COST EFFECTIVE MEASURES TO IMPROVE TRAFFIC MANAGEMENT IN THE JA-ELA TOWN AREA

K. P. J. G. Perera

This thesis was submitted to the Department of Civil Engineering University of Moratuwa in partial fulfillment of the requirement for the Degree of Master of Engineering

Supervised By
Professor Amal S. Kumarage

Department of Civil Engineering
University of Moratuwa
Sri Lanka

January 2006
DECLARATION

The work included in this Thesis is part or whole, has not been submitted for any other academic qualification at any institution

K P J G Perera

Professor Amal S.Kumarage
ABSTRACT

Vehicular transportation activities dominate the movement of passengers as well as freight in Sri Lanka. Road network improvements take place all over the country under development projects. Enormous funds have been allocated for improving roads in order to facilitate the increasing number of vehicles. In order to establish an efficient transport system traffic management measures should be improved in line with the current development programs in the country. Serious thought should be given to such measures where a higher contribution to economic development falls in line with road transportation.

The Ja-ela town is located on A3 road within the Western Province and a part of the northern bound traffic is routed through this town. Economically important places of the country are served by the A3 road and reducing delays on this major arterial road is essential. In drafting methodologies to achieve the said perspective urban cities within the A3 road corridor should be given priority. The objective of this research was to find “Cost effective measures to improve traffic management in the Ja-ela town area”.

Present activities around the town area were broadly considered in drafting development scenarios for traffic improvement. Different modes of transport were considered and survey data were collected for necessary analysis. In addition, pedestrian movements, private vehicular parking and road improvements were identified as essential elements in developing methodical strategies for the new development. Bus transportation was given special consideration in developing these schedules and reducing waiting times. The private bus operating system needs a few changes in route 187 to operate in a more efficient manner. The possibility of extending this particular route to the Tudella junction is one of the major findings of the research. The
owners and users of private buses would yield the benefits of the proposal.

To improve the above areas of influence new construction proposals have been brought forward. These proposals are recommended to be implemented in two stages to reduce the burden on administrative authorities in budgetary allocations. Stage construction will be encouraged by the society due to minimum interruptions to main road traffic. Supportive approach should be needed from different administrative authorities in implementing the proposed development plans.

Cost and benefits over the project life have been considered in the economic evaluation. It is evident from this economic evaluation that the proposed new development plans to improve delays on A3 road enhance benefits to the society. All economic indicators are in favor of the new proposal. Similar studies in other urban areas should be done to find out the possibilities of developing similar scenarios in contributing to the improvement of traffic management measures in the National Road Network.
ACKNOWLEDGEMENT

I wish to extend my heartfelt gratitude to my supervisor, Professor Amal S. Kumarage, for his constant guidance and encouragement given to me throughout the study without whose invaluable commitment and dedication this study may not have been a reality. The valuable suggestions made by Professor J. M. S. Bandara are also worthy of my gratitude. Despite their busy schedules both professors have given me invaluable technical thoughts in completing this study. Special thanks to Lecturer Mr. M.B.S.Fernado, Chairman, Road Development Authority, for the words of encouragement and inculcating the desire in me to complete the study.

Special thanks are also offered to the Head of the Department of Civil Engineering in conducting a Post Graduate course in Highway & Traffic and selecting me to follow this valuable course in year 2003. I also take this as an opportunity to thank my employer Resources Development Consultants Ltd, for releasing me from normal duties on Fridays to follow this Post Graduate program.

I would also extend my thanks to the Traffic Laboratory Staff, Department of Civil Engineering, for extending their support to me during this research. Also I express my gratitude to Mrs Indira J. Mawelle in assessing the text of the thesis. The assistance provided by my friends Kithsiri, Roshan and Malani is commendable.

Finally, I thank my beloved wife Deepika and my two sons for their moral support and tolerance that shone with so many sacrifices made throughout the long period of the two years of my Post Graduate Program and in the preparation of this thesis.
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>i</td>
</tr>
<tr>
<td>Acknowledgment</td>
<td>iii</td>
</tr>
<tr>
<td>Contents</td>
<td>iv</td>
</tr>
<tr>
<td>List of Figures</td>
<td>ix</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xi</td>
</tr>
<tr>
<td>List of Abbreviations</td>
<td>xiii</td>
</tr>
</tbody>
</table>

## Chapter I

1.0 INTRODUCTION

## Chapter II

2.0 PRESENT SITUATION OF ROAD SYSTEM

2.1 Description

2.2 Present Road Network

2.2.1 Major Arterial Road

2.2.2 Minor Arterial Road

2.2.3 Feeder Roads

2.2.4 Road Links to Public Bus Terminal

2.2.5 Church Road

2.3 Summary

## Chapter III

3.0 IDENTIFICATION OF NECESSARY IMPROVEMENTS

3.1 Selection of Area

3.2 Key Areas of Improvements
Chapter IV

4.0 METHODOLOGY AND DATA COLLECTION 14
   4.1 Methodology 14
   4.2 Data Collection 15

Chapter V

5.0 DEVELOPMENT IN PEDESTRAIN FACILITIES 17
   5.1 Methodology Adopted for Pedestrian 17
   5.2 Data Collection on Pedestrian Movement 18
   5.3 Results of Pedestrian Crossing Data Analysis 19
      5.3.1 Crossing at the Urban Council Building 19
      5.3.2 Crossing in front of the Market Building 20
      5.3.3 Crossing near the Bridge 21
      5.3.4 Crossing in front of the People's Bank Building 22
   5.4 Summary 23

Chapter VI

6.0 DEVELOPMENT IN THREE WHEELER CIRCULATION 25
   6.1 Methodology Adopted for Three Wheelers 25
   6.2 Coding System for Trip Origin 28
   6.3 Coding System for Trip Destination 28
   6.4 Data Collection from Three Wheelers 30
   6.5 Three Wheeler Data Analysis 31
   6.6 Origin and Destination Matrix for Three-wheelers 32
   6.7 Results of Three Wheeler Data Analysis 34
      6.7.1 Location A 34
      6.7.2 Location B 35
      6.7.3 Location C 36
      6.7.4 Location D 38
      6.7.5 Location E 39
      6.7.6 Location F 41
      6.7.7 Location G 42
6.7.8 Origin and Destination for all Three Wheelers

6.8 Summary

Chapter VII

7.0 DEVELOPMENT IN BUS TRANSPORTATION FACILITY
- 7.1 Methodology Adopted for Buses
- 7.2 Objectives of Bus Transportation
- 7.3 Data Collection on Buses
- 7.4 Data Analysis on Bus Transportation
- 7.5 Departure and Arrival Statistics
  - 7.5.1 Departure on Route 187
  - 7.5.2 Load Factors on Route 187 Buses
  - 7.5.3 Departure on All Other Routes
  - 7.5.4 Arrivals on All Routes
  - 7.5.5 Load Factors on All Routes (Except #187)
- 7.6 Summary

Chapter VIII

8.0 INTERSECTION IMPROVEMENT
- 8.1 Methodology
- 8.2 Data Collection
- 8.3 Data Analysis of Police Station Intersection
- 8.4 Data Analysis of Urban Council Intersection
- 8.5 Summary

Chapter IX

9.0 BRIDGE WIDENING
- 9.1 Methodology
- 9.2 Travel Time Survey
- 9.3 Data Analysis on Travel Time Survey
- 9.4 Summary
Chapter X

10.0 DEVELOPMENT IN PARKING FACILITIES 71
  10.1 Methodology Adopted for Vehicular Parks 71
  10.2 Data Collection on Parking Facilities 72
  10.3 Data Analysis on Parking 72
  10.4 Summary 74

Chapter XI

11.0 DEVELOPMENT IN TRAFFIC MANAGEMENT 76
  11.1 Methodology Adopted for Traffic Management 76
  11.2 Church Road Intersection 76
  11.3 Traffic Management System within the Town 77
  11.4 Summary 79

Chapter XII

12.0 NEW DEVELOPMENT 80
  12.1 Proposed New Underpass 80
  12.2 Bridge Widening 83
  12.3 Route 187 Buses Extending up to Tudella Junction 83
  12.4 Other Necessary Improvements 86
  12.5 Summary 87

Chapter XIII

13.0 COST AND BENEFIT CALCULATION 88
  13.1 Travel Time Saving 88
    13.1.1 Passenger Travel Time Saving 88
    13.1.2 Freight Travel Time Saving 91
  13.2 Fuel Cost Saving 94
  13.3 Pollutant Cost Saving 97
  13.4 Accident Cost Saving 100
  13.5 Summary 102
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure No.</th>
<th>Description</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Present Congestion level on A3 Road</td>
<td>3</td>
</tr>
<tr>
<td>2.1</td>
<td>Schematic Diagram of Ja-ela Town Area</td>
<td>6</td>
</tr>
<tr>
<td>2.2</td>
<td>Congestion near Bank of Ceylon Building</td>
<td>7</td>
</tr>
<tr>
<td>2.3</td>
<td>Roads within the Town Area</td>
<td>10</td>
</tr>
<tr>
<td>5.1</td>
<td>Pedestrian Movement at UC Intersection</td>
<td>19</td>
</tr>
<tr>
<td>5.2</td>
<td>Pedestrian Movement in front of Market</td>
<td>20</td>
</tr>
<tr>
<td>5.3</td>
<td>Pedestrian Movement Near the Bridge</td>
<td>21</td>
</tr>
<tr>
<td>5.4</td>
<td>Pedestrian Movement in front of People’s Bank</td>
<td>22</td>
</tr>
<tr>
<td>6.1</td>
<td>Number of Accidents in Sri Lanka</td>
<td>25</td>
</tr>
<tr>
<td>6.2</td>
<td>Three-wheeler Locations and Destination Coding</td>
<td>27</td>
</tr>
<tr>
<td>6.3</td>
<td>Number of Three Wheeler Trips from Location A</td>
<td>34</td>
</tr>
<tr>
<td>6.4</td>
<td>Number of Three Wheeler Trips from Location B</td>
<td>35</td>
</tr>
<tr>
<td>6.5</td>
<td>Number of Three Wheeler Trips from Location C</td>
<td>36</td>
</tr>
<tr>
<td>6.6</td>
<td>Number of Three Wheeler Trips from Location D</td>
<td>38</td>
</tr>
<tr>
<td>6.7</td>
<td>Number of Three Wheeler Trips from Location E</td>
<td>39</td>
</tr>
<tr>
<td>6.8</td>
<td>Number of Three Wheeler Trips from Location F</td>
<td>41</td>
</tr>
<tr>
<td>6.9</td>
<td>Number of Three Wheeler Trips from Location G</td>
<td>42</td>
</tr>
<tr>
<td>6.10</td>
<td>Origin and Destination for all Three Wheelers</td>
<td>43</td>
</tr>
<tr>
<td>7.1</td>
<td>Bus Terminal Facilities</td>
<td>45</td>
</tr>
<tr>
<td>7.2</td>
<td>Number of Passengers in Route 187 Private Buses</td>
<td>49</td>
</tr>
<tr>
<td>7.3</td>
<td>Number of Private Buses in Route 187</td>
<td>49</td>
</tr>
<tr>
<td>Figure No.</td>
<td>Description</td>
<td>Page No</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>7.4</td>
<td>Load Factor in Route 187 Private Buses</td>
<td>50</td>
</tr>
<tr>
<td>7.5</td>
<td>Load Factor Variation in Route 187 Private Buses</td>
<td>51</td>
</tr>
<tr>
<td>7.6</td>
<td>Passenger Distributions in All Routes (Except 187)</td>
<td>52</td>
</tr>
<tr>
<td>7.7</td>
<td>Trip Distributions in All Routes (Except #187)</td>
<td>52</td>
</tr>
<tr>
<td>7.8</td>
<td>Passenger Arrivals in All Routes</td>
<td>53</td>
</tr>
<tr>
<td>7.9</td>
<td>Number of Bus Arrivals in All Routes</td>
<td>54</td>
</tr>
<tr>
<td>7.10</td>
<td>Load Factor on All Routes (Except #187)</td>
<td>55</td>
</tr>
<tr>
<td>7.11</td>
<td>Load Factor Variation in All Routes (Except #187)</td>
<td>55</td>
</tr>
<tr>
<td>8.1</td>
<td>Intersection in front of Police Station</td>
<td>59</td>
</tr>
<tr>
<td>8.2</td>
<td>Intersection in front of Urban Council Building</td>
<td>61</td>
</tr>
<tr>
<td>9.1</td>
<td>Ja-ela Bridge section on A3 Road</td>
<td>64</td>
</tr>
<tr>
<td>9.2</td>
<td>Speed Variation to Colombo Direction</td>
<td>69</td>
</tr>
<tr>
<td>9.3</td>
<td>Speed Variation to Negombo Direction</td>
<td>69</td>
</tr>
<tr>
<td>10.1</td>
<td>Vehicle Parking in Ja-ela Town Area</td>
<td>72</td>
</tr>
<tr>
<td>10.2</td>
<td>Parking Facilities in Ja-ela Town Area</td>
<td>74</td>
</tr>
<tr>
<td>11.1</td>
<td>New Traffic Management Measures in Ja-ela</td>
<td>78</td>
</tr>
<tr>
<td>12.1</td>
<td>Underpass is not usable during rainy season</td>
<td>81</td>
</tr>
<tr>
<td>12.2</td>
<td>Projected Pedestrian Volumes for New Underpass</td>
<td>82</td>
</tr>
<tr>
<td>12.3</td>
<td>Improvements in Pedestrian Facilities</td>
<td>83</td>
</tr>
<tr>
<td>12.4</td>
<td>Waiting Time of Route 187 Buses</td>
<td>84</td>
</tr>
<tr>
<td>12.5</td>
<td>Road side Parking of Route 187 Buses</td>
<td>84</td>
</tr>
<tr>
<td>12.6</td>
<td>Road side Parking at Tudella Junction</td>
<td>85</td>
</tr>
<tr>
<td>12.7</td>
<td>Proposed Improvements in Roads</td>
<td>86</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table No.</th>
<th>Description</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Survey Schedule in Ja-ela</td>
<td>16</td>
</tr>
<tr>
<td>6.1</td>
<td>Three Wheeler Park Location and Coding System</td>
<td>28</td>
</tr>
<tr>
<td>6.2</td>
<td>Three Wheeler Trip Destination and Coding System</td>
<td>28</td>
</tr>
<tr>
<td>6.3</td>
<td>Orgin-Destination Trip Matrix for Three-wheelers</td>
<td>33</td>
</tr>
<tr>
<td>7.1</td>
<td>Passenger loading Level</td>
<td>48</td>
</tr>
<tr>
<td>7.2</td>
<td>Route number and Destination</td>
<td>48</td>
</tr>
<tr>
<td>8.1</td>
<td>Signal Time data Police Station Intersection</td>
<td>60</td>
</tr>
<tr>
<td>8.2</td>
<td>Signal Time data UC Building Intersection</td>
<td>62</td>
</tr>
<tr>
<td>9.1</td>
<td>Travel Time Data</td>
<td>66</td>
</tr>
<tr>
<td>9.2</td>
<td>Travel Time Data in Subsections</td>
<td>67</td>
</tr>
<tr>
<td>13.1</td>
<td>Vehicle Classification at Police Station Intersection</td>
<td>89</td>
</tr>
<tr>
<td>13.2</td>
<td>VOT savings for passengers on A3 road in Colombo direction at Police Station Intersection</td>
<td>89</td>
</tr>
<tr>
<td>13.3</td>
<td>Total VOT at the Police Station Intersection</td>
<td>90</td>
</tr>
<tr>
<td>13.4</td>
<td>Distribution of Commodities in Road Transport</td>
<td>92</td>
</tr>
<tr>
<td>13.5</td>
<td>Colombo direction Freight Transport Savings on A3 road</td>
<td>93</td>
</tr>
<tr>
<td>13.6</td>
<td>Freight Transport Saving at Police Station Intersection</td>
<td>94</td>
</tr>
<tr>
<td>13.7</td>
<td>Parameters for fuel saving cost analysis</td>
<td>96</td>
</tr>
<tr>
<td>13.8</td>
<td>Fuel Savings cost on A3 road for Colombo bound traffic</td>
<td>96</td>
</tr>
<tr>
<td>Table No.</td>
<td>Description</td>
<td>Page No</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>13.9</td>
<td>Fuel saving Cost for All Direction</td>
<td>97</td>
</tr>
<tr>
<td>13.10</td>
<td>Calculations of Emission Cost Savings for Colombo bound traffic on A3 road</td>
<td>99</td>
</tr>
<tr>
<td>13.11</td>
<td>Emission Cost Saving</td>
<td>99</td>
</tr>
<tr>
<td>13.12</td>
<td>Accident Data within study area</td>
<td>100</td>
</tr>
<tr>
<td>13.13</td>
<td>Accident Cost within the study section in year 2005</td>
<td>101</td>
</tr>
<tr>
<td>13.14</td>
<td>Total Benefits per year</td>
<td>101</td>
</tr>
<tr>
<td>14.1</td>
<td>Economic Evaluation of Traffic Management at Ja-ela</td>
<td>107</td>
</tr>
<tr>
<td>14.2</td>
<td>Sensitivity Test Results</td>
<td>108</td>
</tr>
<tr>
<td>14.3</td>
<td>Sensitivity Test 1</td>
<td>109</td>
</tr>
<tr>
<td>14.4</td>
<td>Sensitivity Test 2</td>
<td>110</td>
</tr>
<tr>
<td>14.5</td>
<td>Sensitivity Test 3</td>
<td>111</td>
</tr>
</tbody>
</table>
### LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSD</td>
<td>District Secretariat Division</td>
</tr>
<tr>
<td>AGA</td>
<td>Assistant Government Agent</td>
</tr>
<tr>
<td>FTZ</td>
<td>Free Trade Zone</td>
</tr>
<tr>
<td>ADT</td>
<td>Average Daily Traffic</td>
</tr>
<tr>
<td>UC</td>
<td>Urban Council</td>
</tr>
<tr>
<td>RDA</td>
<td>Road Development Authority</td>
</tr>
<tr>
<td>PCU</td>
<td>Passenger Car Unit</td>
</tr>
<tr>
<td>VOT</td>
<td>Value of Time</td>
</tr>
<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>BCR</td>
<td>Benefit Cost Ratio</td>
</tr>
<tr>
<td>EIRR</td>
<td>Economic Internal Rate of Return</td>
</tr>
<tr>
<td>A3</td>
<td>Peliyagoda Puttalam Road</td>
</tr>
<tr>
<td>A33</td>
<td>Ja-ela - Gampaha - Yakkala - Road</td>
</tr>
</tbody>
</table>