A Study on Bicycle Flow in Mixed Traffic – Indian Study

SESSION: PLANNING BASED ON STUDIES
THEME: URBAN PLANNING

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Orientation of Presentation

Present Scenario
Guidelines
Government Initiatives
Bicycle flow analysis
Innovative practices
Present Scenario

Statistics show that the share of bicycle trips out of the total trips in Delhi has declined from 17% in 1981 to 7% in 1994. The longer trip lengths have made cycling more difficult.

Nearly 45% households, i.e., about 111 million households in India owned bicycles in 2011 (GoI 2011)

Growth in number of households owning cars, two-wheelers and cycles between 2001 and 2011
Notes: R—Rural; U—Urban

Figure 1.1: Percentage share of households owning cycles (2001–2011)
Present Scenario

Sri Lanka May 2017

Figure 2.3: Number of cyclists’ deaths in road accidents
Source: MoRTH (Various years), NCRB (Various years)
Note: MoRTH data on cyclists’ deaths in road accidents was not available before 2009.
Issues Identified

Safety
- Equipment
- Personal
- Along route/path

Encroachments

Continuity and connectivity

Adequacy of facility size
## Modal shares - MOUD 2008

1 Lakh = 0.10 million

<table>
<thead>
<tr>
<th>City Category</th>
<th>Population</th>
<th>Walk</th>
<th>Cycle</th>
<th>Two wheeler</th>
<th>Public Transport</th>
<th>Car</th>
<th>IPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1a</td>
<td>&lt;5 lakhs with plain terrain</td>
<td>34</td>
<td>3</td>
<td>26</td>
<td>5</td>
<td>27</td>
<td>5</td>
</tr>
<tr>
<td>Category 1b</td>
<td>&lt;5 lakhs with hilly terrain</td>
<td>57</td>
<td>1</td>
<td>6</td>
<td>8</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td>Category 2</td>
<td>5-10 lakhs</td>
<td>32</td>
<td>20</td>
<td>24</td>
<td>9</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Category 3</td>
<td>10-20 lakhs</td>
<td>24</td>
<td>19</td>
<td>24</td>
<td>13</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Category 4</td>
<td>20-40 lakhs</td>
<td>25</td>
<td>18</td>
<td>29</td>
<td>10</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Category 5</td>
<td>40-80 lakhs</td>
<td>25</td>
<td>11</td>
<td>26</td>
<td>21</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Category 6</td>
<td>&gt;80 lakhs</td>
<td>22</td>
<td>8</td>
<td>9</td>
<td>44</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>National</td>
<td></td>
<td>28</td>
<td>11</td>
<td>16</td>
<td>27</td>
<td>13</td>
<td>6</td>
</tr>
</tbody>
</table>
Guidelines Available

Indian Roads Congress code IRC:11-1962 “Recommended Practice for The Design and Layout of Cycle Tracks”

Def.: A way or a part of a roadway designed and constructed for the use of pedal bicycles, and over which a right-of-way exists.

Warrant for separate cycle track:
- Peak hour cycle traffic $\geq 400$ and motor vehicles 100 – 200/hr
- OR motor vehicles > 200 /hr and cycles 100/hr

Capacity values for 2, 3 and 4-lane with one-way and two-way traffic

Tracks – Parallel (adjoining/raised/free) or Independent

Geometrics – Lane width 1 m and track width 2 m (minimum)
Government Initiative(s)

National Urban Transport Policy - Vision

“Encourage greater use of public transport and nonmotorized modes by offering Central financial assistance for this purpose”

“Bringing about a more equitable allocation of road space with people, rather than vehicles, as its main focus”

Implementation -

The Central Government would also take up pilot projects, in a sample set of cities, to demonstrate the improvements that are possible through the enhanced used of cycling, for possible replication in other cities.
Government Initiative(s)

Cycle path network proposed in Lucknow, Uttar Pradesh State in India for a length of 270 km.

Noida and Greater Noida, Uttar Pradesh State having 65 km of bicycle network, increasing to 100 km, but very few users

207 km long cycle highway along Lucknow – Agra expressway
Government Initiative(s)

Department of Tourism, Govt. of Uttarakhand in association with Cycling Federation of India organized the 3rd edition of The Ultimate Uttarakhand Himalayan MTB Challenge, a premier mountain biking cycling event, from 8th to 16th April 2017 (884 km)
Case Study – Roorkee City, Uttarakhand, India

BICYCLE FLOW IN MIXED TRAFFIC CONDITION
Roorkee City
Roorkee City

NH section – Least Friction

New Urban section – Moderate Friction

Old City section – Highest Friction
### NMT Flows – Bicycle and Total

<table>
<thead>
<tr>
<th>Location – Direction of traffic</th>
<th>Proportion of</th>
<th>Proportion of</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bicycles</td>
<td>Non-motorized traffic</td>
</tr>
<tr>
<td>1 – Down</td>
<td>43.31</td>
<td>47.12</td>
</tr>
<tr>
<td>1 – Up</td>
<td>16.15</td>
<td>18.23</td>
</tr>
<tr>
<td>2 – Down</td>
<td>15.11</td>
<td>16.93</td>
</tr>
<tr>
<td>2 – Up</td>
<td>17.73</td>
<td>19.58</td>
</tr>
<tr>
<td>3 – Down</td>
<td>59.14</td>
<td>68.10</td>
</tr>
<tr>
<td>3 – Up</td>
<td>28.23</td>
<td>40.76</td>
</tr>
<tr>
<td>4 – Down</td>
<td>53.31</td>
<td>72.45</td>
</tr>
<tr>
<td>4 – Up</td>
<td>33.63</td>
<td>43.65</td>
</tr>
<tr>
<td>5 – Down</td>
<td>12.89</td>
<td>15.37</td>
</tr>
<tr>
<td>5 – Up</td>
<td>10.56</td>
<td>27.90</td>
</tr>
<tr>
<td>6 – Up</td>
<td>37.84</td>
<td>51.04</td>
</tr>
<tr>
<td>7 – Down</td>
<td>12.11</td>
<td>16.49</td>
</tr>
<tr>
<td>7 – Up</td>
<td>11.92</td>
<td>25.03</td>
</tr>
<tr>
<td>8 – Down</td>
<td>20.73</td>
<td>33.06</td>
</tr>
<tr>
<td>8 – Up</td>
<td>21.19</td>
<td>28.31</td>
</tr>
<tr>
<td>9 – Up</td>
<td>30.31</td>
<td>37.44</td>
</tr>
<tr>
<td>9 – Down</td>
<td>32.13</td>
<td>42.82</td>
</tr>
<tr>
<td>10 – Up</td>
<td>36.82</td>
<td>45.93</td>
</tr>
<tr>
<td>10 – Down</td>
<td>38.41</td>
<td>48.39</td>
</tr>
</tbody>
</table>
Temporal Variations in Flow
Temporal Variations in Flow

![Graph showing temporal variations in flow]

- **Cycle flow**
- **Cycle rickshaw flow**
- **NMVs flow**

Flow (pcu/hr) vs. Time (min.)
### Speed Variations across Locations (km/h)

<table>
<thead>
<tr>
<th>Speed Data</th>
<th>Location S1</th>
<th>Location S2</th>
<th>Location S3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>31</td>
<td>92</td>
<td>60</td>
</tr>
<tr>
<td>Maximum</td>
<td>19.87</td>
<td>14.71</td>
<td>10.2</td>
</tr>
<tr>
<td>Minimum</td>
<td>14.07</td>
<td>9.6</td>
<td>5.24</td>
</tr>
<tr>
<td>Range</td>
<td>5.79</td>
<td>5.11</td>
<td>4.96</td>
</tr>
<tr>
<td>Mean</td>
<td>16.79</td>
<td>12.59</td>
<td>8.88</td>
</tr>
<tr>
<td>Variance</td>
<td>1.77</td>
<td>.99</td>
<td>1.26</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>1.33</td>
<td>.99</td>
<td>1.12</td>
</tr>
</tbody>
</table>
Speed Prediction Models

Mean speed v/s proportion of traffic

\[ S_{AVE} = 1837.42 - 18.239PNMT - 18.232PMT \]

Where, \( S_{AVE} \) = Mean Speed of bicycle (kmph)

- PNMT = Proportion of Non-motorized traffic (%)
- PMT = Proportion of Motorized traffic (%)
Speed Prediction Models

Mean speed v/s volume of motorized traffic

\[ S_{AVE} = 15.18 - 0.0030VMT \]

Where, VMT = Volume of Motorized vehicles (pcu/h)

Mean speed v/s categorised traffic volume

\[ S_{AVE} = 16.61 - 0.0033VMT - 0.0066VNMT \]

Where, VNMT = Volume of Non-motorized vehicles (pcu/h)
Speed v/s Flow Variations

![Graph showing the relationship between cycle speed and total flow in pcu/hr. The x-axis represents total flow ranging from 1300 to 2300 pcu/hr, while the y-axis represents cycle speed ranging from 6 to 21 km/hr. The data points are scattered across the graph, indicating variations in speed with different flows.](image-url)
Lateral Placements

% PERCENTAGE NMVs

UNIT METER SECTION FROM LEFT TO RIGHT

NMVs MOVE FROM LEFT SIDE OF ROAD

NMVs MOVE FROM RIGHT SIDE OF ROAD

NMVs MOVE FROM LEFT SIDE OF ROAD
Speed Impacted due to Mix

![Graph showing the impact of speed on flow](image)

- MVs
- NMVs

SPEED (km/h) vs TOTAL FLOW (pcu/h) for MVs and NMVs.
Speed Impacted due to Mix

- **SPEED (km/h)**
  - **TOTAL FLOW (Pcu/h)**
  
- **MVs**
- **NMVs**

- **Test Location (in order of higher friction)**
  - Location 1
  - Location 2
  - Location 3
Innovative Practices

“Cycle Chalao!” was a private initiative for a cycle sharing scheme started in Pune in 2010

“Green Bike” was another initiative planned by the Delhi Integrated Multi-Modal Transit System (DIMTS) Limited

MyBike – Bike share programme in Ahmedabad

Raahgiri Day, India's first sustained car-free event, launched about two years ago in the city of Gurgaon
Questions Remained Un-answered

How to arrive at Design Flow Value, when flow characteristic relationships are non-conclusive?

Are warrants specified in guidelines not influenced by temporal and spatial variations?

What shall be the hierarchy for bicycle facilities and how to plan/decide for the same?

Does one attach Level-of-Service to facilities designed and constructed?