneuver is slightly restricted |
| LOS C | 50 % Of Free Flow Speed | Ability to maneuver and change in midblock locations may be more restricted and Longer Queues. |
| LOS D | 40 % Of Free Flow Speed | substantial increase in delay and decreases in travel speed. |
| LOS E | 33 % Of Free Flow Speed | combination of adverse progression, high signal density, high volumes, extensive delays |
| LOS F | 25 % Of Free Flow Speed | high delays, high volumes, and extensive queuing. |

## 4. PROPOSALS

1. To extend the road to desired arterial road standards with provision of service roads, street lights, median and Traffic Signs, this enables the smooth flow of the traffic.
2. Traffic route diversion should be made or users should be charged for the usage of the major corridors at peak hours.
3. Proper road geometry should be maintained with medians, maximum carriage way, shoulders and Footpaths for the good quality of traffic.
4. Management of U turns at correct locations and checking out illegal parking.
5. Obstructions should be made to deny the direct access of local roads to national highways.
6. Extension of the Puranapool Stretch to 60 Mts wide road which is according to the proposed road in master plan of GHMC 2031.

## 5. CONCLUSION

Capacity of the roads should be more than 1400/lane for urban corridor and LOS should be C where, it describes stable operations and average travel speeds of about 50% of the FFS for the street class. Here in the two cases the capacity of the roads are below 1400/lane and their density is above 30 PCU /km/ln which increases the travel time and reduces the average speed below to 35 kmph. This scenario is due to existing traffic conditions (Traffic composition, flow rate, U turns, parking zones), Road way Conditions (Road inventory, medians, footpaths, street lights, No of lanes and lane widths & shoulders widths) and operational conditions (volume, speed, density, free flow speed, peak hour factor and travel time).

After the assessment of these conditions the capacity and LOS are affected mainly by mixed traffic and high volumes of vehicles. This is clearly observed in the morning and evening Peak hours. Mostly capacity is affected by improper Cross sections, Traffic signs, U turns, Bus bays and Illegal parking on the roads. Level of service is dependent on the Volume/capacity ratio of the roads, density of the traffic, surrounding land use, flow rate, travel time and freedom for the movement. In the case of core area the traffic flow is in peak hours and in one direction (i.e. into the city or out to the Peri-urban areas.) But in case Peri-Urban area there is flow in both directions from rural and core areas.

The traffic flow behavior in the heterogeneous traffic is observed to be quite complex with loose lane discipline and diverse static and dynamic characteristics of the vehicles. This study is carried out on access controlled arterial road which could be the base for capacity calculation of the arterial roads with other traffic and roadway conditions. The established capacity and LOS criteria will be useful for the long and short term transport infrastructure planning by the local government.

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