TABLE OF CONTENTS

TITLE PAGE ..... **i**
APPROVAL PAGE ..... **ii**
PROCESS VERBAUX (BERITA ACARA) ..... **iii**
ABSTRACT ..... **iv**
ABSTRAK ..... **v**
MOTTO AND DEDICATION ..... **vi**
ACKNOWLEDGEMENT ..... **ix**
TABLE OF CONTENT ..... **xiii**
LIST OF TABLE ..... **xvi**
LIST OF FIGURE ..... **xvii**
LIST OF ABBREVIATIONS ..... **xviii**

CHAPTER 1 INTRODUCTION
1.1 Background 1
1.2 Problem Limitation 3
1.3 Objectives of the Study 3
1.4 Scope of the Study 4

CHAPTER 2 LITERATURE REVIEW
2.1 Introduction 5
2.2 Asphalt Recycling 5
2.3 Hot In Place Recycling (HIR) 6
2.4 Dense Graded Asphalt Mixtures 13
2.5 Stone Mastic Asphalt 15

CHAPTER 3 DESIGN AND METHODOLOGY
3.1 Introduction 17
3.2 Bitumen Characterization 17
3.3 Extracting Reclaimed Asphalt Pavement 19

3.4 New Material for SMA-14 and AC-WC 19
3.4.1 Aggregate 19
3.5 Design of Dense Graded Asphaltic Mixture 20
3.5.1 Asphaltic Concrete Wearing Course 20
3.5.2 Stone Mastic Asphalt 27
3.6 Marshall Test 35
3.6.1 Preparation of Speciment for Marshall test 36

CHAPTER 4 RESULT AND DISCUSSION

4.1 Introduction 46
4.2 Bitumen characterization 46
4.3 Reclaimed Asphalt Pavement 46
4.4 Sieve Analysis 47
4.5 Aggregate composition by sieva analysis 48
4.6 Marshall Mix Design 50
4.7 Marshall test 50

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions 52
5.2 Recommendations 52

REFERENCES .....
APPENDIX .....

LIST OF TABLE

Figure Number Description Page

Table 2.1. Grading Limits for combined aggregate/Filler content of AC mixes ... 14
Table 2.2. Gradation limits of combined for SMA [19] ... 16
Table 3.1. Grading limit for combined aggregate/Filler content of AC mixes ... 22
Table 3.2. Properties of Polymer Modified Binder ... 30
Table 3.3 Properties of Cellulose fiber ... 31
Table 3.4 Properties of Bitumen precoated Pelletizzed Cellulose fibre ... 31
Table 3.5 Gradation limits of combined aggregate ... 32
Table 3.6 SMA Mix Requirement ... 34
Table 3.7. Tolerances for Stone Mastic Asphalt ... 35
Table 3.8. LTA W3B Mix Specification (see also PWD 1992) ... 42
Table 4.1.The result of extracting RAP ... 47
Table 4.2. Sieves Analysis from RAP ... 47
Table 4.3 sieve Analysis Stone Mastic Asphalt-14 ... 48
Table 4.4 Gradation limits of combined aggregate DG-WC ... 49
Table 4.5 Marshall sample measurement for SMA-14 ... 50
Table 4.6 Marshall sample measurement for DG-WC ... 50
Table 4.7 The result of Marshall test for DG-WG with RAP ... 51
Table 4.8 The result of Marshall test for DG-WG without RAP ... 52
Table 4.9 The result of Marshall test for SMA-14 with RAP ... 53
Table 4.10 The result of Marshall test for SMA-14 without RAP ... 54
Table 4.11 Marshal test result compare to the specification for SMA-14 ... 55
Table 4.12 Marshal result compare to the specification for DG-WC ... 55

LIST OF FIGURE

Figure Number Description Page

Figure 2.1.Surface Recycling Heating units 8
Figure 2.2Surface Recycling Scarification teeth 9
Figure 2.3 Recycled Mix placement..... 9
Figure 2.4 HIR Remixing Train 10
Figure 2.5. Single Stage Remixing Train..... 10
Figure 2.6 Multiple stage Remixing with window of scarified material 11
Figure 2.7 Multiple pass Repaving..... 11
Figure 2.8 Single pass Repaving 12
Figure 2.9 Cross sectional view of a typical SMA and a dense graded HMA..... 16
Figure 3.1 Flowchart of Design and Methodology. 18
Figure 3.2 Reclameid Asphalt Pavement RAP 20
Figure 3.3 Specification of Marshall Equipment..... 36
Figure 3.4 Mass Volume Relationships in Asphalt mix (adapted from atkins) 38
Figure 3.5 LTA W3B Gradation Envelope 43
Figure 3.6 Sample Tesr Result from a Marshall Mix design 45
Figure 4.1 Aggregate Gradation Chart of RAP..... 48
Figure 4.2 Aggregate Gradation Chart of SMA-14 49
Figure 4.3 Aggregate Gradation Chart of DG-WC..... 49