

**STUDY ON WORK ZONE MANAGEMENT IN  
HIGHWAY REHABILITATION PROJECTS IN URBAN  
AREAS**

Madhusa Bhathiya Mettananda

(138316P)

Degree of Master of Engineering

Department of Civil Engineering

University of Moratuwa

Sri Lanka

August 2017

**STUDY ON WORK ZONE MANAGEMENT IN  
HIGHWAY REHABILITATION PROJECTS IN URBAN  
AREAS**

Madhusa Bhathiya Mettananda

(138316P)

Thesis submitted in partial fulfillment of the requirements for the degree  
Master of Engineering in Highway and Traffic Engineering

Department of Civil Engineering

University of Moratuwa

Sri Lanka

August 2017

## DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature:

Date:

The above candidate has carried out research for the Master's thesis under my supervision.

Signature of the supervisor:

Date:

---

## **ABSTRACT**

The safe and efficient flow of traffic through work zones is a major concern to transportation officials (government authorities, contractors), the public, businesses, and road users. Key areas for performance measures of work zones include delays, user costs, exposure, safety, and public perception.

This paper presents an investigation on current work-zone practices in highway rehabilitation projects around Colombo and sub-urbs. Three (03) ongoing road rehabilitation projects have been identified for the study. Separate questionnaire surveys were carried out for road users and for residents/ businesses to identify the major difficulties, inconveniences and probable reasons. The major issues identified are; dust and noise pollution, lack of advanced signage, increment in travel time, accesses and utility disturbances, and drainage issues. The root causes identified are; lack of focus on guidelines, non availability of experienced and qualified officers, lack of space, higher traffic volume throughout the day, and public interferences. With the reference with the guidelines of other countries, a comprehensive check list has been suggested at the conclusion.

**Key words: Work-zone Management, Traffic Management, Road User Safety**

---

## TABLE OF CONTENTS

ABSTRACT .....	ii
TABLE OF CONTENTS .....	iii
LIST OF FIGURES .....	vii
LIST OF TABLES .....	x
1. INTRODUCTION .....	1
1.1 Background .....	1
1.2 Introduction .....	2
1.2.1 Noise Pollution.....	3
1.2.2 Air pollution .....	3
1.3 Objective .....	4
1.4 Research Methodology.....	4
2. LITERATURE REVIEW.....	5
2.1 Assessing Public Inconvenience in Highway Work Zones.....	5
2.2 Strategy to Minimize User Inconvenience during Road Rehabilitation .....	5
2.3 Available Guideline .....	6
2.3.1 <i>Manual on Traffic Control Devices; Part II, Road Work Areas- Second Edition by Ministry of Transport and Road Development Authority, Sri Lanka</i> .....	6
3. METHODOLOGY .....	9
3.1 Galle Road (A002) (Ratmalana – Moratuwa section) .....	9
3.1.1 <i>General Observations</i> .....	10
3.2 Colombo - Horana Road (B084) (Boralesgamuwa – Piliyandala section) .....	13
3.2.1 <i>General Observations</i> .....	15
3.3 Ethulkotte – Kohuwala Road (B120) (Ethulkotte – Pitakotte section) .....	17
3.3.1 <i>General Observations</i> .....	18
4. ANALYSIS OF WORK-ZONE PRACTICES .....	20
4.1 Dust Generation and Air Pollution.....	20
4.2 Noise Pollution.....	24

---

4.3 Disturbances to the Service Connections.....	26
4.4 Disturbances to the accesses .....	28
4.5 Travel Time Increment/ Reduction of Fuel Efficiency .....	28
4.6 Lack of Space for the Pedestrians .....	29
4.7 Traffic Management.....	32
<b>5. QUESTIONNAIRE SURVEYS .....</b>	<b>41</b>
5.1 Questionnaire for Road Users .....	41
5.1.1 <i>B120 Road</i> .....	41
5.1.2 <i>B084 Road</i> .....	46
5.1.3 <i>A002 Road</i> .....	52
5.2 Questionnaire for Residents/ Business Places .....	56
5.2.1 <i>B120 Road</i> .....	57
5.2.2 <i>B084 Road</i> .....	60
5.2.2 <i>A002 Road</i> .....	64
5.3 Comparison of Responses for Each Road based on Road User Responses.....	67
5.3.1 <i>Dust Generation as an Inconvenience</i> .....	67
5.3.2 <i>Possible Damages to Vehicles as an Inconvenience</i> .....	68
5.3.3 <i>Inadequate Safety Arrangements as an Inconvenience</i> .....	68
5.3.4 <i>Incapable Traffic Controllers as an Inconvenience</i> .....	69
5.3.5 <i>Road Side Friction as an Inconvenience</i> .....	69
5.3.6 <i>Increment of Travel Time as an Inconvenience</i> .....	70
5.3.7 <i>Lack of Advanced Signage as an Inconvenience</i> .....	71
5.3.8 <i>Overall Comparison and Possible Reasons</i> .....	71
5.3.9 <i>Ranking of Road User Inconveniences</i> .....	74
5.4 Comparison of Responses for Each Road based on Responses from Residents and Business Places .....	75
5.4.1 <i>Access Damages as an Inconvenience</i> .....	75
5.4.2 <i>Drainage Issues as an Inconvenience</i> .....	75
5.4.3 <i>Dust Generation as an Inconvenience</i> .....	76
5.4.4 <i>Utility Interruptions as an Inconvenience</i> .....	76
5.4.5 <i>Water Pollution as an Inconvenience</i> .....	77
5.4.6 <i>Noise as an Inconvenience</i> .....	77
5.4.7 <i>Overall Comparison and Possible Reasons</i> .....	78
5.4.8 <i>Ranking of Road User Inconveniences</i> .....	80

---

6. ANALYSIS OF INCONVENIENCES .....	81
6.1 Prioritized list of Inconveniences.....	81
6.2 Air Pollution.....	81
6.2.1 <i>Dust Generation</i> .....	81
6.2.2 <i>Harmful Emissions</i> .....	82
6.2.3 <i>Proposed Air Pollution Mitigation Measures</i> .....	82
6.3 Noise Pollution.....	83
6.3.1 <i>Proposed Noise Pollution Mitigation Measures</i> .....	84
6.4 Increment of travel time .....	85
6.4.1 <i>Proposals to minimize traffic delays</i> .....	85
6.5 Disturbances to the accesses .....	86
6.5.1 <i>Proposals to minimize inconveniences due to access damages</i> .....	86
6.6 Interruptions to the utility lines .....	87
6.6.1 <i>Strategies to Minimize Interruptions to the Utility Lines</i> .....	87
7. CONCLUSION AND RECOMENATIONS .....	89
7.1 Summary of Findings.....	89
7.1.1 <i>Summary of Findings at B120 Road Workzone</i> .....	89
7.1.2 <i>Summary of Findings at B084 Road Workzone</i> .....	89
7.1.3 <i>Summary of Findings at A002 Road Workzone</i> .....	90
7.2 Limitations of the Study.....	90
7.2.1 <i>Selection of Workzones</i> .....	90
7.2.2 <i>Data Collection and Sample Sizes</i> .....	91
7.3 Recommendations for Future Work.....	91
7.3.1 <i>Economic Loss during Road Rehabilitation Works</i> .....	91
7.3.2 <i>Road Users' Safety and Workers' Safety</i> .....	92
7.4 Recommendations .....	92
7.4.1 <i>Introduction and Implementation of a Check List</i> .....	92
7.4.2 <i>Proper Co-ordination and Communication</i> .....	96
7.4.3 <i>Strict Adherence to the Guidelines</i> .....	96
REFERENCE LIST .....	97
ANNEX 1-1: QUESTIONNAIRE USED FOR ROAD USERS .....	98
ANNEX 1-2: QUESTIONNAIRE USED FOR RESIDENTS .....	99

---

ANNEX 02 - GUIDELINES FOR TEMPORARY TRAFFIC MANAGEMENT DURING ROAD CONSTRUCTION .....	100
APPENDIX 1 - RANKING CALCULATION FOR ROAD USER INCONVINENCES .....	110
APPENDIX 02 - RANKING CALCULATION FOR RESIDENTS/ BUSINESSES INCONVINENCES .....	113



---

## LIST OF FIGURES

Figure 3-1: Location map of Maliban Junction – Nalluruwa Project Road.....	10
Figure 3-2: Disturbances to the Pedestrian Foot-walks .....	11
Figure 3-3: Lane provided from opposite direction .....	11
Figure 3-4: No space for pedestrians .....	12
Figure 3-5: Properly arranged temporary sign boards .....	12
Figure 3-6: Traffic diversion during night time .....	13
Figure 3-7: Location Map of Pamankada – Kesbewa Road Project .....	14
Figure 3-8: Dust Generation on ABC Fill.....	15
Figure 3-9: Demarcation of work-zone.....	15
Figure 3-10: Water stagnation at ABC Fill.....	16
Figure 3-11: Poor Barricading at the middle of the carriageway.....	16
Figure 3-12: No safe passage demarcated for pedestrians .....	17
Figure 3-13: Location Map of B120 Road.....	18
Figure 3-14: Existing drain walls raising to provide foot-walks.....	19
Figure 3-15: Single pile traffic allowed in construction zones .....	19
Figure 4-1: Dust Generation on completed ABC fill.....	23
Figure 4-2: Water lines to be relocated at B084 Road project.....	27
Figure 4-3: Electricity posts/line to be relocated in B084 Road project .....	27
Figure 4-4: No space for the pedestrians at B120 Road Project .....	30
Figure 4-5: Temporary pedestrian Bridge at B084 Road Project .....	31
Figure 4-6: Temporary Pedestrian Crossings at B084 Road Project .....	32
Figure 4-7: Endangered pedestrian movement at B084 road.....	32
Figure 4-8: Traffic Management during the reconstruction of a culvert; phase 1 .....	33
Figure 4-9: Traffic Management during the reconstruction of a culvert; phase 2 .....	34
Figure 4-10: Traffic Management during culvert construction at A002 road.....	35
Figure 4-11: Traffic Management during culvert construction at B084 road.....	35
Figure 4-12: Proposed traffic management during road widening works of B084 project; phase 1 .....	36
Figure 4-13: Proposed traffic management during road widening works of B084 project; phase 2 .....	37
Figure 4-14: Proposed traffic management during asphalt paving of outer lane of B120 project.....	38

---

Figure 4-15: Proposed traffic management during asphalt paving of inner lane of B120 project.....	39
Figure 4-16: Traffic Management during asphalt paving at B120 road.....	40
Figure 5-1: Responses in Travel Time Increment of B120 Road .....	42
Figure 5-2: Impact of Dust Generation of B120 Road.....	42
Figure 5-3: Impact of Possible Damages to Vehicles in B120 Road.....	43
Figure 5-4: Impact of Inadequate Safety Arrangements of B120 Road.....	43
Figure 5-5: Impact of Incapable Traffic Controllers of B120 Road .....	44
Figure 5-6: Impact of Road Side Friction of B120 Road.....	44
Figure 5-7 Impact of Increment of Travel Time of B120 Road.....	44
Figure 5-8: Impact of Lack of Advanced Signage of B120 Road.....	45
Figure 5-9: Responses in Travel Time Increment of B084 Road .....	47
Figure 5-10 Impact of Dust Generation of B084 Road.....	48
Figure 5-11: Impact of Possible Damages of Vehicles of B084 Road .....	48
Figure 5-12: Impact of Inadequate Safety Arrangements of B084 Road.....	48
Figure 5-13: Impact of Incapable Traffic Controllers of B084 Road .....	49
Figure 5-14: Impact Road Side Friction of B084 Road .....	49
Figure 5-15 Impact of Increment of Travel Time of B084 Road.....	49
Figure 5-16: Impact of Lack of Advanced Signage of B084 Road.....	50
Figure 5-17: Responses in Travel Time Increment of A002 Road .....	52
Figure 5-18: Impact of Lack of Advanced Signage of B084 Road.....	53
Figure 5-19: Impact of Lack of Advanced Signage of B084 Road.....	53
Figure 5-20: Impact of Lack of Advanced Signage of B084 Road.....	54
Figure 5-21: Impact of Lack of Advanced Signage of B084 Road.....	54
Figure 5-22: Impact of Lack of Advanced Signage of B084 Road.....	54
Figure 5-23: Impact of Lack of Advanced Signage of B084 Road.....	55
Figure 5-24: Impact of Lack of Advanced Signage of B084 Road.....	55
Figure 5-25: Responses in Impact of Inconveniences of B120 Road .....	57
Figure 5-26: Inconveniences due to Access Damages of A002 Road .....	58
Figure 5-27: Inconveniences due to Access Damages of A002 Road .....	58
Figure 5-28: Inconveniences due to Dust Generation of A002 Road .....	58
Figure 5-29: Inconveniences due to Utility Interruptions of A002 Road .....	59
Figure 5-30: Inconveniences due to Water Pollution of A002 Road.....	59

---

Figure 5-31: Inconveniences due to Noise of A002 Road .....	59
Figure 5-32: Responses in Impact of Inconveniences of B084 Road .....	61
Figure 5-33: Inconveniences due to Access Damages of B084 Road .....	61
Figure 5-34: Inconveniences due to Drainage Issues of B084 Road .....	62
Figure 5-35: Inconveniences due to Dust Generation of B084 Road .....	62
Figure 5-36: Inconveniences due to Utility Interruptions of B084 Road.....	62
Figure 5-37: Inconveniences due to Water Pollution of B084 Road .....	63
Figure 5-38: Inconveniences due to Noise of B084 Road .....	63
Figure 5-39: Responses in Impact of Inconveniences of A002Road.....	64
Figure 5-40: Inconveniences due to Access Damages of A002 Road .....	65
Figure 5-41: Inconveniences due to Drainage Issues of A002 Road.....	65
Figure 5-42: Inconveniences due to Dust Generation of A002 Road .....	65
Figure 5-43: Inconveniences due to Utility Interruptions of A002 Road .....	66
Figure 5-44: Inconveniences due to Water Pollution of A002 Road.....	66
Figure 5-45: Inconveniences due to Noise of A002 Road.....	66
Figure 5-46: Comparison of Dust Generation as an Inconvenience .....	67
Figure 5-47: Comparison of Possible Damages to Vehicles as an Inconvenience ...	68
Figure 5-48: Comparison of Inadequate Safety Arrangements as an Inconvenience	68
Figure 5-49: Comparison of Incapable Traffic Controllers as an Inconvenience.....	69
Figure 5-50: Comparison of Road Side Friction as an Inconvenience .....	70
Figure 5-51: Comparison of Increment of Travel Time as an Inconvenience .....	70
Figure 5-52: Comparison of Lack of Advanced Signage as an Inconvenience .....	71
Figure 5-53: Comparison of Highest Impact on Each Road.....	75
Figure 5-54: Comparison of Inconvenience of Each Factor .....	76
Figure 5-55: Comparison of Access Damages as an Inconvenience .....	76
Figure 5-56: Comparison of Drainage Issues as an Inconvenience .....	77
Figure 5-57: Comparison of Dust Generation as an Inconvenience .....	77
Figure 5-58: Comparison of Utility Interruptions as an Inconvenience .....	78
Figure 5-59: Comparison Water Pollution as an Inconvenience .....	78
Figure 5-60: Comparison of Noise as an Inconvenience.....	78
Figure 5-61: Comparison of Highest Impact on Each Road.....	79
Figure 5-62: Comparison of Inconvenience of Each Factor.....	80
Figure 6-1: Entrance/outlet Tyre Wash.....	83

---

## **LIST OF TABLES**

Table 4-1: Air Quality Permissible Limits .....	22
Table 4-2: Noise Generation in Construction Activities.....	24
Table 4-3: Categorizing Noise Levels.....	25
Table 4-4: Permissible Noise Levels .....	25
Table 5-1: Recommendations to Minimize Inconvinineces in B0120 Road as per the responses received.....	46
Table 5-2: Recommendations to Minimize Inconvinineces in B084 Road as per the responses received.....	51
Table 5-3: Recommendations to Minimize Inconvinineces in A002 Road as per the responses received.....	56
Table 7-1: Number of responces received for each types of questionnaire surveys....	91
Table 7-2: Proposed Checklist to be followed in construction activities.....	93