“BEHAVIOUR OF SPEED-FLOW RELATIONSHIP AND CAPACITY ESTIMATION ON SH-41”

Project guide: Prof. Hiren V. Patel

Prepared By,

Shrimali Krunal M.
Sharma Sumit M.
Desai Dipak T.
CONTENT

1.) Introduction

- General
- Traffic Characteristics
- Time-Space Diagram
- Various Mode of Transportation
- Objective
- Scope of study

2.) Literature Review

- Research Paper
3.) Methodology

- General
- Methodology
- Various surveys
- Study area map

4.) Results

- Volume count sheets
- PCU values for vehicle
- Traffic density
- Line chart diagram
- Speed-flow diagram
- Traffic composition

5.) Conclusion

6.) References
Introduction

1.) General

- Highway capacity values and speed-flow relationships used for planning, design and operation of highways, in most of the developed countries.

- Based on Manuals and Codes of practices, which are valid for fairly homogeneous traffic comprising vehicles of more or less uniform static and dynamic characteristics.
Even under nearly homogeneous traffic conditions, it is necessary to convert heavy vehicles such as buses and trucks, which constitute a small proportion of traffic, into equivalent number of a standard type of vehicle (usually passenger cars) to measure the traffic flow using a single unit.

The road traffic in most developing countries such as India comprises vehicles of wide ranging physical dimensions, weight and dynamic characteristics.
2.) Traffic Characteristics

- Composition of traffic
- Speed and travel time
- Traffic volume and rate of flow
- Traffic density
- Spacing and headways.
- Relation between speed-density-volume
3.) The Time-Space Diagram
4.) Various Mode of Transportation

- Marine transportation
- Rail transportation
- Road transportation
- Air transportation
5.) Objectives

- Collection of data for existing condition.

- To study the effect of influencing parameters like gradient, lane width, shoulder width, traffic composition, directional split and pavement surface roughness on capacity of roads under mixed traffic conditions.

- To determine capacity of road using speed-flow relationship.

- To quantify Average Speed, Travel Time, Gap and Headway on SH-41.
6.) **Scope of the study**

- In view of constraints, like computational facilities, time and information resource.
- The study is dedicated to the only SH-41 (Unjha-Mehsana) and determine Capacity of road using speed-flow relationship. Based on which alternatives for improvements can be suggested.
1.) Speed-flow analysis for interrupted over saturated traffic flow with heterogeneous structure for urban roads.

**AUTHOR:** Hemant Kumar Sharma, Mansha Swami, Bajrang Lal Swami  
**PUBLISHED IN:** *International Journal for Traffic and Transport Engineering*, 2012,

* ✓ This paper presents speed-flow curves for urban roads with interrupted-over saturated flow and heterogeneous traffic. The models developed in this paper predict speed, delay, average queue, maximum queue estimates with varying volume, for urban roads.*
2.) Capacity estimation procedure for two-lane roads under mixed traffic conditions.

- **AUTHOR:** Dr. Satish Chandra
- **PUBLISHED IN:** The present research was carried out under an AICTE sponsored research scheme Capacity Analysis of Two-lane Roads under Mixed Traffic Conditions.

✓ The present research was carried out under an AICTE sponsored research scheme Capacity Analysis of Two-lane Roads under Mixed Traffic Conditions. The financial assistance received from AICTE, New Delhi for collection of traffic data for this project is gratefully acknowledged.
3.) Critical evaluation of roadway capacity of multi-lane high speed corridors under heterogeneous traffic conditions through traditional and microscopic simulation models.

- **AUTHOR:** Dr. S. VELMURUGAN, ERRAMPALLI MADHU, K. RAVINDER, K. SITARAMANJANEYULU & S. GANGOPADHYAY
- **PUBLISHED IN:** *Journal of the Indian Roads Congress, October-December 2010*

✓ In this study, free speed profiles and speed – flow equations for different vehicle types for varying types of multi-lane highways has been established for the first time in the country based on traditional and microscopic simulation models and subsequently roadway capacity has been estimated.

- AUTHOR: Ravikiran Puvvala, Balaji Ponnu and Shriniwas S Arkatkar
- PUBLISHED IN: INDIAN HIGHWAYS, April 2013

✓ It has been found from this study that the micro simulation model VISSIM is suitable for simulating and hence studying heterogeneous traffic flow in expressways with statistical significance.
5.) Determination of Dynamic PCUs of Different Types of Passenger Vehicles on Urban Roads: A Case Study, Delhi Urban Area

- **AUTHOR:** Probhat Kr. Paul and P.K Sarkar
- **PUBLISHED IN:** *INDIAN HIGHWAYS, April 2013*

- Detailed study related to behavior of PCU.
- The PCU value of cycle also decreases with decrease in speed.
- The PCU value of 3-wheeler also decreases with decrease in speed.
Methodology

1.) General

- In this study speed-Flow Relationship is used to find out Congestion effect of parking and pedestrians. For getting the speed-Flow relationship, the space mean speed of the traffic stream is considered. After the collection of data, the volume is converted into PCU.

- Capacity of SH-41 is quantified by developing speed-Flow relationship. Based on which alternatives for improvements can be suggested.
2.) Various surveys

- Traffic volume count
- O-D survey
- Speed survey
3.) Methodology

- Review of study reports by Indian and foreign researchers.
- Conduct of surveys.
- Collection and analysis of data.
- Develop speed-Flow relationship.
- Comparison of Capacity of SH-41 with IRC.
Objective

Data Collection

Analysis of Data

Develop Speed-Flow relationship

Improvement

Conclusion

• Collection of data for existing Condition.
• Traffic Volume Count.
• Travel Time, Speed, Gap and Headway Study

Flow Chart of Methodology
Study Area
<table>
<thead>
<tr>
<th>Time</th>
<th>2w</th>
<th>3w</th>
<th>4w</th>
<th>Bus</th>
<th>Trailor</th>
<th>Total vehical/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:00 to 10:00</td>
<td>186</td>
<td>47</td>
<td>403</td>
<td>14</td>
<td>107</td>
<td>757</td>
</tr>
<tr>
<td>10:00 to 11:00</td>
<td>200</td>
<td>58</td>
<td>428</td>
<td>18</td>
<td>119</td>
<td>823</td>
</tr>
<tr>
<td>11:00 to 12:00</td>
<td>223</td>
<td>73</td>
<td>434</td>
<td>23</td>
<td>133</td>
<td>886</td>
</tr>
<tr>
<td>12:00 to 01:00</td>
<td>237</td>
<td>88</td>
<td>451</td>
<td>39</td>
<td>157</td>
<td>972</td>
</tr>
<tr>
<td>01:00 to 02:00</td>
<td>224</td>
<td>77</td>
<td>437</td>
<td>28</td>
<td>132</td>
<td>898</td>
</tr>
<tr>
<td>02:00 to 03:00</td>
<td>202</td>
<td>57</td>
<td>422</td>
<td>16</td>
<td>114</td>
<td>811</td>
</tr>
<tr>
<td>03:00 to 04:00</td>
<td>213</td>
<td>70</td>
<td>433</td>
<td>25</td>
<td>127</td>
<td>868</td>
</tr>
<tr>
<td>04:00 to 05:00</td>
<td>227</td>
<td>76</td>
<td>449</td>
<td>38</td>
<td>146</td>
<td>936</td>
</tr>
<tr>
<td>05:00 to 06:00</td>
<td>234</td>
<td>81</td>
<td>453</td>
<td>41</td>
<td>152</td>
<td>961</td>
</tr>
<tr>
<td>06:00 to 07:00</td>
<td>240</td>
<td>86</td>
<td>459</td>
<td>44</td>
<td>156</td>
<td>985</td>
</tr>
<tr>
<td>07:00 to 08:00</td>
<td>2186</td>
<td>713</td>
<td>4369</td>
<td>286</td>
<td>1343</td>
<td>8897</td>
</tr>
<tr>
<td>Time</td>
<td>2w</td>
<td>3w</td>
<td>4w</td>
<td>Bus</td>
<td>Trailor</td>
<td>Total vehical/hr</td>
</tr>
<tr>
<td>------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>---------</td>
<td>------------------</td>
</tr>
<tr>
<td>09:00 to 10:00</td>
<td>161</td>
<td>41</td>
<td>320</td>
<td>19</td>
<td>138</td>
<td>679</td>
</tr>
<tr>
<td>10:00 to 11:00</td>
<td>176</td>
<td>48</td>
<td>364</td>
<td>23</td>
<td>150</td>
<td>761</td>
</tr>
<tr>
<td>11:00 to 12:00</td>
<td>192</td>
<td>63</td>
<td>388</td>
<td>26</td>
<td>162</td>
<td>831</td>
</tr>
<tr>
<td>12:00 to 01:00</td>
<td>189</td>
<td>59</td>
<td>369</td>
<td>21</td>
<td>147</td>
<td>785</td>
</tr>
<tr>
<td>01:00 to 02:00</td>
<td>171</td>
<td>47</td>
<td>351</td>
<td>18</td>
<td>136</td>
<td>723</td>
</tr>
<tr>
<td>02:00 to 03:00</td>
<td>152</td>
<td>39</td>
<td>327</td>
<td>15</td>
<td>122</td>
<td>655</td>
</tr>
<tr>
<td>03:00 to 04:00</td>
<td>159</td>
<td>41</td>
<td>340</td>
<td>19</td>
<td>137</td>
<td>696</td>
</tr>
<tr>
<td>04:00 to 05:00</td>
<td>171</td>
<td>52</td>
<td>357</td>
<td>22</td>
<td>144</td>
<td>746</td>
</tr>
<tr>
<td>05:00 to 06:00</td>
<td>184</td>
<td>59</td>
<td>363</td>
<td>26</td>
<td>147</td>
<td>779</td>
</tr>
<tr>
<td>06:00 to 07:00</td>
<td>190</td>
<td>67</td>
<td>373</td>
<td>30</td>
<td>152</td>
<td>812</td>
</tr>
<tr>
<td></td>
<td>1745</td>
<td>516</td>
<td>3552</td>
<td>219</td>
<td>1435</td>
<td>7467</td>
</tr>
</tbody>
</table>
## Volume and Traffic composition

<table>
<thead>
<tr>
<th>Name of vehicle</th>
<th>Average Number of vehicle (hour)</th>
<th>PCU for vehicle</th>
<th>Total PCU</th>
<th>Average speed(km/h)</th>
<th>Density(K) (volume)</th>
<th>Traffic Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 wheeler</td>
<td>219</td>
<td>0.5</td>
<td>109.5</td>
<td>53</td>
<td>2.066</td>
<td>24.55%</td>
</tr>
<tr>
<td>3 wheeler</td>
<td>72</td>
<td>1</td>
<td>72</td>
<td>42</td>
<td>1.714</td>
<td>8.07%</td>
</tr>
<tr>
<td>4 wheeler</td>
<td>437</td>
<td>1</td>
<td>437</td>
<td>97</td>
<td>4.876</td>
<td>48.99%</td>
</tr>
<tr>
<td>Bus</td>
<td>29</td>
<td>3</td>
<td>87</td>
<td>72</td>
<td>1.028</td>
<td>3.25%</td>
</tr>
<tr>
<td>Trailor</td>
<td>135</td>
<td>3</td>
<td>405</td>
<td>40</td>
<td>10.125</td>
<td>15.13%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>892</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## PCU Value for vehicle

<table>
<thead>
<tr>
<th>No.</th>
<th>2w</th>
<th>3w</th>
<th>4w</th>
<th>Bus</th>
<th>Trailer</th>
<th>Total pcu/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>93</td>
<td>47</td>
<td>403</td>
<td>42</td>
<td>321</td>
<td>906</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>58</td>
<td>428</td>
<td>54</td>
<td>357</td>
<td>997</td>
</tr>
<tr>
<td>3</td>
<td>111.5</td>
<td>73</td>
<td>434</td>
<td>69</td>
<td>399</td>
<td>1086.5</td>
</tr>
<tr>
<td>4</td>
<td>118.5</td>
<td>88</td>
<td>451</td>
<td>117</td>
<td>471</td>
<td>1245.5</td>
</tr>
<tr>
<td>5</td>
<td>112</td>
<td>77</td>
<td>437</td>
<td>84</td>
<td>396</td>
<td>1106</td>
</tr>
<tr>
<td>6</td>
<td>101</td>
<td>57</td>
<td>422</td>
<td>48</td>
<td>342</td>
<td>970</td>
</tr>
<tr>
<td>7</td>
<td>106.5</td>
<td>70</td>
<td>433</td>
<td>75</td>
<td>381</td>
<td>1065.5</td>
</tr>
<tr>
<td>8</td>
<td>113.5</td>
<td>76</td>
<td>449</td>
<td>114</td>
<td>438</td>
<td>1190.5</td>
</tr>
<tr>
<td>9</td>
<td>117</td>
<td>81</td>
<td>453</td>
<td>123</td>
<td>456</td>
<td>1230</td>
</tr>
<tr>
<td>10</td>
<td>120</td>
<td>86</td>
<td>459</td>
<td>132</td>
<td>468</td>
<td>1265</td>
</tr>
<tr>
<td>Total</td>
<td>1093</td>
<td>713</td>
<td>4369</td>
<td>858</td>
<td>4029</td>
<td>11062</td>
</tr>
</tbody>
</table>
Time vs. Volume (In Peak hour)
Time vs. Volume (In Peak hour)
Conclusion

- Based on detail studies and analysis carried out on section of four lane two way divided road (Study area) of Unjha-Mehsana SH-41, following conclusions are drawn.

  - Capacity of SH-41 as per IRC is 1400 PCU/hr, but as capacity of studied road were reduced due to traffic congestion.
  - Capacity of studied street as per Unjha-Mehsana link road is 1170 PCU/hr and study conducted Mehsana-Unjha link road is 1230 PCU/hr.
  - Capacity reduction as compared to standard capacity was quantified and found to be 16% for Unjha-Mehsana link road and 17% for Mehsana-Unjha link road.
  - The presence of SH-41 makes the traffic system a complex one. This survey shows the PCU/ hr is 1200.
  - During morning and evening peaks, the capacity of road exceeds its limits and congestion occurs.
  - L.O.S of C and D was observed under prevailing condition which could be improved to B by designing proper geometric design and taking regulatory enforcement measures.
References

• IRC sp30 (2010), manual on economic evaluation of highway projects in india, Indian roads congress.
• Highway capacity manual (2000)
• Journal of the Indian roads congress, October-December 2010
• CRRI, capacity of roads in urban areas 1988 New Delhi
• Publishers, New Delhi.

• Website
• Derivation of capacity estimates for urban expressway using computer simulation. (Ravikiran puvvala, balaji ponnu and shriniwas S arkatkar)

• Reliability of freeway traffic flow: a stochastic concept of capacity. (Werner brilon, justin geistefeldt, matthias regler)

• Study of the effect of traffic volume and road width on pcu value of vehicles using microscopic simulation. (V. Thamizh arasan, k. Krishnamurthy)

• Speed-flow analysis for interrupted oversaturated traffic flow with heterogeneous structure for urban roads (hemant kumar sharma, mansha swami, bajranglal swami)

• Simulation of heterogeneous traffic to derive capacity and service volume standards for urban roads.(Dr. V. Thamizh arasan, reebu zachariah koshy)
The object of education is to prepare the young to educate themselves throughout their lives.

Thank You