

TABLE OF CONTENTS

APPROVAL SHEET.....	i
ACKNOWLEDGMENT SHEET.....	ii
DECLARATION OF ACADEMIC INTEGRITY	iii
ACKNOWLEDGEMENTS	iv
PREFACE.....	v
TABLE OF CONTENTS	vi
LIST OF FIGURES.....	viii
LIST OF TABLES	x
NOMENCLATURE	xi
ABSTRACT	xiii
1 INTRODUCTION.....	1
1.1 Background.....	1
1.2 Research Questions	2
1.3 Aims	2
1.4 Objectives	2
1.5 Scope of The Research	2
1.6 Dissertation Framework	2
1.6.1 Literature Review	3
1.6.2 Methodology.....	3
1.6.3 Result.....	3
1.6.4 Discussions	3
1.6.5 Conclusions and Recommendations.....	4
2 LITERATURE REVIEW	5
2.1 Background of Study	5
2.2 Polyurethane Application	6
2.3 Definition of the Transition zone	9
2.4 Problems in transition zones.....	13
2.4.1 Track Roughness	13
2.4.2 Hanging sleeper	14
2.5 Maintenance of Track.....	16
2.5.1 Tamping.....	16
2.5.2 Stone blowing.....	17
2.6 Cumulative Plastic Deformation	17
2.6.1 Cumulative plastic deformation of ballast	17
2.6.2 Cumulative plastic deformation of subballast.....	18
2.6.3 Cumulative plastic deformation for fine-grained soils (Subgrade)	18
2.7 Analytical Track Models	19
2.7.1 Li-Selig Method.....	19
2.8 Previous research studies on countermeasure railway for transition zones settlement.....	20
2.8.1 Auxiliary track.....	20
2.8.2 Three-dimensional polyurethane reinforcement.....	21

3	METHODOLOGY	24
3.1	Pseudo Numerical Analytic	24
3.2	Research Steps	25
3.3	Data Collection	26
3.3.1	Ballast properties	26
3.3.2	Subgrade properties	27
3.4	Data Analysis	29
3.4.1	Ballast calculation	29
3.4.2	Sub-ballast calculation	30
3.4.3	Subgrade calculation	30
3.5	Layer Design of reinforcement track	34
4	RESULT	36
4.1	Settlement on Ballast without reinforcement	36
4.2	Settlement on Ballast with reinforcement	36
4.3	Effect of combination between reinforced and unreinforced ballast	37
4.4	Subballast Settlement	38
4.5	Subgrade Settlement	39
4.6	Effect of Total Settlement on Transition Zones Based on Slicing Method	40
5	DISCUSSION	44
5.1	Analysis of the Result	44
5.2	Conformity with previous research	44
5.3	Benefit from this study result	45
5.4	Relation between result with research aims	45
5.5	Future action	45
6	CONCLUSIONS AND RECOMMENDATION	46
6.1	Conclusions	46
6.2	Recommendation	46
	REFERENCES	47
	Appendix A Ballast Settlement Calculation	52
	Appendix B Subballast Calculation	55
	Appendix C Ballast and Xitrack Settlement Calculation	57
	Appendix D subgrade calculation	60
	Appendix E Settlement Total	67