

LIST OF CONTENTS

TITLE PAGE	i
APPROVAL	ii
PROCES VERBAUX	iii
ABSTRACT	iv
ABSTRAK	v
MOTTO	vi
DEDICATION	vii
ACKNOWLEDGEMENT	viii
LEMBAR ASISTENSI	xi
LIST OF CONTENTS	xvi
LIST OF TABLE	xx
LIST OF FIGURE	xxi
ABBREVIATIONS	xxiii
CHAPTER I INRODUCTION	1
1.1 Background and Problem Statement.....	1
1.2 LRT Overview	3
1.3.Objectives of the Study.....	5
1.4.The Scope of Study.....	5
CHAPTER II LITERATURE REVIEW	6
2.1 Introduction.....	6
2.2 Light Rail Transit.....	6
2.3 Non Ballasted Track	7
2.4 Ballasted Track	9
2.5 Deck Slab	10
2.5.1. Prestressed Concreate.....	11
2.5.1.1.Pre Tensioned	13
2.5.1.2. Post Tensioned Concreate.....	13
2.5.2. Reinforced Concreate	14
2.6 Available Design of Light Rail Transit Bridge	15
2.6.1. Bridge Design Codes for LRT Bridges.....	17
2.6.2. Bridge Aesthetics	22
2.6.3. Light Rail Bridge Maintanance Issues	25
2.6.4. Welded Rail on Bridges	27
2.6.5. Power and Signal Sistem Conserdation	33

CHAPTER III DESIGN AND METHODOLOGY	37
3.1 Introduction.....	37
3.2 Preliminary Design.....	37
3.3 Determination of Loading.....	39
3.3.1. Vertikal Force	40
3.3.1.1. Total Vertical Wheel Loads	41
3.3.2. Lateral Force	41
3.3.2.1 Total Lateral Wheel Loads.....	41
3.4 Determination of Railway Track strukture	42
3.4.1. Spesifikasi Light Rail Transit.....	42
3.4.2. Calculation of Basic Ballasted Track	43
3.4.2.1. Design speed	43
3.4.2.2. Class of Road	43
3.4.2.3. Dynamic Load.....	44
3.4.2.4. Rail Dimension.	48
3.4.2.5. Minimum Lenght of Rail	48
3.4.2.6. Sleeper.....	49
3.4.2.7. Ballast.....	52
3.4.2.8. Railway Widening.....	54
3.4.2.9. Railway Switch	55
3.4.3. The Basic Calculation of the Non Ballasted Track	57
3.4.3.1 Rail Seat Load.....	58
3.4.3.2. The Elastic Lenght Radius	60
3.5 Determination of Upper Structure	61
3.5.1. Deck Slab.....	61
3.5.2. Analysis Ultimate Method	63
3.5.3. Controlling if cracks in the concrete appear	64
3.5.4. Bending Moment Capacity of Concrate Slab	65
3.5.5. Deformation of the slab	67
3.5.6. Crack Width.....	67
3.5.7. Self Load.....	69
3.5.8. Live Load.....	70
3.5.9. Load of LRT	70
3.5.10. Wind Load	70
3.5.11. Earthquake Load	71
 CHAPTER IV DESIGN AND CALCULATION	 72
4.1 Introduction	72
4.2 Preliminary Design	72
4.2.1. Technical Specification of the Rail Profile.....	73
4.2.2. Technical Specification of Concrate Deck Slab	74

4.2.3. Spesification And Data for Bridge Design	75
4.3 Calculation of Ballasted Track	75
4.3.1. Rail Dimension	77
4.3.2. Calculation of Minimum Lenght	77
4.3.3.Design of Sleeper.....	79
4.3.4.Determination the Distance of the Sleeper	82
4.3.5. Design of Ballast.....	84
4.4 Calculation of Non Ballasted Track.....	87
4.4.1.Rail Seaat Loads	87
4.5 Calculation of Deck Slab	92
4.5.1. Self Loads	92
4.5.2. Additional Dead Load.....	92
4.5.3. Load of LRT	92
4.5.4. Wind Load	93
4.5.5. Earthquake Load	93
4.5.6. Moment Deck Slab.....	94
4.5.7. Moment of Additional Dead Load	95
4.5.8. Moment of LRT load	95
4.5.9. Deformation of Deck Slab	96
CHAPTER V CONCLUSIONS AND RECOMMENDATIONS	100
5.1 Conclusions.....	100
5.2 Rekomendation	100
REFRENCES	101
APENDICS.....	103

LIST OF FIGURE

Figure Number	Description	Page
1.1.LRT Jakarta Route		2
1.2.LRT Carriages in Jakarta		4
1.3.LRT in Jakarta.....		4
2.1. Non ballasted track		8
2.2. Ballasted track		9
2.3. Ballasted track.....		10
2.4. Composite slab with profiled steel decking.....		11
2.5. Prestressed concrete.....		12
2.6. Pre-tensioned concrete.....		13
2.7. Post- tensioned slab		14
2.8. The differences between reinforced concrete and prestressed concrete		15
2.9. Vehicle bending moments on simple spans.....		18
2.10. Section through open deck bridge and weld detail		20
2.11. Section through ballast deck bridge and weld detail		20
2.12. Typical bridge live-load to dead load ratios		22
2.13. St Lois Metro link delta bridge pier elevation.....		23
2.14. Metro link cast-in place concrete box girder bridge.....		24
2.15. Elevation showing handrail by Metro link's design		24
2.16. Typical section retained fill bridge approach at catenary poles		26
2.17. Typical Section LRT Carriage from Hyundai		7
2.18. Non ballasted track		8
2.19. AASHTO beam span ballast deck		28
2.20. Typical section steel girder span.....		29
2.21. Typical section girder span.....		29
2.22. Typical section concrete segmental bridge.....		31
2.23. Ballast deck.....		31
2.24. Open deck		31
2.25. Direct fixation deck		31
2.26. Typical rail expansion joint configuration.....		34

2.27. Typical pole mounting detail on pier	35
2.28. Typical pole mounting detail on pier ballast deck slab	35
2.29. Dart system for mounting catenary poles on side of bridge deck.....	36
2.30. Metro link system for straycurrent grounding	36
3.1. Followhart of Design and Methodology	38
3.2. The Force acting on the rails	39
3.3. Pre-stress Concrate sleeper	49
3.4. The length of Frog	56
3.5. The length of Point	56
3.6. The radius length of outside curves	57
3.7. Ultimate tensile strength	58
4.1. Section Properties of concrete deck slab	74
4.2. Sleeper dimnsion	79
4.3. Sleeper dimension.....	81

LIST OF ABBREVIATIONS

⓪	= Track
UIC	= Union Internationale des Chemins de Fer
RPM	= Rotary per Minute
m	= Meters
mm	= Milimeters
kg	= Kilograms
cm	= Centimeters
N	= Newton
KN	= Kilo Newton
MPa	= Mega Pascal
kNm	= Kilo Newton Meters
km	= Kilo Meters
R	= Radius
V	= Velocity
I	= Moment Inertia
°C	= Celcius
λ	= Lamda
E	= The Young Modulus Elestisitas
ϕ	= Diameter of the Reinforcement
Kph	= Kilo per hours
GPa	= Giga pascal
A	= Area
a	= Distance of lenght between upper to bottom slab
G	= Modulus Shear
g	= Earth gravity acceleration (9.81 m/det2)
H	= High box girder
h	= High walls
M_{ET}	= Moment due to temperature
M_{EW}	= Maximum moment due to wind load
M_{LL}	= Maximum moment due to live load

M_{MA} = Maximum moment due to superimposed dead load
 M_{MS} = Maximum moment due to self weight construction
 M_n = Nominal moment strength of section
Mpa = Mega Pascal
 M_{PR} = Moment due to prestress
 M_R = The moment due to creep
 M_{RS} = Moment due to shrinkage and creep
 M_S = The moment due to shrinkage
 M_{uk} = Ultimate moment capacity
 M_{TD} = The maximum moment on beam due to "D" line load
 Q_{TD} = Load evenly on the girder box
 Q_{BS} = Self weight of box girder
 Q_{EW} = Self weight due to wind load
 Q_{MA} = Self weight due to superimposed dead load
 Q_{MS} = Self weight construction
q = Load evenly
S = Longitudinal spacing of the web reinforcement
T = Average temperature
 t' = Age of concrete hardening corrected when burdened
 t_a = Thickness of slab
 T_{EW} = Wind load
th = Thick puddle of rain
 T_{ps} = Internal force of prestressed steel tendon
 α = Change in the total angle of the tendon
 β = Wobble coefficient
 μ = Friction curvature coefficient
 σ_1 = Service stress due to self weight construction
 σ_2 = Service stress due to dead load and superimposed dead load