

Comprehensive Study Of Traffic Congestion, Travel Time And Traffic Variation At Hebbal Flyover Using VISSIM Software

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Abstract: Study on travel time reliability of transportation system is becoming more important in developed and developing countries due to increased economic activities and improvements in quality of life. Till to date various congestion level performance measurements are developed but most of these measures represents the average and total level of congestion of the road network. Whereas the travel time reliability-based performance measures represent the variability in travel time of the road/ network. Most of the congestion level performance measures considers the average travel time of the trip, whereas the travel time reliability-based performance measures consider the TTT distribution. This implies that the travel time reliability measures are capable of measuring the variability in congestion. Further, a detailed investigation is required to study the relation between the travel time reliability measurement and the congestion measures. Hebbal flyover is an important junction on ORR formed with intersection of two major roads namely, ORR which is an arterial road and Bellary road which is a NH-7. In order to provide adequate roadway capacity in this stretch for present traffic and increased traffic at future, NHAI has constructed 6 lane elevated road after Hebbal flyover towards KIAL with provision of 6 lane surface road and 4 lane SR(2 on either side). The traffic from KIAL towards city will suddenly converge from 8 lanes at existing 2-lane Hebbal flyover. In perpendicular direction Bellary road is one of the important roads of the city connecting CBD and NH-7 leading to Hyderabad.

Index Terms: CBD- Central Business District, KIAL - Kempegowda International Airport Limited, NHAI- National Highway Authority of India, NH.7-National Highway number 7, ORR-Outer Ring Road, SR-slip road, TTT-trip travel time.

1. INTRODUCTION

Bengaluru is one the most dynamic city in world spreading over an area of 709km² known for its weather, diversity, culture and IT industries. It is also known as Silicon Valley. It is India's third biggest road system in India. Bangalore's road network exceeds 3,000 km (1,800 mi) and consists of ring roads, arterial roads, sub-arterial roads and residential streets. Bengaluru city has over 25 flyovers and several underpasses. Major flyovers of the city are

- KR market Flyover
- Hebbal Flyover
- Hosur road Flyover
- Mysore Road flyover
- Tumkur Road Flyover
- BGS flyover and many more

Hebbal Junction flyover, situated on the Airport road is the major connecting road to International Airport Road, which is one among many traffic congestion zones in the city. With about 19157 PCU/hr (6917 PCU/hr at grade), It is also one of the busiest junctions along ORR in Bangalore today. In order to make Outer Ring road through traffic Signal free,

Grade Separation is essential at the junction. Further, there has been manifold increase in passenger car and bus traffic in perpendicular direction (along Bellary road) due to shift in Bangalore airport from HAL to Devannahalli (KIAL). Considering the increase in traffic, NHAI has built 6 lane elevated road beyond Hebbal flyover leading to airport. The surface level road has been upgraded to 6 lane main carriageway with 2 lane service road both sides. Presently the traffic from these 16 lanes is converging to 4 lane flyover at existing Hebbal flyover which is bottleneck. In opposite direction the city bound traffic from Bellary road is converging from 10 lanes to existing 4 lane flyovers resulting in traffic congestion. The converging traffic towards Majestic and bottleneck descend is causing the greater traffic congestion which has been greater matter of consent for the traffic movement.

1.1 Objectives

- 1) To reduce congestion caused by vehicles
- 2) To avoid congestion and travel time
- 3) To decrease the traffic manoeuvres.
- 4) To enhance the level of service on the flyover.

1.2 Study Area

Hebbal flyover mainly connects 6 routes spreading over 5 kms in total. The routes are:

1. A two lane ramp for road from Mekhri Circle to Esteem Mall whose length is 700mts
2. A two lane ramp for road from Esteem mall towards Mekhri circles whose length is 700 mts.
3. A two lane ramp from KR Puram Road and gets connected to the ramp from Airport length is 900mts.
4. A two lane Ramp for Vehicles from BHEL circle toward Mekhri Circle which is 450 mtrs long.
5. A single lane ramp which diverges for double lane road

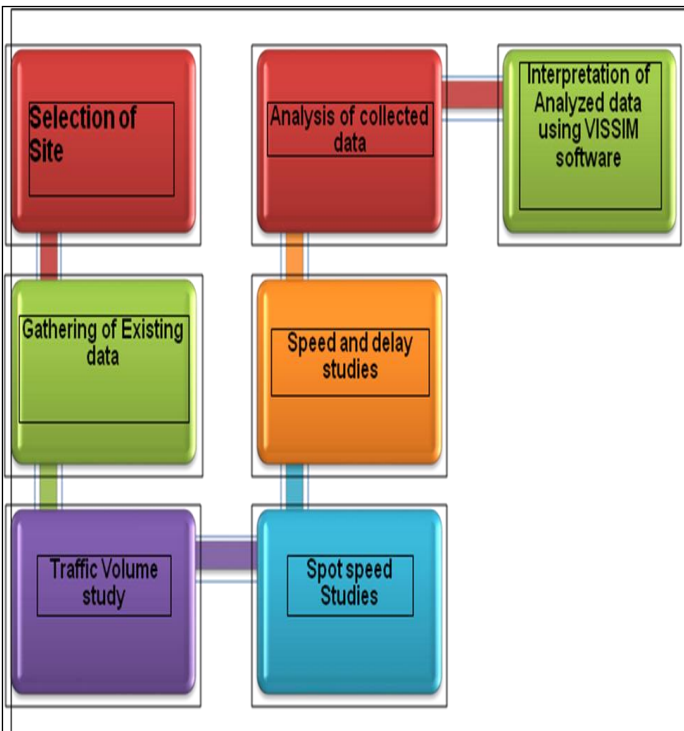
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for vehicles from Mekhri circle to BHEL circle whose total length is 900 mts.

6. A single lane ramp which diverges for a double lane ramp for vehicles from Mekhri circle to KR Puram of total length 1km.



Fig.1.Satellite image from Google of Study Area



2 METHODOLOGY

Fig.2.Flowchart

2.1 Methods

Road Inventory Studies – It is the study of site to know all the properties of given roadway including the length, width and other properties. Traffic volume count – The term traffic volume study can be termed as traffic flow survey or simply the traffic survey. It is defined as the procedure to determine mainly volume of traffic moving on the roads at a particular

section during a particular time.

Spot speed studies – It is the speed of traffic at one point or spot on a traffic way (instantaneous speed). It helps in

- Establishing the speed zone of new or existing speed limit or enforcement practices.
- To determine speeds at the problem locations; to validate whether speeds are too high
- For Traffic operation and control ;To establish speed limits to determine safe speeds at curves
- Establishing Speed trends at the local, state and national level to assess effectiveness of speed limit policy.

Travel delay Studies - It is the sum of time lost due to congestion expressed in vehicle-hours. It gives us information about the total time lost in traffic.

Usage of VISSIM Software – Capacity is analyzed with various data available using VISSIM software – Traffic PTV VISSIM is a microscopic multi-modal traffic flow simulation software package developed by PTV Planning Transport Verkehr AG in Karlsruhe, Germany. The name is derived from "Verkehr in Städten – Simulations model" (German for "Traffic in cities - simulation model"). PTV VISSIM was first developed in 1992 and is today a global market leader.

3 DATA COLLECTION

3.1 OBSERVATIONS

- The number of vehicles travelling over the flyover at peak hour is over 10,000 in total.
- The PCU of the route connecting Esteem Mall to Mekhri Circle will reach up to 2800, on Monday morning.
- The bottleneck exit at Hebbal is slowing down the traffic over the flyover which again slows down the queue vehicles behind.
- The Bus stop near to the exit of flyover at Hebbal, where the busses stop making a lane less for normal movement which again is leading to congestion.

3.2 Volume count survey

Table.1 Volume Count at Mekhri towards Airport Road

ROUTE :MEKHRI CIRCLE TO ESTEEM MALL(EVENING)		
DAY	PCU/HR	PEAK HOURS
MONDAY	2456	6-00 PM TO 7-00PM
THURSDAY	2456	5-45PM TO 6-45AM
FRIDAY	2460	5-45PM TO 6-45AM
SATURDAY	2641	6-00AM TO 7-00AM

Table.2 Volume Count at Mekhri towards Airport Road

ROUTE:MEKHRI CIRCLE TO ESTEEM MALL (MORNING)		
DAY	PCU/HR	PEAK HOURS
MONDAY	2710	9-15AM TO 10- 15AM
THURSDAY	2582	9-15AM TO 10- 15AM
FRIDAY	2696.5	9-15AM TO 10- 15AM
SATURDAY	2452	9-30AM TO 10-30AM

Fig.3. Volume Graph. 1

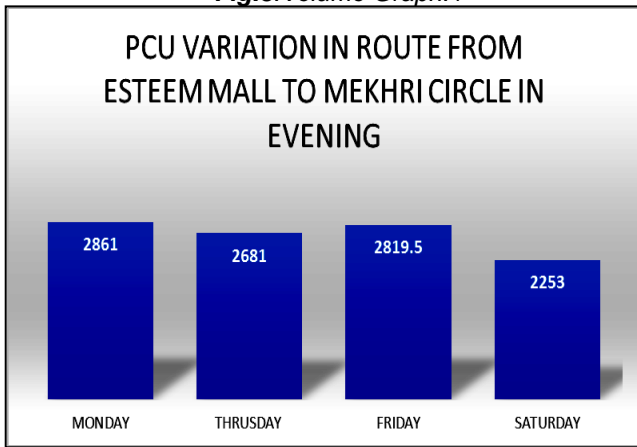
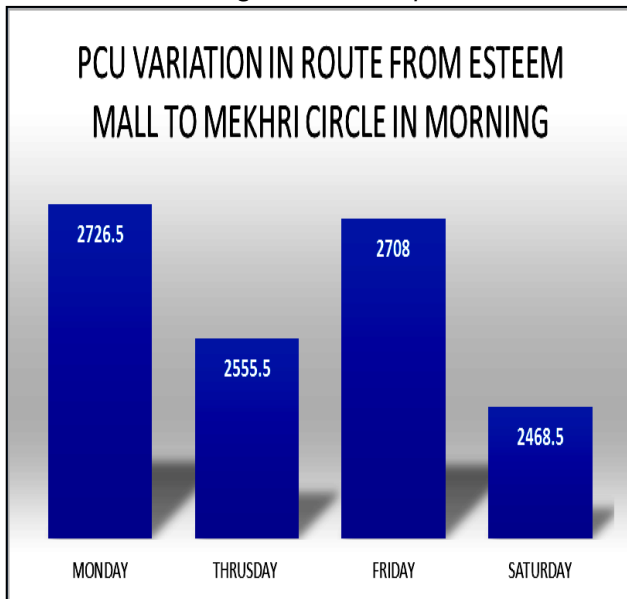


Fig.4. Volume Graph.2



3.3 Spot Speed Study

Table.3 Spot speed data at Airport Road towards Mekhri

PLACE: HEBBAL FLYOVER (ON FLY OVER)				
ROUTE: AIRPORT TO MEKHRI CIRCLE				
TIMEINGS: 5-15AM to 6-15AM				
VEHICLE: BIKE, CARS, BUSES				
Speed	Mid Speed	Frequency	Percentile Frequency	Cumulative Frequency
0 TO 10	5	16	26.667	26.667
10 TO 20	15	24	40	66.667
20 TO 30	25	14	23.33	90
30 TO 40	35	6	10	100
40 TO 50	45	0	0	100
50 TO 60	55	0	0	100

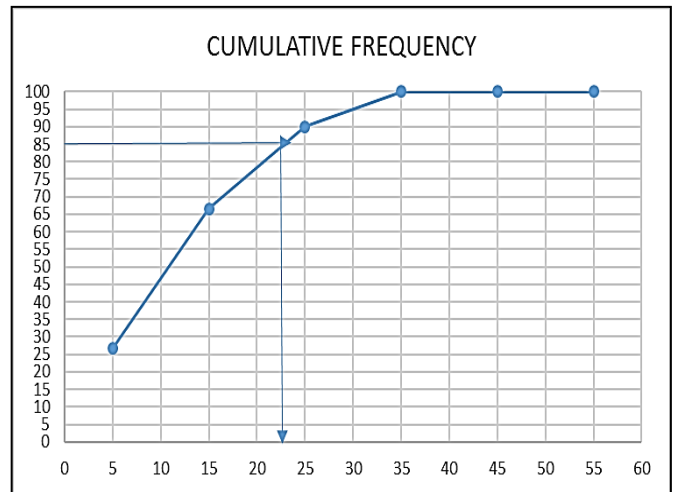
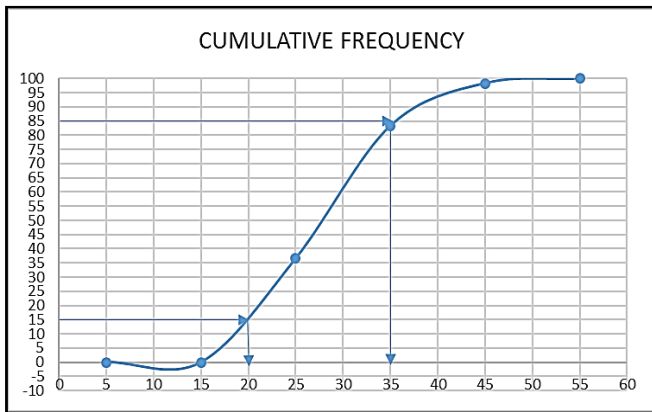


Table.4 Spot speed data at Mekhri towards Airport Road

PLACE: HEBBAL FLYOVER (ON FLYOVER DIRECTION)				
ROUTE: MEKHRI CIRCLE TO AIRPORT				
TIMEINGS: 5-15AM to 6-15AM				
VEHICLE: BIKES,CARS,BUSES				
SPEED	MID SPEED	FREQUENCY	PERCENTILE FREQUENCY	CUMULATIVE FREQUENCY
0 TO 10	5	0	0	0
10 TO 20	15	0	0	0
20 TO 30	25	22	36.667	36.667
30 TO 40	35	28	46.667	83.33
40 TO 50	45	9	15	98.33
50 TO 60	55	1	1.667	100



- The traffic congestions are observed at the junctions as expected. The queues are formed and there are even instances of vehicles being stopped.
- The respective figures are attached below. The vehicles are being slowed down to less than 10kmph and we have observed up to 9 kmph on road.
- Hence there have been the similar results with respect to manual and software based analysis.

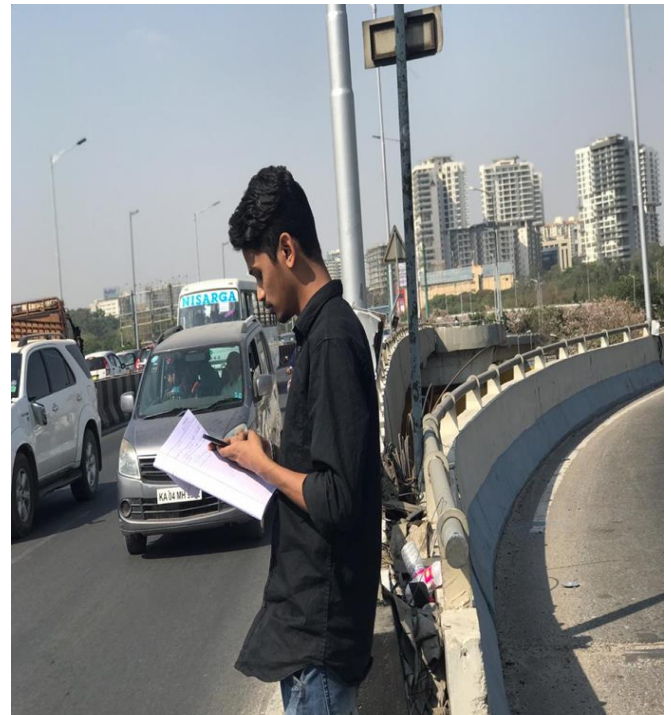


Fig-5. Queue being formed observed at junction in VISSIM software

3.4 Speed and Delay Study

DAY: FRIDAY
 DATE: 5-04-2019
 ROUTE: ESTEEM MALL TO CBI

Table.5 Speed and Delay Study data

Trip No	Journey Time In Min	Stopped Delay In Min	No of Vehicles Overtaking	No of Vehicles Overtaken	No Of Vehicles In Opposite Direction
1	15	2.5	87	30	320
3	18	3	83	32	120
5	13	2	90	26	299
7	14	2.5	91	32	309
	Avg=15	Avg=2.5	Avg=87.75	Avg=30	Avg=262

DAY: FRIDAY
 DATE: 5-04- 2019
 ROUTE: CBI TO ESTEEM MALL

Table.6 Speed and Delay Study data

Trip No	Journey Time In Min	Stopped Delay In Min	No of Vehicles Overtaking	No of Vehicles Overtaken	No of Vehicles In Opposite Direction
2	5	0.3	70	20	120
4	6	0.5	71	18	130
6	5	0.16	77	23	140
8	6	0.3	77	20	133
	Avg=5.5	Avg=0.31	Avg=73.75	Avg=20.2	Avg=130.75



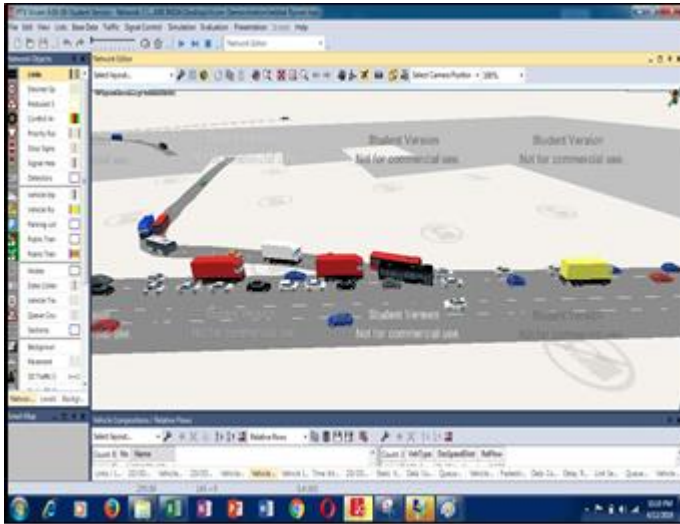
Fig-6. Traffic congestion observed in VISSIM software

4 RESULTS

4.1 Vissim Simulation

Various parameters like delay and speed were analyzed using VISSIM simulation and the results obtained were similar to that of our manual calculations.

- The delay obtained in VISSIM was in the range of 1.8 mins to 4.8 mins and the delay observed was in the range of 2 to 4 mins.



PHOTOS during Data collection
PHOTO-1
PHOTO-2

4.2 Result Summary

- 1) The number of vehicles travelling over the flyover at peak hour is over 10,000 in total. The vehicles from various routes converge to move towards Mekhri circle leads to congestion of traffic over the flyover. This leads to delay in travel time of the journey.
- 2) The PCU of the route connecting Esteem Mall to Mekhri Circle will reach up to 2800, on Monday morning. The number of vehicles entering the city through Flyover will make this happen
- 3) The traffic movement in ramps moving away from Hebbal will have a normal flow even in Peak Hour. The diversions for KR Puram and BHEL Road have a separate ramp from the beginning of the flyover at Hebbal Bus stop. This helps in ease of flow.
- 4) At junction of ramp from BHEL traffic and that from Esteem mall gives rise to a conflict point which slows down the speed of vehicle on the flyover. This slowed down traffic again meets the junction of traffic from KR Puram, 200 meters ahead of first junction which again slows down the traffic.
- 5) Almost 6 lane vehicles near Esteem Mall converge to 2 lanes at the entry of flyover which forms a long queue of vehicles at the entry progressing towards Mekhri circle. This queued traffic again faces the junctions.
- 6) It is also observed the traffic from KR Puram is also remarkable which adds up in a greater amount and shall be considered as similar to that of traffic from Esteem Mall. This traffic when added to the existing traffic leads greater congestion.
- 7) The bottleneck exit at Hebbal is slowing down the traffic over the flyover which again slows down the queue vehicles behind.
- 8) The Bus stop near to the exit of flyover at Hebbal, where the busses stop making a lane less for normal movement which again is leading to congestion. This problem is seen on the other lane where getting into the flyover is slowed

down.

- 9) The speed of vehicles observed is very less for the route from various routes towards Mekhri Circle. At the entrance of flyover, the average speed is observed to be less than 15 Kmph. Over the flyover it is observed to be around 15 to 20 Kmph and it decreases at descend.

5 CONCLUSION

1. The congestions caused are mainly due to huge number of vehicles coming on to the road. As the number of vehicles increase the space occupied over the road also increases, but the number of passengers travelling is relatively low compared to the total capacity of vehicles on the road. Car pooling, bike pooling, use of public transport will reduce the number of vehicles on the road, this also helps in increasing the space on the road.
2. By using time sharing concept we can avoid congestion & travel time like staggered office hours, School, College, and BRTS.
3. Here, to avoid the congestion at junction's signals can be installed. The proper use of signals can avoid spontaneous congestions.

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