

# QUALITY CONTROL ASPECTS OF ASPHALT CONCRETE SURFACE REGULARITY

S.Gnanasekaran

(06/8849)



Master of Engineering in Highway & Traffic Engineering

University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

Department of Civil Engineering

University of Moratuwa

Sri Lanka

March 2010

# QUALITY CONTROL ASPECTS OF ASPHALT CONCRETE SURFACE REGULARITY

S.Gnanasekaran

(06/8849)



University of Moratuwa, Sri Lanka.

Electronic Theses & Dissertations

Thesis submitted in partial fulfillment of the requirements for the Degree of Master of Engineering in Highway & Traffic Engineering.

Department of Civil Engineering

University of Moratuwa

Sri Lanka

March 2010

## DECLARATION OF THE CANDIDATE

“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 University or other 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”

.....  
Signature

.....  
Date



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## DECLARATION OF THE SUPERVISOR

“I have supervised and accepted this thesis for the submission of the degree”

.....

Signature of the Supervisor

.....

Date



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## **DEDICATION**

This report is dedicated to my parents.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## ACKNOWLEDGEMENTS

I am grateful to my supervisor Dr. W.K.Mampearachchi for all the help and encouragement given throughout the period of research and especially for the advice and direction to prepare my report. His devotion in the subject of Asphalt concrete is also acknowledged.

My gratitude is extended to Road Development Authority, Director General, Director Planning and his staff for giving me valuable assistance in completing this study.

My sincere thanks are to the University of Moratuwa for the services provided during my research period. I wish to thank the Road Development Authority for sponsoring and granting me leave to follow up this degree course.

22<sup>nd</sup> March, 2010.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## **ABSTRACT**

The purpose of this study is to set an initial road smoothness specification for asphalt concrete overlaid roads in Sri Lanka and to find out the road roughness when the road satisfies the regularity requirement which is given in the Standard Specifications for Construction and Maintenance of Roads and Bridge (SSCM) Published in 1989.

Numbers of newly asphalt overlaid roads in various parts of Sri Lanka were surveyed using Vehicle Mounted Bump Integrators and corresponding International Roughness Indices (IRI) were derived. The change of roughness for a short period was also observed. Asphalt overlaid roads with various undulations were surveyed for roughness with Bump Integrator (BI) and the same locations were run with straight edge to measure bump and dip.

Smoothness specifications which are currently in use in other countries are taken into consideration. The outcome of roads of those countries as a result of setting a smoothness target is also discussed.

This study revealed that it is practical to set an initial roughness value in terms of IRI when the roughness is measured with BI and the roughness does not change drastically in a short period. Also, it is revealed that the maximum tolerance of surface regularity given the SSCM published in 1989 results a higher IRI value.

## TABLE OF CONTENTS

Declaration of the candidate	i
Declaration of the supervisor	ii
Dedication	iii
Acknowledgement	iv
Abstract	v
Table of content	vi
List of Figures	viii
List of Tables	ix
Chapter 1: Introduction	1
1.1 Background	1
1.2 Problem statement	2
1.3 Objectives	3
1.4 Research approach, scope and limitation	3
Chapter 2: Literature review	4
2.1 Road roughness	4
2.2 Roughness measuring systems	5
2.2.1 Profiling devices	5
2.2.2 Response type devices	10
2.3 Pavement roughness indices	12
2.3.1 International Roughness Index (IRI)	12
2.3.2 Present Serviceability Rating (PSR), Present Serviceability Index PSI and Mean Panel Rating (MPR)	14
2.3.4 Ride Number	16
2.3.5 Slope Variance	17
2.3.6 Other roughness indices	17
2.4 Roughness measurement- Current practice in Sri Lanka	18
2.4.1 Roughness measuring devices	18
2.4.2 The use of roughness measurements	18
2.5 Pavement smooth specifications	22



Chapter 3	Methodology of study	27
	3.1 Calibration of Vehicle Mounted Bump Integrator using Merlin	27
	3.2 Measuring roughness	28
	3.2.1 Using Bump Integrator	28
	3.2.2 Using Straightedge measurements	30
Chapter 4:	Observation and Results	31
	4.1 Variation of roughness with time	31
	4.2 IRI and Straightedge	43
Chapter 5:	Analysis and discussion of results	45
	5.1 Introduction	45
	5.2 Initial road roughness and its variation with time for a Short period	45
	5.2.1 General observations and preliminary data analysis	45
	5.2.3 Data analysis	46
	5.3 IRI and Straightedge	48
Chapter 6:	Conclusions and recommendations	50
	6.1 Conclusions	50
	6.2 Recommendations	50
Reference List:		52
Appendix A:	Straightedge readings	53
Appendix B:	MERLIN chart	106
Appendix C:	Roughness measurements- Southern Expressway	107

## LIST OF FIGURES

Figure 2.1	Straightedge	6
Figure 2.2	Dipstick	7
Figure 2.3	MERLIN Machine	8
Figure 2.4	Inertial Profiler	10
Figure 2.5	Vehicle Mounted Bump Integrator	11
Figure 2.6	Quarter Car Model	13
Figure 2.7	Sensitivity of IRI to Wave Numbers	13
Figure 2.8	IRI Roughness scale	14
Figure 2.9	Present Serviceability Rating scale	15
Figure 2.10	Sensitivity of RN to Wave numbers	16
Figure 2.11	Correlation between PI (used to define RN) and IRI	17
Figure 2.12	Road length distributions by roughness in 2008	19
Figure 2.13	Roughness distributions by province in 2007	20
Figure 2.14	Roughness distributions by province in 2008	21
Figure 4.1	Roughness on CRWB road	32
Figure 4.2	Average IRI variation with time on CRWB road	33
Figure 4.3	Roughness on CGHW road	34
Figure 4.4	Average IRI variation with time on CGHW road	35
Figure 4.5	Roughness on CK road	36
Figure 4.6	Average IRI variation with time on CK road	37
Figure 4.7	Roughness on PNR road	38
Figure 4.8	Average IRI variation with time on PNR road	39
Figure 4.9	Roughness on MHT road	41
Figure 4.10	Average IRI variation with time on MHT road	41
Figure 4.11	IRI vs. Straightedge	44
Figure 5.1	IRI vs. Straightedge	49

## LIST OF TABLES

2.1	Road Length Distribution by Roughness	18
2.2	Roughness Distribution by Province in 2007	19
2.3	Roughness Distribution by Province in 2008	20
2.4	Summary of Acceptance Requirements and Pay Adjustments in Canada	23
2.5	Comparison of Smoothness Specifications from Selected European Countries	25
2.5	Tolerance of surface regularity in Sri Lanka -SSCM, 1989	26
2.6	Tolerance of surface regularity in Sri Lanka -ICTAD Specification	26
3.1	Selected roads for calibrating Bump Integrator	27
3.2	Selected roads for measuring roughness	29
4.1	Roughness measurement on CRWB road	31
4.2	Summary on Roughness measurement on CRWB road	33
4.3	Roughness measurement on CGHW road	34
4.4	Summary on Roughness measurement on CGHW road	35
4.5	Roughness measurement on CK road	36
4.6	Summary on Roughness measurement on CK road	37
4.7	Roughness measurement on PNR road	38
4.8	Summary on Roughness measurement on PNR road	39
4.9	Roughness measurement on MHT road	40
4.10	Summary on Roughness measurement on MHT road	41
4.11	Roughness measurement on KKP road	42
4.12	Summary on Roughness measurement on KKP road	43
4.13	IRI measurement vs. Straightedge	44
5.1	Summary of IRI values	47
5.1	Summary of 5%, 50% and 95% Values	47