

TABLE OF CONTENTS

TITLE	i
APPROVAL SHEET	ii
DECLARATION OF ACADEMIC INTEGRITY	iii
ACKNOWLEDGMENT	iv
TABLE OF CONTENTS	v
LIST OF TABLES	viii
LIST OF FIGURES	ix
INTISARI	x
ABSTRACT	xi
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 Problem Formulation	2
1.3 Aims and Objectives	2
1.4 Scope	3
1.5 Thesis Structure	3
CHAPTER 2 INDONESIAN RAILWAY	5
2.1 Location of Indonesia	5
2.2 Railway History in Indonesia	5
2.3 Train Operation in Indonesia	7
2.3.1. Infrastructures	7
2.3.2. Rolling Stock	10
2.4 Level of Service	12
2.4.1. Train Service Classification	12
2.4.2. Service Improvement	21
2.5. Regulation	21
CHAPTER 3 LITERATURE REVIEW	24
3.1 Air Conditioning	24
3.1.1 Mechanism of Air Conditioning	25

3.1.2	Classification of Air Conditioning	26
3.2	Railway Air Conditioning	28
3.2.1	General Comfort Considerations	29
3.2.2	Problem Faced in Railway Air Conditioning	33
CHAPTER 4	RESEARCH METHODOLOGY	35
4.1	Outline of the Research	35
4.2	Thesis Flowchart	37
4.3	Data Collection and Analysis	38
CHAPTER 5	THEORETICAL BACKGROUND	39
5.1	Cooling Load	39
5.1.1.	External Cooling Loads	40
5.1.2.	Internal Cooling Loads	42
5.1.3.	Total Heat to be Remove	43
5.2	Cost analysis	44
5.3	Performance of Air Conditioning	45
5.4	Risks Identification	46
CHAPTER 6	AIR CONDITIONING IN INDONESIAN RAILWAY	48
6.1	Railway Air Conditioning in Indonesia	48
6.1.1.	Air Conditioning Manufactory	48
6.1.2.	Specification	48
6.1.3.	Main components	52
6.2	Home Air Conditioning for Passenger Carriages	57
6.2.1	Specification	58
6.2.2	Installation	58
CHAPTER 7	RESULT AND DISCUSSION	67
7.1	Quantitative Analysis	67
7.1.1	Cooling Load Calculation	67
7.1.2	Cooling Capacity and Cost	73
7.1.3	Performance of Air Conditioning	78
7.2	Qualitative Analysis	82
7.2.1	Installation	82

7.2.2 Lifespan	83
7.2.3 Guarantee.....	83
7.2.4 Maintenance and Inspection	84
7.2.5 Controlling.....	84
7.2.6 Air Circulation.....	85
7.3 Discussion	85
7.3.1 Comparison of Air Conditioning.....	85
7.3.2 Risks Identification.....	87
CHAPTER 8 CONCLUSIONS	92
8.1 Findings	92
8.2 Recommendations	94
8.3 Areas for Further Work / Research	94
REFERENCES	95
APPENDIX.....	98

LIST OF TABLES

Table 3.1 – Typical Temperature Design with 60% Maximum RH (ASHRAE, 2014).....	32
Table 5.1 – Risk Level Classification (Author, 2016)	47
Table 6.1 - Railway air conditioning type RPU-6035V specification (Toshiba, 2011).....	49
Table 6.2 – Specification of typical home air conditioning (Panasonic, 2015)....	58
Table 7.1 - Cooling Performance and Cost (Author, 2016).....	77
Table 7.2 – Energy efficiency ratio of air conditioning (Author, 2016).....	79
Table 7.3 – Energy consumption of air conditioning per day at 14 hours (Author, 2016).....	82
Table 7.4 – Comparison of Home AC and Railway AC (Author, 2016).....	86
Table 7.5 – Risk level of the event that could be occur (Author, 2016).....	89

LIST OF FIGURES

Figure 2.1 – Indonesian map (www.worldstatesmen.org, 2016).....	5
Figure 2.2 – The first station in Semarang (Unit Preservation and Architecture, 2016).....	6
Figure 2.3 – Railway links in Java (PT. Kereta Api Indonesia, 2016)	9
Figure 2.4 – Railway links in Sumatera (PT. Kereta Api Indonesia, 2016)	10
Figure 2.5 – Electric Multiple Units (Author, 2014)	14
Figure 2.6 – Diesel Multiple Units (Author, 2014)	15
Figure 2.7 – Executive class train (Author, 2012)	17
Figure 2.8 – Business class train (Author, 2012).....	18
Figure 2.9 – Economy commercial class train (Author, 2012).....	19
Figure 2.10 – Economy class train (Author, 2014).....	20
Figure 3.0.1 – Principle Mechanism of Air Conditioning (Talal, 2016)	26
Figure 4.1 – Outline of the research (Author, 2016).....	36
Figure 4.2 – Thesis Flowchart (Author, 2016)	37
Figure 5.1 – Appearance of Railway Air Conditioning (Toshiba, 2011)	51
Figure 5.2 – Inside of Railway Air Conditioning (Toshiba, 2011).....	51
Figure 5.3 – Compressor (Toshiba, 2011)	53
Figure 5.4 – Condenser (Toshiba, 2011)	54
Figure 5.5 – Evaporator (Toshiba, 2011).....	55
Figure 5.6 – Fresh Air Filter (Toshiba, 2011).....	57
Figure 5.7 – Thermostat and Sensor (Toshiba, 2011).....	57
Figure 5.8 – Interior coach before using air conditioning (Author, 2011).....	59
Figure 5.9 – Installation air conditioning on the side wall (Okezone.com, 2012) 60	
Figure 5.10 - Installation indoor part at flat plafond (author, 2014).....	62
Figure 5.11 – Installation air conditioning under the curve roof (Author, 2014) .	63
Figure 5.12 – Welding bracket for outdoor part of AC (Author, 2014)	65
Figure 5.13 – Installation outdoor part of air conditioning (Author, 2014).....	66
Figure 7.1 – Condition of outdoor parts (Author, 2014).....	91