

# TABLE OF CONTENTS

TABLE OF CONTENTS	i
LIST OF TABLES	iii
LIST OF FIGURES	iv
ACKNOWLEDGEMENTS	vi
<b>1.0 INTRODUCTION</b>	<b>1</b>
1.1 General Problem Statement	1
1.2 Objective of the Study	4
1.3 Approach of the Study	5
1.4 Synopsis	6
<b>2.0 LITERATURE REVIEW</b>	<b>7</b>
2.1 The Need to Predict Deterioration	7
2.2 The Roles of Empirical and Mechanistic Methods	9
2.3 Structural Evaluation of Existing Pavements	10
2.4 Nondestructive Deflection Testing	12
2.4.1 Temperature-deflection Corrections	12
2.4.2 Determination of Average Pavement Temperature	13
2.4.3 Effective Structural Number	14
<b>3.0 NETWORK-LEVEL FWD TESTING</b>	<b>17</b>
3.1 Introduction	17
3.2 Data Collection	17
3.3 Response Variable and Analysis Method	19
3.4 Trends of Response Variables	20
3.5 Limit of Accuracy Curves	20
3.6 Error Analysis	25
3.7 Prediction of the Decrease in Structural Number	29
3.7.1 Model Development	30
3.8 Models Obtained and the 'Model Utility' Test	32

<b>4.0</b>	<b>CLASSICAL REGRESSION ANALYSIS</b>	<b>35</b>
4.1	Multiple Regression Analysis	35
4.2	Selection of Independent Variables	35
4.3	Criteria Used to Select a Model	37
4.4	Models Obtained and the 'Model Utility' Test	38
<b>5.0</b>	<b>BAYESIAN REGRESSION ANALYSIS</b>	<b>42</b>
5.1	Bayesian Regression Methodology	42
5.1.1	Introduction	42
5.1.2	An Overview of the Bayesian Regression Approach	42
5.1.3	Bayesian Regression Software	44
5.2	Bayesian Regression to Predict the Decrease in PSE Values	44
5.2.1	Developing Prior and Assembling Sample Data	44
5.2.2	Results of Bayesian Regression and Selected Posterior Models	45
5.3	Model Evaluation	46
5.3.1	Data, Prior, and Posterior PDF Plots	47
5.3.2	t-Statistic	47
5.3.3	Standard Error of the Residuals	61
<b>6.0</b>	<b>RESULTS AND DISCUSSION</b>	<b>63</b>
6.1	Prediction of PSE Values Using the Selected Models	63
6.2	Range of Independent Variables	68
6.3	Paired t-Test Results	68
<b>7.0</b>	<b>SUMMARY</b>	<b>70</b>
7.1	Conclusions	70
7.2	Recommendations	71
	<b>REFERENCES</b>	<b>73</b>
	<b>APPENDIX A : Typical SAS Code Files, Log Files, and Output of the Selected Models for the Prediction of Decrease in Structural Number</b>	<b>76</b>
	<b>APPENDIX B : Typical SAS Code Files, Log Files, and Output of the Selected Models for the Prediction of Decrease in PSE Values</b>	<b>87</b>

## LIST OF TABLES

Table 1.1	PSE Rating Guide for Bituminous Surfaces	4
Table 3.1	Data Collection Summary	19
Table 3.2	Characteristics of the Study Sections	19
Table 3.3	Summary Statistics of the Response Variables	21
Table 3.4	Students t-test Results at 5% level of Significance	22
Table 3.5	Error Analysis Results	26
Table 3.6	Determination of the Number of Tests Per Mile	28
Table 3.7	Variable Selection Process Summary	32
Table 3.8	SAS ANOVA Results for the Model Developed for FDBIT Pavements	33
Table 3.9	SAS ANOVA Results for the Model Developed for PDBIT Pavements	34
Table 4.1	Distress Level Due to Transverse Cracks	37
Table 4.2	SAS ANOVA Results for the Model Developed for FDBIT Pavements	40
Table 4.3	SAS ANOVA Results for the Model Developed for PDBIT Pavements	41
Table 5.1	Required Prior Information	45
Table 5.2	Standard Deviation and t-Statistic of the Posterior Coefficients	62
Table 6.1	Results of Paired t-Test	69

## LIST OF FIGURES

Figure 2. 1	Illustration of Structural Capacity Loss Over Time And With Traffic	11
Figure 2. 2	Determination of $E_p/M_r$	16
Figure 3. 1	Typical Limit of Accuracy Curve for All Pavement variables	24
Figure 3. 2	Network Level FWD Testing Requirements	26
Figure 5. 1	The Bayesian Statistical Approach	43
Figure 5. 2	PDF Plot for Age for FDBIT Pavements	48
Figure 5. 3	PDF Plot for Thickness for FDBIT Pavements	49
Figure 5. 4	PDF Plot for Decrease in SN for FDBIT Pavements	50
Figure 5. 5	PDF Plot for PSE for FDBIT Pavements	51
Figure 5. 6	PDF Plot for Distress Level 1 for FDBIT Pavements	52
Figure 5. 7	PDF Plot for Distress Level 2 for FDBIT Pavements	53
Figure 5. 8	PDF Plot for Distress Level 3 for FDBIT Pavements	54
Figure 5. 9	PDF Plot for Age for FDBIT Pavements	55
Figure 5. 10	PDF Plot for Decrease in SN for FDBIT Pavements	56
Figure 5. 11	PDF Plot for PSE for PDBIT Pavements	57
Figure 5. 12	PDF Plot for Distress Level 1 for PDBIT Pavements	58
Figure 5. 13	PDF Plot for Distress Level 2 for PDBIT Pavements	59
Figure 5. 14	PDF Plot for Distress Level 3 for PDBIT Pavements	60
Figure 6. 1	Graphical Comparison of Rated and Predicted PSE Values	64

Figure 6.2	Graphical Comparison of Rated and Predicted PSE Values	65
Figure 6.3	Graphical Comparison of Rated and Predicted PSE Values	66
Figure 6.4	Graphical Comparison of Rated and Predicted PSE Values	67