Abstract

The fast growing traffic population with restricted right of way in the undulating terrain conditions always poses challenges to Traffic management and planning process. It lowers the Level of Service (LOS) as well as increases density to regulate the flow in peak hours. With these prevailing conditions, a study was carried out for Port Blair town, capital of Andaman & Nicobar Islands, to carry out the traffic analysis and to find out the impact of Mass Transportation in improving the present traffic flow. Eight major roads contributing to Port Blair traffic were selected and their profile survey and traffic volume survey was carried out to assess the gradient and LOS respectively. LOS was compared as per the standards given in Highway Capacity Manual (HCM) and as per the User perception inputs collected by Questionnaire survey carried out amongst the road users. In order to reduce the density and to improve the flow the impact of Mass transportation system was analysed which reflected towards the reduction of density and regulating traffic stream to a great extent.
1. INTRODUCTION

The road network is an important component of the transportation system. In Port Blair, it is the principle means of transportation facilitating the socio-economic activities of the people. Two-lane road (single carriageway) with restricted right of way formed the main component of this system. The width of carriageway varies from one road to other with undulating terrain conditions and frequent intersection. Traffic flow represents the interaction between vehicles, drivers and infrastructure thereby the perception of road user about the facility decides the Level of Service. As 80% of the population are government servants, therefore land use pattern mostly evolved for basic amenities for the residential settlement. This had resulted the expansion of town in a haphazard manner. The increase in the vehicular traffic in past one decade has deteriorated the flow pattern resulting economic and environmental loss for the population, in terms of vehicle operation and noise level in surroundings. This situation lead to reduction of Level of Service and with restricted scope of expansion of facilities, it envisages the need for carrying out a study on Traffic flow parameters for Arterial and Downtown roads of Port Blair. The study revealed the prevailing LOS for the facility and how it differently varies with the LOS assigned for standard urban roads by norms and standards both by Indian Road Congress (IRC) and HCM. Therefore the need to introduce mass transport system was analysed by evaluating the resulting reduction in density of traffic.

2. OBJECTIVES DERIVED FOR STUDY

Based on the review of the existing literature and emerging issues of road traffic in national and international perspective, the traffic conditions in the capital town of Port Blair required detailed investigation with respect to the stagnant right of way. In the absence of any industry and related commercial activities the road traffic requirements are entirely different from mainland roads. In view of the evident increase in vehicular population, the present study was been mainly objected on analysing Level of Service (LOS) for Terrain conditions for major roads of Port Blair and determining the impact of Mass transportation. Therefore the objectives derived for the study were to

i.) Determining the gradient of major roads of Port Blair.
ii.) Carrying Out Road User Satisfaction Survey and accordingly defining Level of Service
iii.) Identifying major points contributing density to traffic stream
iv.) Forecasting Traffic as per the present trend
v.) Finding out the influence of Mass Transportation on LOS and forecasting the traffic parameters using statistical methods.

3. METHODOLOGIES ADOPTED

Port Blair town being the capital of Andaman and Nicobar islands has maximum commercial activities, in terms of developmental programs, which has resulted in drastic increase in vehicular population in past few years, especially after the disaster of...
Tsunami which hit the island in December 2004. Geographically isolated and strategically important for India, these islands not only has rich historical background but also has become a well-known place in international tourist map. This has resulted in migration of population and boost to tourism industry which added to the vehicular population and resulted in traffic congestion. Thus the overloaded arterial roads and down-town roads which feed about 90% of the town traffic gave following scope for study.

i.) Traffic volume analysis for eight roads contributing to maximum amount of traffic flow viz; VIP road, VKV road, Bengali Club road, Middle Point road, Phoenix Bay road, CID road, Delanipur road and Junglighat road.

ii.) Measurement of Spot speed during peak and off peak hours

iii.) User perception survey for defining Level of Service

iv.) Traffic forecasting

v.) Identifying the roads having major traffic due to presence of schools

vi.) Impact of mass transportation in reduction of flow density

4. FINDINGS FROM STUDY

4.1 Analysis of Peak Traffic Volume

The rolling terrain and the frequent intersection classify most of the eight selected roads into downtown roads. The terrain and the grade separated intersection have its effect on LOS. The haphazard settlement and residential pockets had created alignment in an unplanned manner which is connected for the abutting structures creating extremely narrow conditions for maintaining design speed. The Traffic Volume survey data observed for the peak hours is shown in following graphs (Fig 4.1 to 4.8)
Traffic Analysis For Major Roads Of Port Blair And Impact Of Mass Transportation

Fig 4.2 Traffic flow in peak hours at VIP road

Fig 4.3 Traffic flow in peak hours at Phoenix Bay road

Fig 4.4 Traffic flow in peak hours at Modal School road
Traffic Analysis For Major Roads Of Port Blair And Impact Of Mass Transportation

Fig 4.5 Traffic flow in peak hours at Middle Point Road

Fig 4.6 Traffic flow in peak hours at Bengali Club Road

Fig 4.7 Traffic flow in peak hours at Delanipur Road
4.2 Analysis of Speed Data

The Spot Speed survey was carried out for all the selected roads to find out the maximum speed attained by the vehicles in the stream. The earlier surveys had observed a theoretical free flow speed ranging from 51 to 55 kmph for all the roads under study. The undivided carriageway with a width ranging from 10 m to 14.5 m varying throughout its length gives stringent spacing for vehicular movement. The lane width restricts four wheelers to move in stream flow speed whereas the two wheelers take the freedom to vary in between the spacing available in the stretch. The overall stream speed remains well below 45 Kmph during peak hours which will deteriorate with vehicular population in near future. Therefore all these main roads envisage for alternate routes for one way traffic movement which will enhance the traffic flow during peak hours. The observed spot speed during peak hours for different roads is given below in figures 4.9 to 4.16

Fig 4.9 Spot Speed of Vehicle in VKV Road
Traffic Analysis For Major Roads Of Port Blair And Impact Of Mass Transportation

Fig 4.10 Spot Speed of Vehicle in VIP Road

Fig 4.11 Spot Speed of Vehicle in Phoenix Bay Road

Fig 4.12 Spot Speed of Vehicle in Modal School Road
Traffic Analysis For Major Roads Of Port Blair And Impact Of Mass Transportation

Fig 4.13 Spot Speed of Vehicle in Middle Point Road

Fig 4.14 Spot Speed of Vehicle in Bengali Club Road

Fig 4.15 Spot Speed of Vehicle in Delanipur Road
4.3 User Perception Survey

In order to understand the perception, experience and expectations of different types/groups of respondents a user satisfaction survey was conducted in the initial phase of the project. The target respondents were drivers of different kind of vehicles. The survey was conducted for the selected eight stretches using a questionnaire using a 5-point scale (5 = "Highly Satisfied" to 0 = "Highly Dissatisfied") This quantitative study using face-to-face mode helped in arriving at the overall satisfaction level figures with respect to road infrastructure, safety and comfort levels of road users. In the questionnaire respondents were asked to rate their satisfaction with parameters on the following 6 attributes viz.

i. **Speed achieved**
   a. Speed range the user drives

ii. **Travel time**
   a. Level of congestion
   b. Delay due to road works
   c. Delay due to police/ RTO checking
   d. Impact on vehicle maintenance cost
   e. Impact on fuel consumption
   f. Impact on travel time

iii. **Riding comfort**
   a. Improvement in road condition
   b. Overall comfort levels
   c. Smoothness and appearance of road surface
   d. Road cleanliness

iv. **Sight distance**
   a. visibility during manoeuvring
   b. clarity in road curves
v. Safety
   a. Overall safety perception
   b. Availability of Police assistance
   c. Design of road bends
   d. Dedicated lanes for pedestrians/ cyclists
   e. Speed breakers

vi. Overall rating
Considering all the above parameters
   a. Speed achieved
   b. Travel time
   c. Riding comfort
   d. Sight distance
   e. Safety

List Of Target Respondents
Drivers/staffs on vehicle/passengers/owners of –
   ➢ Motorized two wheelers
   ➢ 3Wheelers/Auto Rickshaw
   ➢ Car/Jeep/Van/Taxi/SUVs/MUVs
   ➢ Bus drivers/support staffs (Regular bus & mini bus)

Figure 4.17 Carrying out User Satisfaction Questionnaire survey to road users
### Traffic Analysis for Major Roads of Port Blair and Impact of Mass Transportation

<table>
<thead>
<tr>
<th>Category</th>
<th>VKV Road</th>
<th>VIP Road</th>
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</thead>
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<tr>
<td>Speed Achieved in Driving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 to 20 kmph</td>
<td>38%</td>
<td>38%</td>
</tr>
<tr>
<td>19%</td>
<td>15%</td>
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<tr>
<td>6%</td>
<td>32%</td>
<td>28%</td>
</tr>
<tr>
<td>32%</td>
<td>38%</td>
<td>27%</td>
</tr>
<tr>
<td>Riding Comfort</td>
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<td></td>
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<tr>
<td>Very Good (5)</td>
<td>16%</td>
<td>16%</td>
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<td>45%</td>
<td>25%</td>
</tr>
<tr>
<td>6%</td>
<td>16%</td>
<td>19%</td>
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<tr>
<td>0%</td>
<td>32%</td>
<td>27%</td>
</tr>
<tr>
<td>Safety</td>
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</tr>
<tr>
<td>Very Good (5)</td>
<td>32%</td>
<td>28%</td>
</tr>
<tr>
<td>17%</td>
<td>15%</td>
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<td>Good (4)</td>
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<td>4%</td>
<td>32%</td>
<td>0%</td>
</tr>
<tr>
<td>Sight Distance Clearance</td>
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</tr>
<tr>
<td>Very Good (5)</td>
<td>32%</td>
<td>32%</td>
</tr>
<tr>
<td>16%</td>
<td>16%</td>
<td>27%</td>
</tr>
<tr>
<td>17%</td>
<td>28%</td>
<td>19%</td>
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<td>0%</td>
<td>17%</td>
<td>0%</td>
</tr>
<tr>
<td>Travel Time</td>
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<td></td>
</tr>
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<td>Very Good (5)</td>
<td>38%</td>
<td>38%</td>
</tr>
<tr>
<td>23%</td>
<td>23%</td>
<td>32%</td>
</tr>
<tr>
<td>0%</td>
<td>28%</td>
<td>33%</td>
</tr>
<tr>
<td>Overall Rating of the Road</td>
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<td></td>
</tr>
<tr>
<td>Very Good (5)</td>
<td>38%</td>
<td>38%</td>
</tr>
<tr>
<td>28%</td>
<td>38%</td>
<td>33%</td>
</tr>
<tr>
<td>Good (4)</td>
<td>32%</td>
<td>27%</td>
</tr>
</tbody>
</table>

**Figure 4.18 User perception of VKV road**

**Figure 4.19 User perception of VIP road**
Figure 4.20 User perception of Junglighatr road

Figure 4.21: User perception of Delanipur road

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Figure 4.22 User perception of Bengali Club road

5. COMPARISON OF LOS

5.1 Existing LOS for Major Roads of Port Blair as Highway Capacity Manual (HCM)

According the operating conditions HCM has classified level of service into six levels, starting from level of service A to level of service F. The level of service of major roads of Port Blair for speed according to the HCM was found to be as given in Table 5.1

Table 5.1 LOS for major roads of Port Blair, as per Highway Capacity Manual (HCM)

<table>
<thead>
<tr>
<th>S.N</th>
<th>Name of The Stretch</th>
<th>Speed Limit As Per HCM</th>
<th>Type Of Road</th>
<th>LOS (As Per Speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Middle Point Stretch</td>
<td>30 KPH</td>
<td>Down-town Road</td>
<td>B</td>
</tr>
<tr>
<td>2</td>
<td>VKV Stretch</td>
<td>30 KPH</td>
<td>Down-town Road</td>
<td>B</td>
</tr>
<tr>
<td>3</td>
<td>Junglighat Stretch</td>
<td>30 KPH</td>
<td>Down-town Road</td>
<td>B</td>
</tr>
<tr>
<td>4</td>
<td>VIP Stretch</td>
<td>40 KPH</td>
<td>Arterial Road</td>
<td>B</td>
</tr>
<tr>
<td>5</td>
<td>Light House Stretch</td>
<td>40 KPH</td>
<td>Down-town Road</td>
<td>A</td>
</tr>
<tr>
<td>6</td>
<td>Model School Stretch</td>
<td>30 KPH</td>
<td>Down-town Road</td>
<td>B</td>
</tr>
<tr>
<td>7</td>
<td>Delanipur Stretch</td>
<td>30 KPH</td>
<td>Down-town Road</td>
<td>B</td>
</tr>
<tr>
<td>8</td>
<td>Phoenix bay Stretch</td>
<td>40 KPH</td>
<td>Arterial Road</td>
<td>B</td>
</tr>
</tbody>
</table>
The LOS of all the roads was found to be “B” except Light House Stretch, which was found to be “A” for operating condition according to the HCM. It indicates that all the seven roads with LOS B gives stable flow with an average over all speed drop down to 40 K.P.H.

5.2 Assessment of LOS as per User Perception Survey

The survey was conducted for the selected stretches using a questionnaire using a 5-point scale (5 = “Highly Satisfied” to 0 = “Highly Dissatisfied”) This quantitative study using face-to-face mode helped in arriving at the overall satisfaction level figures with respect to road infrastructure, safety and comfort levels of road users. According the user perception level of service has been classified into six levels, starting from level of service A with a point of 5 in the scale to level of service F with a point of 0 in the scale. The LOS for all the selected roads according to the user perception is given in Table 5.2

<table>
<thead>
<tr>
<th>S.N</th>
<th>Name Of The Stretch</th>
<th>User Perception</th>
<th>Type Of Road</th>
<th>LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Middle Point Stretch</td>
<td>Average</td>
<td>Down-town Road</td>
<td>C</td>
</tr>
<tr>
<td>2</td>
<td>VKV Stretch</td>
<td>Average</td>
<td>Down-town Road</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>Junglighat Stretch</td>
<td>Average</td>
<td>Down-town Road</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>VIP Stretch</td>
<td>Good</td>
<td>Arterial Road</td>
<td>B</td>
</tr>
<tr>
<td>5</td>
<td>Bengali Club Stretch</td>
<td>Average</td>
<td>Down-town Road</td>
<td>C</td>
</tr>
<tr>
<td>6</td>
<td>Model School Stretch</td>
<td>Average</td>
<td>Down-town Road</td>
<td>C</td>
</tr>
<tr>
<td>7</td>
<td>Delanipur Stretch</td>
<td>Average</td>
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<td>C</td>
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<tr>
<td>8</td>
<td>Phoenix Bay Stretch</td>
<td>Average</td>
<td>Arterial Road</td>
<td>C</td>
</tr>
</tbody>
</table>

6. SCOPE OF MASS TRANSPORTATION TO REDUCE THE VOLUME AND IMPROVING LOS

To improve the quality of travel and to safeguard the environment it is required to promote mass transportation and discourage the private transport rider ship. The route with maximum demand for Mass Transport are those which have schools nearby them as the volume terminating from these schools contribute hugely to the overall volume of the roads causing congestion during morning and evening peak hours. The selected eight stretches which were considered for the above study consist of 12 schools. A volume survey was conducted to determine the no. of vehicles which only come to drop or pick the students and the school staff during morning peak hour (7:00 -8:00 am) and evening peak hour (1:15-2:15 pm).

A survey to determine the total volume of all the roads was also conducted. The volume terminating from the schools was deducted from the total volume which shows that, with the introduction of an appropriate mass transportation facility the volume of the roads can be reduced. The deduction was done with an assumption that all the students and the staff are using the mass transport facility.
Traffic Analysis For Major Roads Of Port Blair And Impact Of Mass Transportation

Figure 6.1: Reduction of the total volume by deducting the school traffic during Morning Hours

Figure 6.2: Reduction of the total volume by deducting the school traffic during Evening Hours

Figure 6.3: Percentage Reduction in the total volume of all the roads during Morning peak
7. FORECASTING OF VEHICULAR POPULATION

7.1 Need of Traffic Forecasting

Investment in transport sector constitutes a significant part of the total investment. This is especially true in the case of developing nations, where transport is the catalyst for all-round development and is one of the basic infrastructures. When the capital available is scarce and as competing demands, the investment in the transport project have to be planned carefully keeping the view not only the present demand but also the requirements for a responsible period in future. This underlines the need for estimating the need for estimating the future traffic accurately, whether the plan should be for construction of a new facility or the improvement of existing facilities. To a great extent, the accurate estimate of future traffic will influence the engineering design of the facility and the economic decision whether to take up the project or not.

7.2 Forecasting based on past trends

The simplest method of forecasting is to analyze the past data for a number of year and to extrapolate the past trends assuming that the conditions will continue to change in the future at the same rate as in the past. Obviously such a simplification suffers from many disadvantages, although it is relatively easy and cheap, it is good enough in a stable environment, which is beyond the influence of any major change in production, population and so on. The analyst has to carefully study the past data and lookout for any indicators that are likely to influence the future patterns.

Based on previous data of traffic population the trend line was obtained with projection till the year 2025 and the Polynomial relation was also established with $R^2$ equal to 0.98 which is an optimistic relation giving scope to assess the future trend of traffic growth in Port Blair Roads.
The Gross Domestic Product (GDP) influences the growth of all sector, therefore the vehicular population was linked with the same which is shown in Figure 7.2. The Blue series refers to traffic and red ones refer to GDP trend for future.
Thereafter the relation was obtained, as shown in Figure 7.3, comparing the traffic with GDP which revealed a $R^2$ value of 0.94 which is giving a very accurate relation for forecasting with present trend and growth.

\[
y = 2E-06 x^2 + 0.1547x + 227.84 \\
R^2 = 0.9404
\]

![GDP vs TRAFFIC POPULATION](GDP vs TRAFFIC POPULATION)

Figure 7.3 Graph showing Future traffic population based on GDP

8 Conclusion
The LOS- “B” obtained for Middle Point, VKV, Junglighat, VIP and Model School Stretch reveals that these roads are providing a good facility for the road user. Flow is stable and the user may experience an unreasonable delay with an average speed of 30 Kmph. LOS C for Light House, Delanipur, Phoenix bay Stretch reveals that these roads provide an average facility for the road user. Flow is stable and the user may experience an acceptable delay with an average speed of 25kmph. Introduction of appropriate mass transport facility will reduce the school traffic volume up to 63% in Morning peak and 51% in Evening peak. Thus congestion during peak hours can be relieved. This will enhance Level of service further and also there will be a considerable reduction in the pollution level. Traffic Forecasting of vehicular traffic will help in planning a new facility and also improve the existing facility. Study of future traffic trends can be made possible with the forecasting of future traffic.

8.1 Recommendations
The enforcement of traffic regulation required to be substantiated with relevant filed data. Promotion of mass transport ridership in port Blair and environs is to be given Prime importance. At present bus transport is the only mass transport facility in operation. Model can be built for mode choice and to estimate the probable users of mass transportation. An appropriate mass transportation facility to be introduced in the schools whose traffic majorly contribute to the volume of major roads of the city.

8.2 Acknowledgement
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9. REFERENCES
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10. BIOGRAPHIES

Corresponding author is a Civil Engineer and has done her Post graduation (M.E.) in construction Management & Technology. She is born and brought up in Andaman Islands and did her graduation from Gujarat University in the year 1993 and her Post graduation from NITTTR, Chandigarh with Punjab University. She has been in teaching profession for last 22 years and has been actively guiding both Diploma & Degree (B.Tech) students of Civil Engineering Department of BRAIT, in their Major Projects Her field of interest is Traffic Engineering. The other three authors are her students.