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Vehicle Operation Cost Analysis for Mixed Traffic Flow – A Case study at Yelahanka Region

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ABSTRACT - Vehicle operation cost analysis is used to find the solution for excess fuel consumption, grease, lubricating oil, wear & tear and also maintenance cost due to speed, roughness, rise & fall of road and existing traffic volume with high rate of capacity flow at study area and also predicting some other reasons for high/low VOC for all vehicles. Using studies like roughness, rise & fall, traffic volume count, speed & capacity studies find vehicle operation cost for all vehicles and give probable solutions for higher VOC vehicles, increased service charge & maintenance cost for each vehicle and it also helps in finding total road user cost.

Keywords- ET - Excluding Tax; FC - Fuel Cost; HCV- Heavy Commercial Vehicles; IT - Including Tax; LCV - Light Commercial Vehicles; LC - Labour Cost; LOS - Level of Service; MAV - Multi Axle Commercial Vehicles; NTC - New Technology Cars; OTC - Old Technology Cars; PCU - Passenger Car Unit; SPC - Spare Parts Cost; VOC - Vehicle Operation Cost;

INTRODUCTION

In developing countries, where the value of time is usually ascribed relatively little value, travel costs are mainly vehicle operating costs. Vehicle operation cost analysis is used to find the solution for excess fuel consumption, wear & tear and also maintenance cost due to speed, roughness, rise & fall of road and existing traffic volume with high rate of capacity flow at study area and also predicting some other reasons for high/low VOC (vehicle operation cost) for all type of vehicles. Using studies like roughness, rise & fall, traffic volume count, speed & capacity studies find vehicle operation cost for all vehicles and give probable solutions for higher VOC (vehicle operation cost) vehicles, increased service charge & maintenance cost for each vehicle. This case study is based on Vehicle Operation Cost for a mixed traffic flow of vehicles at Yelahanka region. The National Highway-7 roadway traffic is at the centre of these service roads. These stretches are available as divided, two-way service lanes build for the Vehicles merging from Bagalur towards Yelahanka and also vehicles merging from Yelahanka to National Highway-7 respectively. Width of each stretch is 7.0 meters wide and length of each is about 1 Km on both the directions. These stretches consider a mixed flow of traffic, maximum at peak hours and minimum at off peak hours. As part of this study, an attempt was made to build relationships between vehicle operation cost components and road, traffic, vehicle, and environmental factors. This study was carried out by collecting real-time data on cost of operation of about various vehicles of different types. The results prove that traffic volume, vertical profile, pavement roughness, and pavement width are some of the important factors influencing vehicle operating costs. Traffic Volume Count, Roughness study, Rise and fall values are measured using field studies.

OBJECTIVES OF THE STUDY

1) Primary objective of the work is finding Vehicle operation cost for vehicles using a case study.
2) To compare VOC with present and future traffic flow.
3) To check the problem or causes for increase in VOC for all types of vehicles.
4) To finding out the probable solution to reduce the VOC for vehicles.

1. STUDY AREA DETAILS

1.1. Bagaluru Cross to Venkatala Cross (B – V)

It's a road with uni-directional (one way) movement with no median. The carriageway along this stretch is about 7.0 meters width and it has a speed breaker at 300meters from the start point of the stretch at Palanahalli village. The average gradient at this stretch is found to be 1 in 27m. Right of way is provided at the left side of the stretch.

1.2. Venkatala Cross to Bagaluru Cross (V – B)

It's a road with uni-directional (one way) movement with no median. The carriageway along this stretch is about 7.0 meters width and Right of way is provided at the left side of the stretch. The average gradient at this stretch is found to be 1 in 30m.

2. METHODOLOGY& ANALYSIS

As the traffic studies in these stretches were done, the other studies which were conducted are;

[1]. Traffic volume count
[2]. Merlin studies
[3]. Gradient studies
[4]. Desired Capacity and Level of service

2.1. TRAFFIC VOLUME COUNT

Traffic volume count is carried out on both the stretches on weekends and alternative weekdays during morning and evening peak hour traffic volume. Those data are converted into standard PCU values as per IRC tabulated and are tabulated below.

Table.1 Average PCU at both the stretches

Directions	Morning (PCU/hr)	Evening (PCU/hr)
B - V	2197.5	1777.25
V –B	2398.45	2552.1
B - V	1771.7	1962.9
V –B	1873.3	2521.35
B - V	1838.65	1871.5
V –B	1696.1	1971.4
B - V	1766.5	2381.55
V –B	2101.75	2384.45

- The highest and lowest Traffic flow in PCU/hr at peak hour flow at Stretch 1 (Bagaluru cross to Venkatala cross) is 2197.5 PCU/hr (highest), 1766.5 PCU/hr (lowest) in the morning session and 2381.55 PCU/hr (highest), 1777.25 PCU/hr (lowest) in the evening session respectively.
- The highest and lowest Traffic flow in PCU/hr at peak hour flow at Stretch 2 (Venkatala cross to Bagalur cross) is 2398.45 PCU/hr (highest), 1696.1 PCU/hr (lowest) in the morning session and 2552.1 PCU/hr (highest), 1971.4 PCU/hr (lowest) in the evening session respectively.

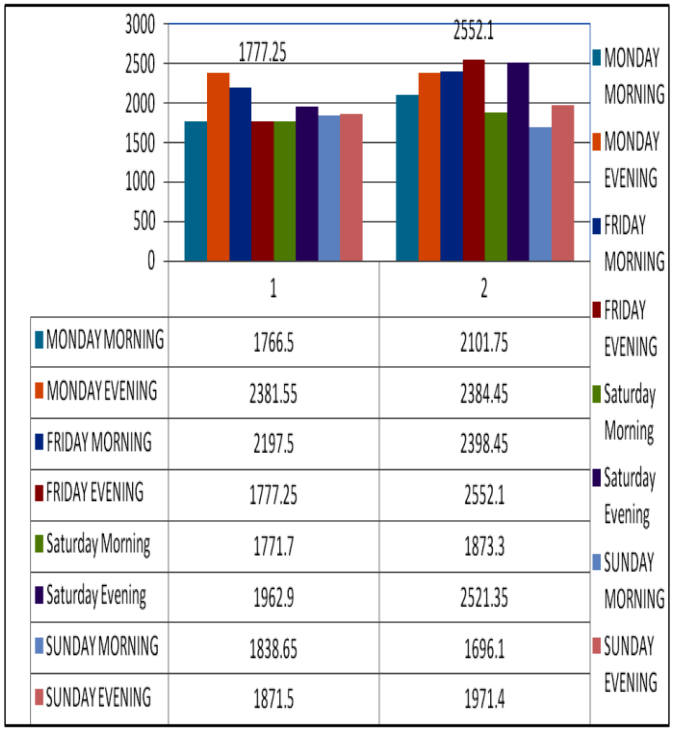

Fig.1 Showing Variation of Traffic flow in terms of PCU/hr

2.2 VOC FOR PRESENT & FUTURE TRAFFIC VOLUME WITH RESPECT TO DIRECTION OF FLOW

Table.2 VOC for Present traffic volume at both the stretches

Directions	Present traffic volume PCU/hr	Present VOC Rs/km
B - V	2475.26	4429.3
V –B	2087.85	5371.55
B - V	1867.3	4170.625
V –B	2197.3	4906.37
B - V	1855.075	4264.755
V –B	1833.75	4040
B - V	2079.025	4642.95
V –B	2243.1	4844.55

Table.3 VOC for future traffic volume at both the stretches

Directions	Future traffic volume (next 5 years) PCU/hr	Future(next 5 years) VOC Rs/km
B - V	3808.47	6821.3
V –B	3298.75	8264.2
B - V	2907.68	6417.26
V –B	3406.14	7549.03
B - V	2856	6565.83
V –B	2796	6301.3
B - V	3198.77	6601.693
V –B	3799.55	7453.2

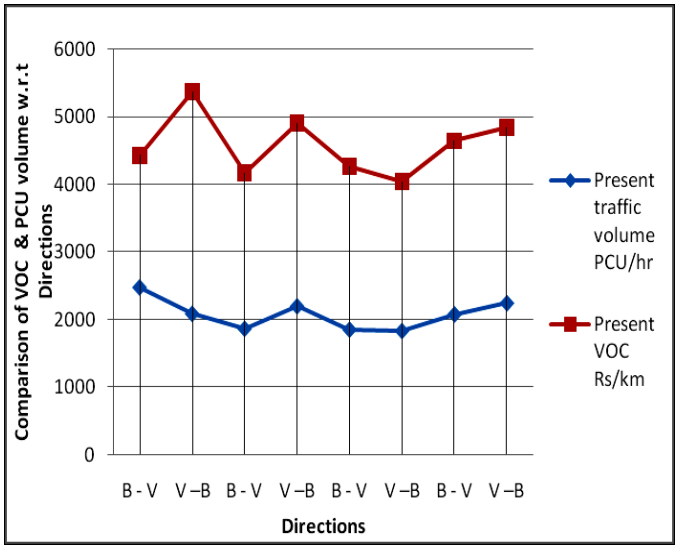

Fig.2 Showing Present VOC & Volume (PCU/hr) at both stretches

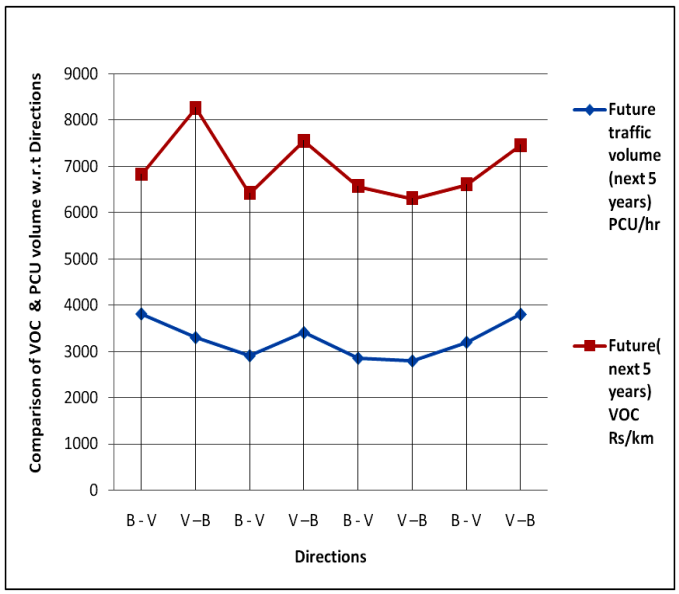

Fig.3 Showing Future VOC & Volume (PCU/hr) at both stretches

2.3 DESIRED CAPACITY AND LOS

As we are explained about capacity studies and level of service under chapter.3, same method followed and we found capacity of roadway in terms of Veh/hr/lane at each stretch selected for the study and calculated the traffic volume by capacity ratio as q/qc, using this ratio compare with LOS (level of service) chart and find the level of service for each stretch selected for the study. And related calculations are shown below-

Stretch 1- Bagaluru cross to Venkatala cross

Morning Peak Hour Traffic = q = 2081.65 vehicles/hour.

Evening Peak Hour Traffic = q = 2045.18 vehicles/hour.

Morning q/qc = 2081.65/2768.031 = 0.75

Level of Service = F

Evening q/qc = 1998.3/2768.031 = 0.73 Level of Service = F

Stretch 2- Venkatala cross to Bagaluru cross

Morning Peak Hour Traffic = q = 1896.08 vehicles/hour.

Evening Peak Hour Traffic = q = 1998.3 vehicles/hour.

Morning q/qc = 1896.08/2534.21 = 0.748

Level of Service = F

Evening q/qc = 1998.3/2534.21 = 0.78 Level of Service = F

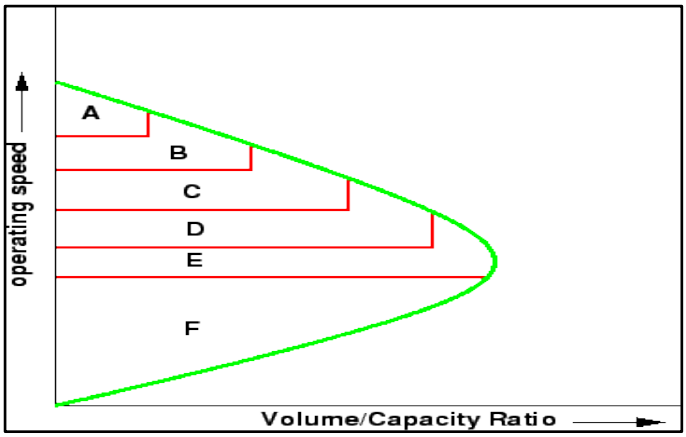

Fig.4 Level of service chart verses volume/capacity ratio

2.3 VARIATION OF VOC, FUEL COST (FC), SPARE PARTS COST (SPC) AND LABOUR COST (LC) WITH RESPECT TO ROUGHNESS AT BOTH STRETCHES

Table.4 Variation of VOC, fuel cost, spare parts cost and Labour cost at both the stretches

Roughness value mm/ km	VOC Rs/Km	Fuel cost Rs/km	Spare parts cost Rs/km	labor cost Rs/km
(Stretch.1) 4286.1	5442.18	8464.6	792.4	388.17
(Stretch.2) 3677.59	5604.64	9056.64	749.1	323.3

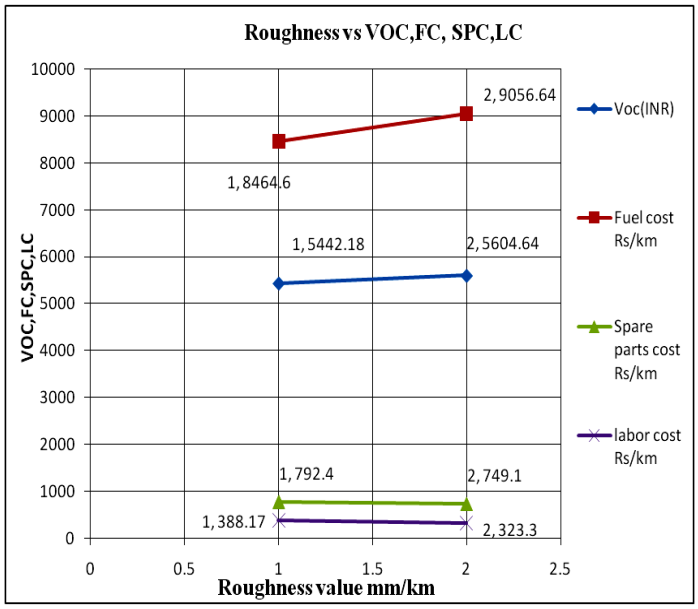

Fig.5 Showing Change in VOC, FC, SPC and LC with respect to roughness at both stretches

3. CONCLUSION

With In this chapter we are going to brief about the conclusions that are obtained from the case study.

1) Vehicle Operation Cost, Fuel Cost, Spare Parts Cost, Labour Cost increases with increase in Average roughness value for both the stretches so maintenance of road surface should be given prior importance to both the stretches.
2) Average growth of vehicular traffic for the next 5 years is found get increased by average 9% for every year, therefore the present Level of service is L-F. Since the capacity of roadway increases and Level of service goes on increasing beyond1, thus resulting in undue congestion and sometimes may expect traffic jam.
3) Regular Maintenance of vehicles should be done periodically, in order to avoid higher vehicle operation cost and decrease in fuel consumption.
4) The main cause for increase in Vehicle Operation Cost for all types of vehicles is high traffic flow at both the stretches.
5) The probable solution to reduce the Vehicle Operation Cost for vehicles is by control of old commercial vehicles, stoppage of breakdown vehicles at mid-region of road, avoid suddenly block of roads for other reasons and also provide adequate roughness for road surface on both the stretches to improve smooth flow of traffic.

4. ACKNOWLEDGEMENT

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