

## Improvement of the Level of Service of A Road Extending from Katraj to Khadi Machine

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**Abstract:** A rapid growing component of urban transportation problem in the cities across the world is traffic congestion. Because of population, economic and vehicular ownership growth, increasing traffic demands exceeds the carrying capacity of the intersections during peak periods, which causes congestion. The congested and hazardous traffic conditions in the city increase fuel consumption of the vehicles, causes noise and air pollution, delay and accidents. There is a need for defining traffic congestion on rational basis and use for measurement of L.O.S. (Level of Service) of roads. The congestion is measured by determining the level of service of the street (L.O.S.) through calculating the traffic flow rate of the street and free flow rate. This paper presents the study of the existing traffic situation for the selected 3.8km stretch located in the city of Pune, computation of the level of service for the entire roadway and suggests ways to improve the Level of Service of the selected project stretch. Aim of this research is to improve L.O.S. (Level of Service) of congested road in urban areas by giving various solutions to current problems.

**Keywords:** Traffic congestion, Level of Service, Traffic volume studies, Passenger car units(PCU).

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### I. Introduction

Poor public transport, increase in vehicular ownership and individual mobility are the main factors contributing to the increased traffic. The increase in traffic draws its roots from increased population which cannot be managed substantially hence an improvement of the former has been considered in this project. Thus, for the improvement of traffic, improvement of level of service has been taken into account. Level of service gives the qualitative measure of traffic facilities. The topic thus deals precisely with a major aspect of traffic engineering i.e. the improvement of traffic performance on roads and terminals by systematic study and analysis. Traffic volume studies have been taken as the tool to study the traffic characteristics.

#### 1.1 Traffic Volume Studies

Traffic volume studies are conducted to determine the volume of the moving traffic and the classification of roads at a particular section and time. It involves the decision for improvement and upgradation of roads, geometric and pavement design, computation of roadway capacity, analysis and planning of traffic patterns, operations and other regulatory measures.

#### 1.2 Passenger Car Units (PCU)

The PCU is considered as a measure of the relative space requirement of a vehicle class compared to that of a passenger car under a specified set of roadway, traffic and other conditions. The PCU value depends on various factors such as dimensions of the vehicle, dynamic characteristics of the vehicle such as power, braking, etc., transverse and longitudinal gaps between the moving vehicles and traffic stream characteristics such as composition of different vehicle classes, mean speed and speed distribution of the mixed traffic stream and volume to capacity ratio.

#### 1.3 Level of Service (L.O.S.)

Level of service is a qualitative measure to relate the quality of the traffic services. LOS is used to analyse highways by categorizing traffic flow and assigning quality levels of traffic based on performance measures.

There are 6 L.O.S. gradings: which are Free flow (A), Reasonably free flow (B), Stable flow at or near free flow (C), Approaching unstable flow (D), unstable flow (E) and Forced or breakdown flow (F).

## II.METHODOLOGY



### 2.1 Finalization of stretch

The road which has maximum traffic problems and the one which is most feasible for survey, is best suited for this research. After shortlisting multiple roads, the stretch that extended from Katraj chowk to Khadi machine chowk, located in Pune was selected. In the selected stretch of road, the width of carriageways is uneven and most of the stretch is two a lane road with undivided carriage except between Gokulnagar Junction and Iskcon junction where it is a divided carriageway but width of the road lies between two lane and intermediate lane on each side. Out of 5 junctions, 3 have signals (ICICI junction, PMC junction and Khadi machine junction).

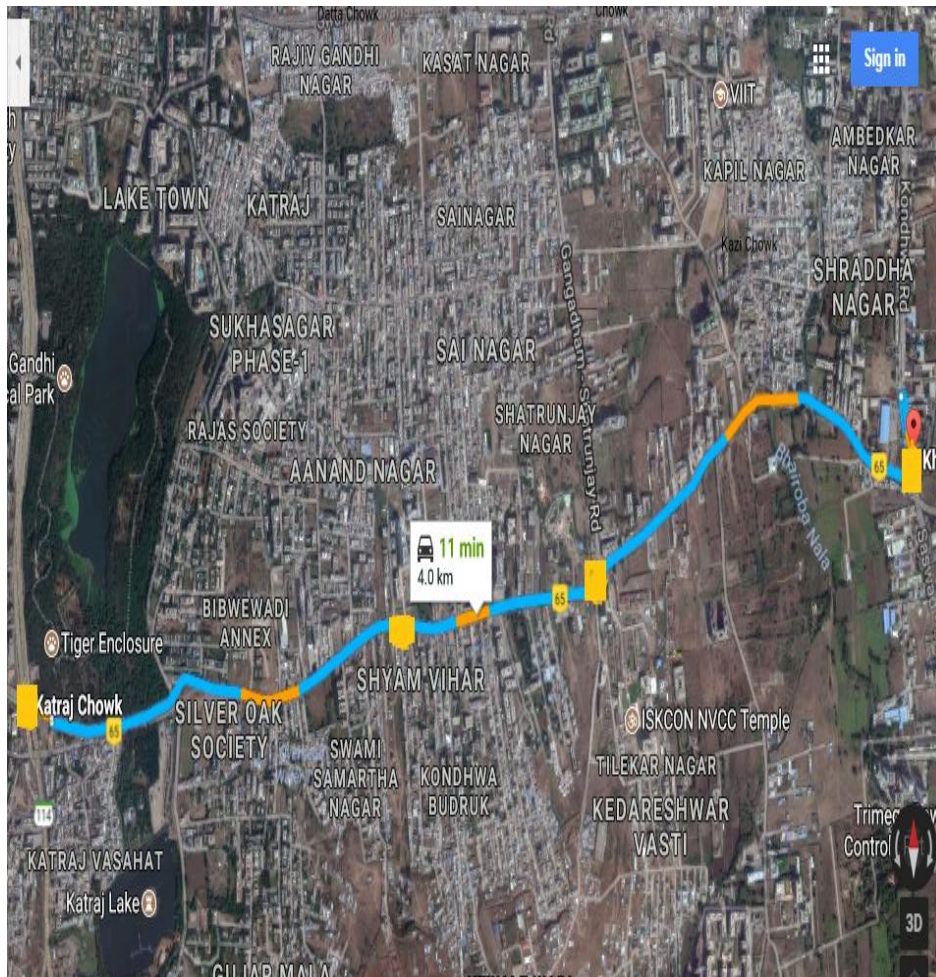


Fig 1. Location of junctions (marked in yellow squares) along the experimental stretch of road

### 2.2 Finalizing location of Traffic survey

The selected stretch had a span of 3.8 kms which was then inspected for the persisting traffic problems and the factors that caused delays. An ethical survey was able to provide prior information about the extent of the work that had to be carried out. Location that was accessible for the installation of cameras to gather data were such chosen which would provide unrestricted visibility of the junctions.



Fig 2. Camera view at Iscon Junction



Fig 3. Measuring width of footpath

### 2.3 Traffic survey

#### 2.3.1 Turning movement survey:

Existing traffic condition of the intersections were studied and the data was collected manually with the help of the cameras and was then analysed. Cameras were installed at each intersection for counting vehicles for traffic volume study.

#### 2.3.2 Road inventory survey

Current condition of the stretch was observed and noted which included measuring width of shoulders, carriageways, cross roads, etc. For reference, IRC: SP 19: 2001 “Manual for survey, investigation, and preparation of road projects” was referred.

#### 2.4 Traffic Analysis

From videos taken, number of vehicles were counted manually and grouped in a systematic format which was later used to analyse and to determine to the L.O.S.

#### 2.5 Measuring current Level of Service and measures to improve it.

By data analysis, current L.O.S. of road was determined. This helped to then find out the reasons for delay of traffic and to determine the solutions to the same.

## III. Results and discussion

The traffic volume count was done on the 12<sup>th</sup>, 13<sup>th</sup> and 14<sup>th</sup> of January, 2017. These included two weekdays and a weekend (Thursday, Friday and Saturday). The duration of survey was 12 hours, starting from 0700 to 1900 hours. The directional distribution of traffic categorized by the type of vehicles was also obtained to understand the composition and movement pattern of vehicles between each junction. As the road characteristics were not identical throughout the entire stretch, the experimental road length was divided into 3 sections (Table 1), each having its own uniform road characteristics. All the sections were analysed separately. Firstly, a specific junction was selected in a section and a direction of traffic flow was chosen. Number of vehicles were calculated and tabulated in an hourly format for each day. After this, another direction of traffic flow was chosen for the same section and similar data analysis was repeated. These results were then combined to get the average daily traffic (ADT) vehicle composition for that section. This process was then repeated for all the sections and the results obtained were tabulated.

Table 1. Sections of experimental road stretch

Homogeneous Section	Location	Length	Remark
Section 1	Katraj to Gokulnagar	1.9 Kms	2-lane two-way undivided traffic
Section 2	Gokulnagar to Iscon	0.6 Kms	4-Lane divided (two way) traffic
Section 3	Iscon to Khadi Machine	1.3 Kms	2-lane two-way undivided traffic

### 3.1 Section 1

Katraj to Gokulnagar  
Location: Gokulnagar Chowk  
(both ways)

Direction: Combined

Table 2. Classified daily volume of combined traffic in both directions

Time period	Two Wheeler	Three Wheeler	Car	LCV	2-axle Truck	Multi axle truck	Mini Bus	Bus	Tractor	Total Vehicles	Total Traffic (PCU)
Day 1	40178	5875	10093	3807	1737	1251	309	638	20	63908	61344
Day 2	40696	5765	9934	3436	1683	1288	331	651	27	63811	60991
Day 3	44289	5027	13763	5777	2853	1703	339	691	27	74469	73496
Average Daily Traffic (ADT)	41721	5556	11263	4340	2091	1414	326	660	25	67396	65277

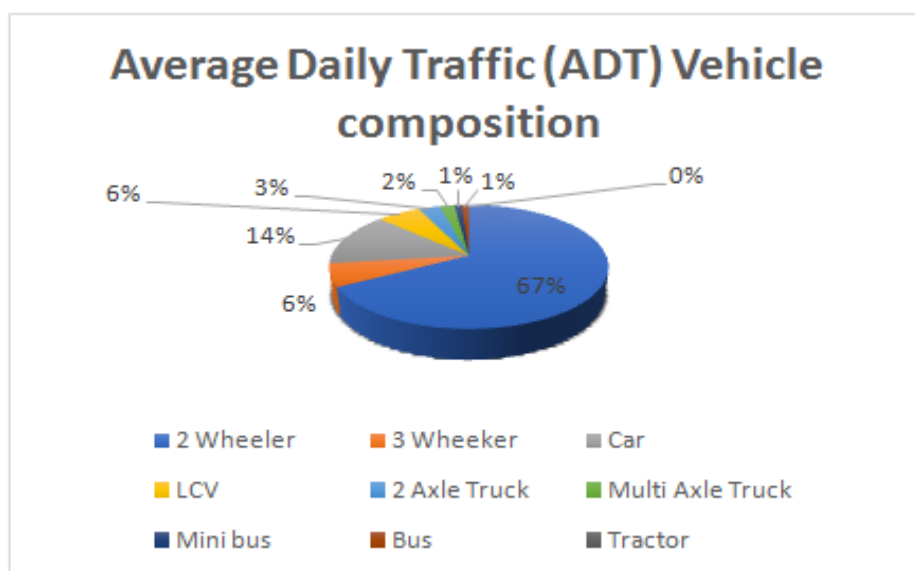


Fig 4. Average daily traffic (ADT) vehicle composition

Table 3. PCU peak hour analysis of Section 1

Time Period	Day 1	Day 2	Day 3	Average PCU
07.00 – 08.00	3124	2905	2974	3001
08.00 – 09.00	4019	4110	4049	4059
09.00 – 10.00	5265	5250	5978	5498
10.00 – 11.00	5668	5639	6556	5954
11.00 – 12.00	5699	5820	7399	6306
12.00 – 13.00	5445	5694	6818	5986
13.00 – 14.00	5364	5331	6151	5615
14.00 – 15.00	5219	5288	6197	5568
15.00 – 16.00	4850	4781	5923	5185
16.00 – 17.00	5301	5121	6966	5796
17.00 – 18.00	5672	5499	7105	6092
18.00 – 19.00	5718	5553	7380	6217

From the above study, we can determine the design service volume for section 1 which is 6306 PCU/hr. As per IRC: 106-1990, the project stretch is defined as sub-arterial road and type of carriageway is 2-lane two-way traffic. The design service volume for LOS-C for sub-arterial road is 1200 vehicles PCU/hour. Hence the project stretch of 1.9 km has crossed design service volume and need augmentation.

### 3.2 Section 2

Gokulnagar to IsckonLocation-Gokulnagar Direction-Combined(both ways)

Table 4. Classified daily volume of combined traffic in both directions

Time period	Two Wheeler	Three Wheeler	Car	LCV	2-axle Truck	Multi axle truck	Mini Bus	Bus	Tractor	Total Vehicles	Total Traffic (PCU)
Day 1	35494	3198	10441	3716	2098	746	263	518	32	56506	54208
Day 2	33159	3230	10835	3789	2088	807	269	521	35	56733	54630
Day 3	35830	2648	12686	4053	2220	609	187	387	18	58638	55972

Average Daily Traffic (ADT)	35494	3025	11321	3853	2135	721	240	475	28	57292	54937
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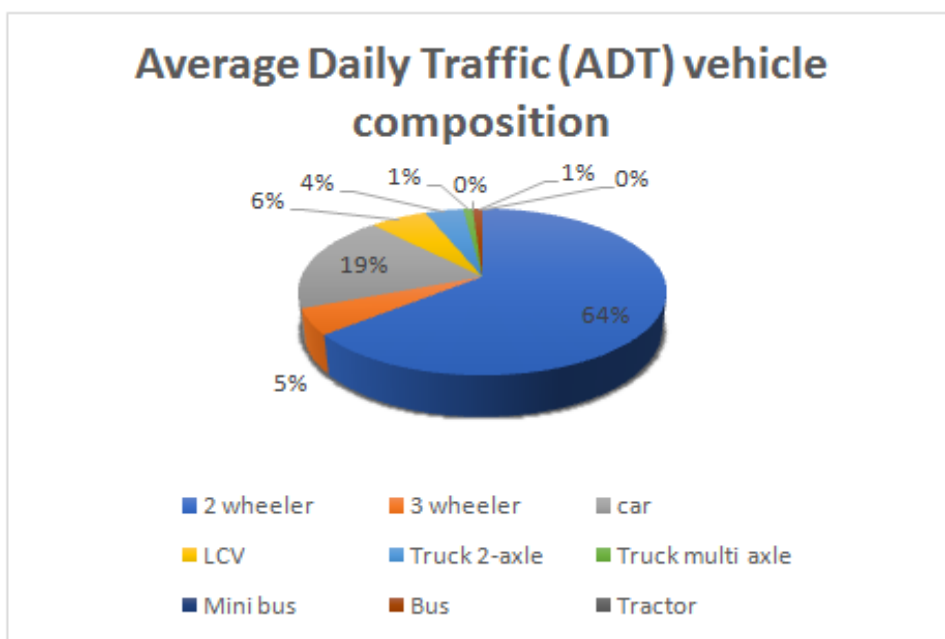


Fig 5. Average Daily Traffic (ADT) vehicle composition

Table 5. PCU Peak hour analysis of section 2

Time period	Day-1	Day-2	Day-3	Average PCU
07.00-08.00	1972	2102	1886	1987
08.00-09.00	3167	3185	3454	3269
09.00-10.00	4139	4048	4848	4345
10.00-11.00	4703	4786	5611	5033
11.00-12.00	5291	5244	5489	5341
12.00-13.00	5093	5094	5310	5166
13.00-14.00	5230	5247	4951	5143
14.00-15.00	4346	4461	4692	4500
15.00-16.00	4620	4577	5212	4803
16.00-17.00	5820	5877	5298	5665
17.00-18.00	5168	5211	4944	5108
18.00-19.00	4659	4798	4277	4578

From the above study, we can determine the design service volume of section-2 which is 5665 PCU/hr. As per IRC: 106-1990, the project stretch is defined as sub arterial road and type of carriageway is 4-Lane divided (two way) traffic. The design service volume for LOS-C for sub-arterial road is 2900 Vehicles PCU/hr. Hence the project stretch of 0.6km has crossed design service volume and needs augmentation

### 3.3 Section 3

Iskcon to Khadi Machine

**Location:** Gokulnagar Chowk

**Direction:** Combined (both ways)

Table 6. Classified daily volume of combined traffic in both directions

Time period	Two Wheeler	Three Wheeler	Car	LCV	2-axle Truck	Multi axle truck	Mini Bus	Bus	Tractor	Total Vehicles	Total Traffic (PCU)
Day 1	22856	2092	9088	3125	2042	808	326	647	37	41021	41673

Day 2	22461	2017	8853	2985	2026	851	329	609	31	40162	40815
Day 3	20327	1236	9663	2678	1756	702	228	327	28	36945	36882
Average Daily Traffic (ADT)	21881	1782	9201	2929	1941	787	294	528	32	39376	39790

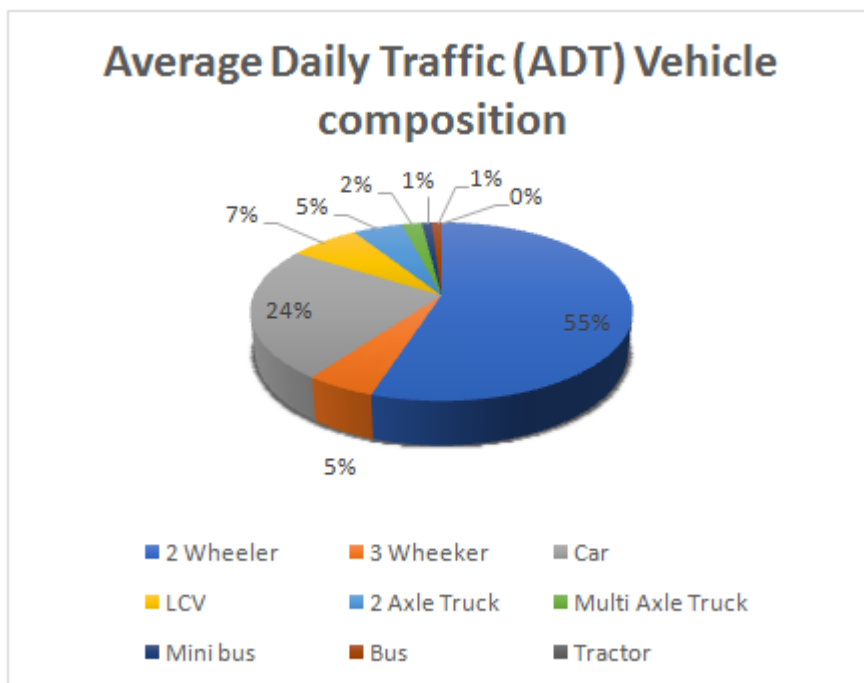


Fig 6. Average daily traffic (ADT) vehicle composition

Table 7. PCU peak hour analysis of Section 1

Time Period	Day 1	Day 2	Day 3	Average PCU
07.00 – 08.00	2145	1963	1413	1840
08.00 – 09.00	2316	2238	2121	2225
09.00 – 10.00	3415	3254	3276	3315
10.00 – 11.00	3440	3467	3151	3353
11.00 – 12.00	4326	4306	3306	3979
12.00 – 13.00	3718	3754	3561	3678
13.00 – 14.00	3628	3641	2967	3412
14.00 – 15.00	3767	3600	3170	3512
15.00 – 16.00	3662	3533	3168	3454
16.00 – 17.00	3722	3686	3423	3610
17.00 – 18.00	3858	3777	3882	3839
18.00 – 19.00	3676	3596	3444	3572

From the above study, we can determine the design service volume for section 3 which is 3979 PCU/hr. As per IRC: 106-1990, the project stretch is defined as sub-arterial road and type of carriageway is 2-lane two-way traffic. The design service volume for LOS-C for sub-arterial road is 1200 vehicles PCU/hour. Hence the project stretch of 1.3 km has crossed design service volume and need augmentation.

#### IV. Conclusion

In general, it was observed that the entire project of 3.8km has reached its maximum design service volume capacity and has crossed the Level of service (L.O.S-C). Furthermore, many other parameters were affecting the travel time. Hence the project stretches needed certain development and up gradation which are given below.

- It has been observed that the bus stops are provided just adjacent to carriage way edge, which needs to be developed with proper entry and exit at bus stop and should be located away from the carriage way edge.
- There are no longitudinal drainage systems along the project stretch. Hence, 1.5m wide, raised covered drain on both the edges of carriage way should be provided with proper inlet and outlet systems.
- Also, no proper traffic signs and safety devices are observed.

### Section 1

- The capacity of project stretch is affected by lane width, improper shoulder facility, on-street parking and lesser considerations for pedestrian facilities.
- It is suggested to improve the travel time by developing and upgrading the road to a 4-lane divided carriageway with raised footpaths and avoiding the on-street parking.
- From the data analysis of traffic volume count between Katraj to Gokulnagar, it was observed that the two-wheeler vehicle composition was around 67%, cars around 14% and three-wheeler around 6%.

### Section 2

- The capacity of the project stretch is affected by lane width, improper shoulder facility, on-street parking and lesser consideration in pedestrian facilities.
- It suggested to improve the travel by providing one lane of 3.5 width on both side with raised footpath and avoiding the on-street parking.
- From the data analysis of traffic volume count between Katraj to Gokulnagar, it was observed that the two-wheeler vehicle composition was around 64%, around 19% was of cars and three-wheelers were around 27%.

### Section 3

- The capacity of the project stretch is affected by lane width, improper shoulder facility, on-street parking and lesser consideration in pedestrian facilities.
- It is suggested to improve the travel time by developing and upgrading the road to a 4-lane divided carriageway with raised 1.5m median, raised footpath and avoiding on-street parking.
- From the data analysis of traffic volume count between Katraj to Gokulnagar, it was observed that the two-wheeler vehicle composition was around 55%, cars around 22% and three-wheeler around 5%.

Further along the project stretch 5 Major At-Grade intersections are available which also need to be developed in categories below.

Sr. no.	Junction name	Type of Junction	Peak hour traffic (VPH)	Peak hour traffic (PCU)	Junction improvement
1	ICICI Junction	4 Legged	14991	14865	As per IRC SP-90, the junction warrants for a Grade Separated Structure, since the peak hour PCU is more than 10,000
2	PMC Junction	4 Legged	5678	5574	AS per IRC SP-41, the junction warrants for a Traffic Signalized AT-Grade intersection, since the peak hour PCU is upto 7500
3	Gokulnagar Junction	3 Legged	7263	7141	As per IRC SP-41, the junction warrants for a Traffic Signalized AT-Grade intersection, since the peak hour PCU is upto 7500 with some free turning facilities
4	Isckon Junction	3 Legged	5312	5224	As per IRC SP-41, the junction warrants for a traffic signalized AT-Grade intersection, since the peak hour PCU is upto 7500.
5	Khadi Machine Junction	4 Legged	7284	7206	As per IRC SP-41, the junction warrants for a traffic signalized At-Grade intersection, since the peak hour PCU is upto 7500 with some free turning facilities.

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