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Evaluation of Different Traffic Models for N.A.D Junction (Visakhapatnam) Using PTV -VISSIM Simulation Software

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Abstract

Road network is an important transportation system. Improper management of roads may lead to the traffic congestions, high transportation cost as well as unnecessary traffic jams. In Visakhapatnam there is a problem in NAD Junction by burgeoning traffic at the intersection by causing traffic jams. This study helps to find out the suitability of two different traffic models to decrease in the traffic queues, waiting time at the signalized intersections. In order to reduce the waiting time, the PTV-VISSIM software is used for the models developed and the simulation results are compared in queue length, traveling time and speed. The data used in the simulation was collected by video recording, the traffic at the study area. Video based technique minimizes the human errors and overcomes the difficulties in gathering the traffic information.

Keywords: *PTV-VISSIM, Traffic Volume, Simulation, Queue length, Signalized intersection, Displaced Right Turn (DRT)*

INTRODUCTION

This paper audits the scope of traffic models, with specific consideration regarding micro simulation.VISSIM is a microscopic, time step and behavior based simulation model for realistic modeling of city and interurban traffic plus pedestrian movements. The traffic flow is simulated considering lane allocation, vehicle compositions, signal control and detection of private and public transport vehicles. PTV-VISSIM is employed to model the heterogeneous traffic-flow. In the recent scenario traffic is the major consent for any developing nation. Visakhapatnam has become a mega city; traffic growth in this city has been more rapid in recent years and the consequent large-scale housing development in the peripheral areas. Due to mixing of the regional and city traffic, there is most prominent on the side (Marripallem- Simhachalam) and the other (Chennai-Kolkata Highway) bypasses. To ease the traffic congestion in the four road junction (NAD), an innovative traffic model has to be constructed. The eastern and western part of N.A.D Junction has developed mainly as a residential & commercial area where as northern and southern has airport and industrial

settlements. Because of this, there is heavy traffic flow towards the junction in the morning and evening. This cause's serious traffic congestion on road and frequent traffic jams during peak hours, accident problem, parking problem besides air pollution. Therefore it's necessary to give attention towards planning of an innovative model at NAD.

Vipul N. Prajapati et. al. (2010) conducted a study entitled "Simulation of Heterogeneous Traffic Intersection using VISSIM". The study mainly concerned with the conceptual simulation model of highly heterogeneous traffic flow, delay and saturation at signalized intersections, various cycle time's effect at intersection and to study the impact of provision of priority for BRTS at various frequencies. DrP.Vedagiri et. al. (2012) had stimulated Continuous Flow Intersection for 3-arm intersection and studied delays by increasing the right turn traffic from 10 to 50%. Shriniwas Arkatkar et. al. (2012) simulated heterogeneous traffic on an Indian urban expressway using VISSIM. An eight-lane divided Delhi-Gurgaon expressway was selected as the study area.

Hemant Kumar Sharma et.al. (2012) carried out the speed-flow analysis for interrupted oversaturated traffic flow under heterogeneous traffic conditions.

By developing the two different models which are suitable for N.A.D junction and performing simulation in PTV VISSIM, the simulation results were obtained and comparison is made between the two models with the existing conditions.

METHODOLOGY

Study area characteristics

It is a four road junction as shown in fig-5, which is a signalized intersection of NH-16 and arterial road of Marripalem – Simhachalam. It has been experiencing lot of moment of Vehicular traffic from all four directions with the development of city and increase of both Public and Private vehicles in the city. The junction is considered as one of the important junctions of the city leading to an international Airport, Industrial area on one side and down town city on the other side of the NH-16. The City Arterial road intersecting with the Highway at this place also connects too many residential areas at Marripalem, Visakhapatnam Railway station on one side and, Simhachalam on the other side. The NAD X Road has basically which got a heavy traffic flow due to prominent commercial establishments in and around the junction. Establishment like government offices, schools and commercial markets. So this route is taken under the study area.

Following are the features of study area

- The Junction is formed by NH16 (NH5) &Marripalem – Simhachalam,
- Existing RoW of NH16 is 60m and that of Marripalem – Simhachlam is 30m,
- ROB Crossing exists on the Airport arm of the junction at a distance less than300m from the Junction ,
- BRTS facility exists on Marripalem – Simhachlam Road

Data collection

Video camera was used to count the traffic volume at the study area. Video based technique minimizes the human errors and overcomes the difficulties in gathering the traffic information. The video camera takes continuous image of the traffic and footage was saved in drive. Vehicles count has been done from the video recorded for different class of vehicles and direction of movement for every 15 minutes interval. The vehicle types considered from the recorded data are motorized and non-motorized vehicles. Motorbike, auto rickshaws, passenger cars, buses; LCV's and freight vehicles (2, 3 and multi-axel) considered

as motorized vehicles. Bicycle, cycle rickshaw, animal drawn vehicles and hand carts are considered as non-motorized vehicles. The disadvantage of video technique is that the great amount of time and energy required for information extraction. Compared to manual counting technique, video based count is correct and can be revised, this requires less man power.

Fig 1. *Sample screen capture from the video recorded*

DATA ANALYSIS

Table 1. *Signal cycle details*

Intersection	Direction	Study approaches	Cycle time (sec)	Green time(sec)
N.A.D junction	SOUTH	From Airport	210	50
	EAST	From Marripallem	210	30
	NORTH	From NSTL	210	60
	WEST	From Simhachalam	210	50
	All directions	For pedestrians	210	20

Table 2. *Traffic volume at N.A.D junction*

Intersection	Lane Group	Total volume of veh/day	Peak volume in veh/hr
N.A.D junction	From Airport	31873	2092
	From Marripallem	19828	1364
	From NSTL	40136	3228
	From Simhachalam	47128	5311

Table 3. *Volume Inputs in VISSIM simulation*

Approach lane	Approach volume	Left		Through		Right	
		%	Vph	%	vph	%	vph
Airport	2092	34	721	42	862	24	509
Marripallem	1364	40	552	50	683	10	129
NSTL	3328	5	154	52	1682	43	1392
Simhachalam	5311	40	2150	24	1270	36	1891
TOTAL	11995						

Table4.*Speeds and composition of vehicles categories stimulated in VISSIM*

Vehicle Types	Percentage of composition	speed
Car	16.60	60 km/h
Bus	3.40	70 km/h
Motor bike	57.60	60 km/h
Trucks/goods carriers	2.10	70 km/h
Cycle	0.20	15 km/h
3 wheeler	17.8	50 km/h
LCV-passenger	0.50	60 km/h
LCV-goods	1.80	70 km/h

Proposed Option-1

Fig 2. *Composite Three Level Grade Separator*

Table 5. *Details of the Option 1*

Traffic movement	Proposal
Vizag to Airport & Airport to Vizag	Six-Lane Under-pass @ (-) 7.00
Marripalem to Simhachalam – Simhachalam to Marripalem	Four-Lane Flyover at (+) 12.00
Left Side Turnings	At Grade signalized turnings with Signals for Pedestrian movement
Right Turn Movements	Elevated Rotary at RL(+) 4.00
Service Roads on Vizag and Airport sides	2 x 2lanes
Service Roads on Marripalem& Simhachalam Sides	2 x 2lanes

Proposed Option 2

Displaced Right Turn (DRT): Displaced right turn intersection removes the right turning traffic from the main intersection and directs them to separate roadway running parallel to the main lanes, this design allows more green time for the major traffic flows. It is an at-grade intersection. The right turn traffic is displaced to separate road way for main intersection at a distance of150 to 250 meters, with a two phase signaling system.

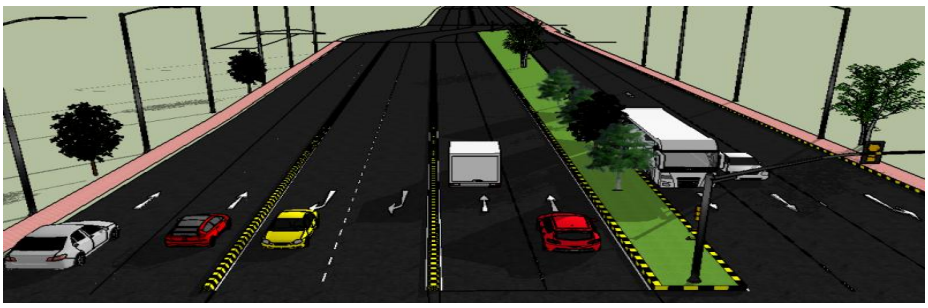

Fig 3. *Main intersection of the DRT*

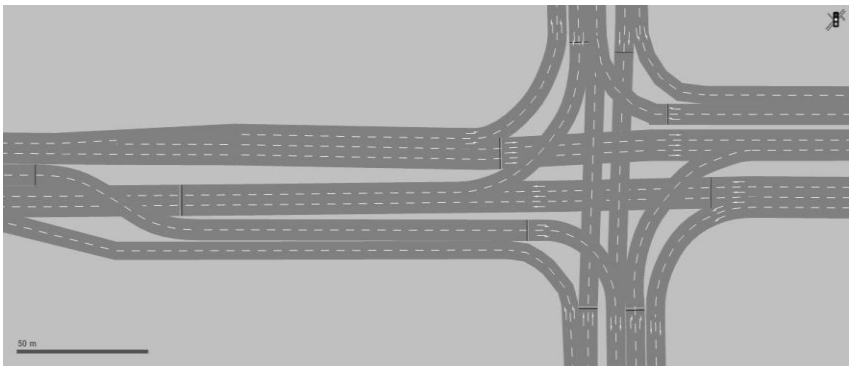

Fig 4. *Layout Plan of DRT Model*

VISSIM Simulation Network

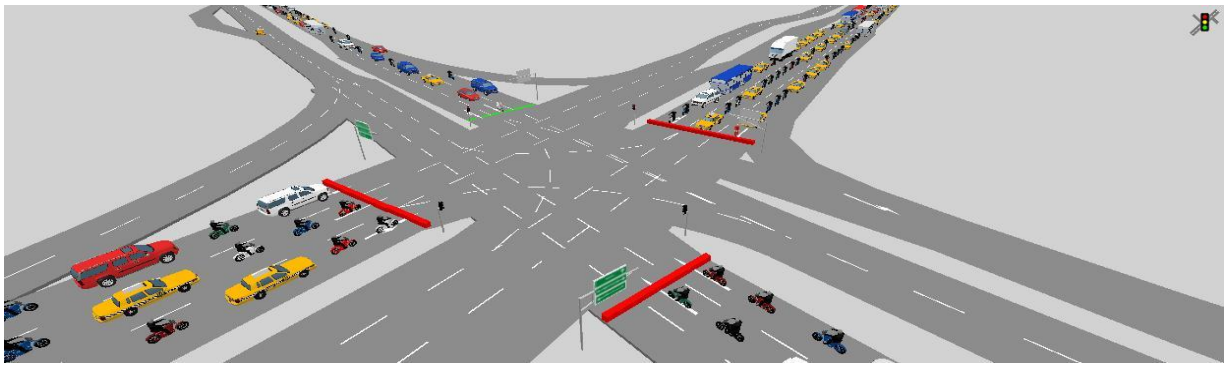

Fig 5. *NAD Existing Intersection.*

Fig 6. *Proposed option - 1 at NAD junction.*

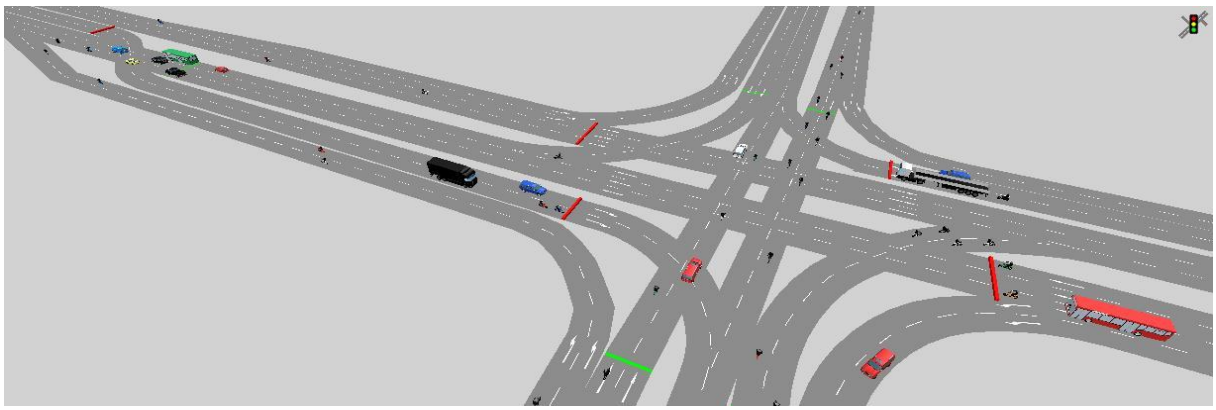

Fig 7. *Proposed option- 2 at NAD junction.*

Results and Discussion

-The results obtained from the VISSIM simulation for the existing traffic and projected traffic for 10 and 25 years is shown below.

-The queue length observed in option 1 were formed on elevated rotary only i.e.; Right turn movements.

Table 6. *N.A.D Intersection -Queue length results for existing traffic volume*

Queue Counter	*For Existing condition*		*For Proposed option 1*		*For Proposed option 2*	
	Queue Length (m)	*Queue Length Maximum (m)*	*Queue Length (m)*	*Queue Length Maximum (m)*	*Queue Length (m)*	*Queue Length Maximum(m)*
Airport	*438*	*510*	*0*	*0*	*5*	*71*
Marripallem	*429*	*475*	*0*	*0*	*8*	*68*
NSTL	*424*	*472*	*0*	*0*	*12*	*105*
Simhachalam	*456*	*513*	*0.01*	*21.56*	*14*	*143*

Table 7. *N.A.D Intersection -Queue length results-10 Years projected traffic*

Queue Counter@10	*For Existing condition*		*For Proposed option 1*		*For Proposed option 2*	
	Queue Length (m)	*Queue Length Maximum (m)*	*Queue Length (m)*	*Queue Length Maximum (m)*	*Queue Length (m)*	*Queue Length Maximum(m)*
Airport	*591*	*661*	*3*	*35*	*24*	*174*
Marripallem	*579*	*648*	*0*	*0*	*285*	*551*
NSTL	*427*	*565*	*28*	*166*	*423*	*653*
Simhachalam	*639*	*703*	*232*	*265*	*61*	*261*

Table 8. *N.A.D Intersection -Queue length results-25Years projected traffic*

Queue Counter@25	*For Existing condition*		*For Proposed option 1*		*For Proposed option 2*	
	Queue Length (m)	*Queue Length Maximum (m)*	*Queue Length (m)*	*Queue Length Maximum (m)*	*Queue Length (m)*	*Queue Length Maximum(m)*
Airport	*591*	*749*	*261*	*310*	*207*	*1034*
Marripallem	*605*	*716*	*35*	*256*	*497*	*664*
NSTL	*424*	*689*	*409*	*453*	*622*	*930*
Simhachalam	*642*	*859*	*217*	*528*	*66*	*270*

Queue length (Average queue length): In each time step, the current queue length is measured upstream by the queue counter and the arithmetic mean is thus calculated per time interval (m).

Queue length maximum: In each time step, the current queue length is measured upstream by the queue counter and the maximum is thus calculated per time interval (m).

Table 9. *N.A.D Intersection Travel time results for Existing Traffic Volume*

	Direction	*Distance (m)*	*For Existing condition*		*Proposed option (1)*		*Proposed option (2)*	
			Travel Time (sec)	*Speed (Kmph)*	*Travel Time (sec)*	*Speed (Kmph)*	*Travel Time (sec)*	*Speed (Kmph)*
AIRPORT	STARIGHT	127	72.24	6	7.71	59	13.18	35
	RIGHT	171	56.08	11	10.53	58	14.50	42
	LEFT	76	8.77	31	4.57	60	4.52	61
MARRIPALEM	STARIGHT	175	105.28	6	10.81	58	25.30	25
	RIGHT	170	203.98	3	10.7	57	19.74	31
	LEFT	133	34.21	14	8.16	59	8.25	58
N.S.T.L	STARIGHT	124	49.47	9	7.62	59	15.03	30
	RIGHT	140	45.87	11	8.83	57	12.96	39
	LEFT	123	8.07	55	7.58	58	7.51	59
SIMHACHALAM	STARIGHT	187	84.15	8	11.51	58	24.41	28
	RIGHT	128	65.96	7	8.19	56	11.50	40
	LEFT	105	19.89	19	6.57	58	6.78	56

Table 10. *N.A.D Intersection Travel time results for 10 Years projected traffic volume*

	Direction	*Distance (m)*	*For Existing condition*		*For Proposed option (1)*		*For Proposed option (2)*	
			Travel Time (sec)	*Speed (Kmph)*	*Travel Time (sec)*	*Speed (Kmph)*	*Travel Time (sec)*	*Speed (Kmph)*
AIRPORT	STARIGHT	127	76.15	6	7.72	59	21.939	21
	RIGHT	171	56.08	11	32.02	19	25.689	24
	LEFT	76	9.38	29	4.66	59	4.874	56
MARRIPALEM	STARIGHT	175	126.34	5	11.15	57	72.072	9
	RIGHT	170	204.00	3	23.48	26	47.634	13
	LEFT	133	34.21	14	8.28	58	8.406	57
N.S.T.L	STARIGHT	124	49.47	9	7.67	58	24.955	18
	RIGHT	140	45.87	11	22.99	22	40.831	12
	LEFT	123	8.22	54	7.52	59	7.488	59
SIMHACHALAM	STARIGHT	187	96.17	7	11.43	59	35.471	19
	RIGHT	128	76.95	6	29.64	16	21.574	21
	LEFT	105	21.00	18	6.62	57	6.761	56

Table 11. *N.A.D Intersection Travel time results for 25Years projected traffic volume*

	Direction	*Distance (m)*	*For Existing condition*		*For Proposed option (1)*		*For Proposed option (2)*	
			Travel Time (sec)	*Speed (Kmph)*	*Travel Time (sec)*	*Speed (Kmph)*	*Travel Time (sec)*	*Speed (Kmph)*
AIRPORT	STARIGHT	127	76.2	6	7.71	59	29.680	15
	RIGHT	171	56.1	11	40.82	15	39.815	15
	LEFT	76	10.1	27	4.73	58	5.161	53
MARRIPALEM	STARIGHT	175	210.6	3	12.67	50	74.241	8
	RIGHT	170	209.1	3	80.12	8	51.733	12
	LEFT	133	59.9	8	12.68	38	8.385	57
N.S.T.L	STARIGHT	124	49.5	9	7.67	58	24.996	18
	RIGHT	140	50.5	10	32.14	16	40.946	12
	LEFT	123	9.1	49	7.49	59	7.538	59
SIMHACHALAM	STARIGHT	187	96.2	7	11.46	59	41.092	16
	RIGHT	128	115.4	4	42.96	11	30.951	15
	LEFT	105	21.1	18	6.69	57	6.648	56

Travel time: Average time (s) taken to travel the specified distance by vehicles in the network.
Speed: Average speed (kmph) of all vehicles to travel the specified distance in the network.

CONCLUSIONS

The study earns out several interesting conclusions. The micro-simulation model VISSIM is suitable to simulating and thus looking for heterogeneous traffic flow in expressways to a satisfactory extent. By simulation it was known that the behavior of traffic changes as the traffic volume in the network increases. In case of any road development project is too done, the diversion plans can be prepared in PTV-VISSIM and can predict the type of problem which may evolve to identify the conflict zone and to develop the alternate solution. When compared to queue length for existing conditions proposed option (1) and (2), it is observed that the option-1 is showing satisfactory. From the data analysis it is observed that two wheeler is the most preferred mode of transport. VISSIM is ready to simulate road corridors of crowded motorways to identify system performance, bottle-necks, and potentials of enhancement Traffic circulation, public transport operations, bicycle facilities, and pedestrian crossings can be modeled for numerous designs of the street network and various composition of vehicle detection.

ABBREVATIONS

RoW: Right of Way
ROB : Road Over Bridge
BRTS: Bus Rapid Transit System
LCV : Light Commercial Vehicles
DRT : Displaced Right Turn

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REFERENCES

1. AlluriSwaroopa, LakkakulaVenkataNarasimha Prasad. Proposed Alternative System to Existing Traffic Signal System. *International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering* Vol:9, No:5, 2015
2. Anusha, C. S., AshishVerma, and G. Kavitha. "Effects of Two-Wheelers on Saturation Flowat Signalized Intersections in Developing Countries", *Journal of Transportation Engineering*, 2013
3. Hemant Kumar Sharma,Mansha Swami, BajrangLal Swami. Speed-Flow Analysis for Interrupted Oversaturated Traffic Flow with Heterogeneous Structure for Urban Roads. *International Journal for Traffic and Transport Engineering*, 2012, 2(2): 142 – 152
4. Mathew, T. V., and Radhakrishnan, K. (2010). "Calibrationofmicrosimulation models for nonlane-based heterogeneous traffic at signalized intersections." *Journal of Urban Planning and Development*, 2010.136:59-66.
5. Ramkrishna P Jagali , Mr. Rahul L Kadam Traffic Queuing Analysis on Chord Road, Vijayanagar, Bengaluru using PTV Vissim Software.*Global Research and Development Journal for Engineering* Volume 1 Issue 9
6. Sitesh Kumar Singh,AnkitBansal , 2016 .Multimodal Interpretation and Analysis of Traffic Survey Data. *International Journal of Innovative Research in Science, Engineering and Technology* Vol. 5, Issue 5
7. Sanjay Singh and Sitesh Kumar Singh,.Traffic Volume Survey

Analysis of the Road Connecting Career Point University. *International Journal of Innovative Research in Science, Engineering and Technology*. Volume - 2, Issue - 10, Oct – 2016

8. UditBatra, Mandar V. Sarode. Traffic Surveying & Analysis. *International Journal of Application or Innovation in Engineering &Management* ISSN 2319-4847, v5 (4), 2013.
9. Velmurugan .S, RavikiranPuvvala,BalajiPonnu and SukritNarula. (2012), "Methodology for simulating heterogeneous traffic on expressways in developing countries: A Case Study in India." Transportation Research Board (2014).