

TABLE OF CONTENTS

TITLE PAGE	i
APPROVAL PAGE	ii
PROCESS VERBAUX (BERITA ACARA)	iii
ABSTRACT	iv
ABSTRAK	v
MOTTO AND DEDICATION	vi
ACKNOWLEDGEMENT	viii
TABLE OF CONTENT	xii
LIST OF TABLE	xvi
LIST OF FIGURE	xviii
ABBREVIATIONS	xxii

CHAPTER 1 INTRODUCTION

1.1. Background and Problem Statement.....	1
1.2. Problem Statement	2
1.3. Objectives of the Study	3
1.4. Scope of the Study	3

CHAPTER 2 LITERATURE REVIEW

2.1. Introduction	4
2.2. Airport	4
2.3.Runway	4
2.3.1. Types of Runway	5
2.3.1.1. Length of runway	5
2.3.1.2. Runway Configuration	6
2.3.2. Comparison between Runway and Roadway	8
2.3.3. Runway traffic areas	8
2.4. Runway Pavement Structure	10
2.4.1. Runway flexible pavement structure	12

2.4.1.1. Hot mix asphalt surfacing	12
2.4.1.2. Base Course	13
2.4.1.3. Subbase	13
2.4.1.4. Subgrade.....	13
2.4.2. Runway rigid pavement structure	15
2.4.2.1. Concrete pavement.....	15
2.4.2.2. Subbase	16
2.5. Aircraft Standard Dimension	17
2.6. Aircraft Weight	19
2.7. Landing Gear Configuration	20

CHAPTER 3 DESIGN AND METHODOLOGY

3.1. Introduction	24
3.2. Design parameters and calculation variables	26
3.2.1. Equivalent Single Wheel Load (ESWL).....	26
3.2.1.1. Determining Gear Loads.....	26
3.2.1.2. Determining Wheel Contact Area.....	27
3.2.1.3. Determining the value of Reduction Factor (RF).....	27
3.2.1.4. Determine the value of ESWL.....	28
3.2.2. Data of the aircraft movement	28
3.2.3. Technical Specifications The aircrafts will be reviewed	29
3.2.4. Condition and Bearing Capacity of Subgrade	36
3.3. Design of Flexible Runway Pavement	36
3.3.1. California Bearing Ratio (CBR) Method	37
3.3.2. Load Classification Number (LCN) Method	41
3.3.3. Federal Aviation Administration (FAA) Method	44
3.4. Design of Rigid Runway Pavement	48
3.4.1. Load Classification Number (LCN) Method	48
3.4.2. Portland Cement Association (PCA) Method	51

3.4.3. Federal Aviation Administration (FAA) Method	56
---	----

CHAPTER 4 DESIGN AND CALCULATION

4.1. Introduction	58
4.2. Calculation of equivalent single wheel load (ESWL) for aircraft.	58
4.3. Design and Calculation of Flexible Runway Pavements	61
4.3.1. California Bearing Ratio (CBR) Method	61
4.3.1.1. Abdul Rachman Saleh Airport of Malang	61
4.3.1.2. Ahmad Yani International Airport of Semarang.....	65
4.3.1.3. Sultan Syarif Kasim II International Airport of Pekanbaru Riau	68
4.3.2. Load Classification Number (LCN) Method	72
4.3.2.1. Abdul Rachman Saleh Airport of Malang	73
4.3.2.2. Ahmad Yani International Airport of Semarang	78
4.3.2.3. Sultan Syarif Kasim II International Airport of Pekanbaru Riau	83
4.3.3. Federal Aviation Administration (FAA) Method	88
4.3.3.1. Abdul Rachman Saleh Airport of Malang	88
4.3.3.2. Ahmad Yani International Airport of Semarang	94
4.3.3.3. Sultan Syarif Kasim II International Airport of Pekanbaru Riau	99
4.4. Design and Calculation of Rigid Runway Pavement	106
4.4.1. Load Classification Number (LCN) Method	106
4.4.1.1. Abdul Rachman Saleh Airport of Malang	108
4.4.1.2. Ahmad Yani International Airport of Semarang	109

4.4.1.3. Sultan Syarif Kasim II International Airport of Pekanbaru Riau	110
4.4.2. Portland Cement Association (PCA) Method	111
4.4.2.1. Abdul Rachman Saleh Airport of Malang	113
4.4.2.2. Ahmad Yani International Airport of Semarang	114
4.4.2.3. Sultan Syarif Kasim II International Airport of Pekanbaru Riau	115
4.4.3. Federal Aviation Administration(FAA) Method	116
4.4.3.1. Abdul Rachman Saleh Airport of Malang	116
4.4.3.2. Ahmad Yani International Airport of Semarang	119
4.4.3.3. Sultan Syarif Kasim II International Airport of Pekanbaru Riau	121

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions	124
5.1.1. Flexible Pavement	124
5.1.2. Rigid Pavement	130
5.2.Recommendations	136

REFERENCES	xxii
-------------------------	-------------

APPENDIX	xxvi
-----------------------	-------------

LIST OF TABLE

Table 2.1. Runway Length	5
Table 2.2. Example naming standard landing gear configuration	22
Table 2.3. Main Landing Gear Configuration.....	23
Table 3.1. Data Annual Departure Abdul Rachman Saleh Airport of Malang	29
Table 3.2. Data Annual Departure Ahmad Yani International Airport of Semarang	29
Table 3.3. Data Annual Departure Sultan Syarif Kasim II International Airport of Pekanbaru Riau	29
Table 3.4. Technical Specifications Aircraft Airbus A319.....	31
Table 3.5. Technical Specifications Aircraft Airbus A320.....	33
Table 3.6. Technical Specifications Aircraft Boeing B737-300	35
Table 3.7. The requirements design CBR method	38
Table 3.8. The thickness of minimum for loading heavy aircraft.....	38
Table 3.9. The thickness of minimum for loading medium aircraft	39
Table 3.10. The thickness of minimum for loading lightweight aircraft	39
Table 3.11. Conversion of aircraft main landing gear configuration	45
Table 3.12. Classifications planning and evaluation of the LCN method	48
Table 3.13. Safety Factor PCA method	51
Table 4.1. Calculation equivalent single wheel load (ESWL) value	61
Table 4.2. Aircraft Data of Abdul Rachman Saleh Airport of Malang.....	62
Table 4.3. Aircraft Data of Ahmad Yani International Airport of Semarang	65
Table 4.4. Aircraft Data of Sultan Syarif Kasim II International Airport of Pekanbaru Riau.....	68
Table 4.5. Result of calculation flexible pavement runway design using CBR method	71
Table 4.6. Aircraft data used for design flexible pavement runway LCN method	72
Table 4.7. Result of calculation flexible pavement runway design using LCN method	87

Table 4.8. Determined Plan Aircraft in Abdul Rachman Saleh Airport of Malang	88
Table 4.9. Determined Plan Aircraft in Ahmad Yani International Airport of Semarang	94
Table 4.10. Determined Plan Aircraft in Sultan Syarif Kasim II International Airport of Pekanbaru Riau.....	99
Table 4.11. Result of calculation flexible pavement runway design using FAA method	105
Table 4.12. Calculation equivalent single wheel load (ESWL) value	106
Table 4.13. Results of LCN value	107
Table 4.14. Result of calculation rigid pavement runway design using LCN method	107
Table 4.15. Summary data pavement structure.....	111
Table 4.16. Result of calculation rigid pavement runway design using PCA method	116
Table 4.17. Determined plan aircraft in Abdul Rachman Saleh Airport of Malang	116
Table 4.18. Determined plan aircraft in Ahmad Yani International Airport of Semarang	119
Table 4.19. Determined plan aircraft in Sultan Syarif Kasim II International Airport of Pekanbaru Riau.....	121
Table 4.20. Result of calculation rigid pavement runway design using FAA method	123
Table 5.1. Result of calculation flexible pavement runway design	125
Table 5.2. Result of calculation rigid pavement runway design	131

LIST OF FIGURE

Figure 1.1. Layout of an airport in general	2
Figure 2.1. Runway configuration type single	6
Figure 2.2. Runway configuration type parallel.....	6
Figure 2.3. Runway configuration type intersect.....	7
Figure 2.4. Runway configuration type Open-V.....	7
Figure 2.5. Typical cross section of a roadway.....	8
Figure 2.6. Typical runway and taxiway cross section	8
Figure 2.7. Layout Traffic areas.....	10
Figure 2.8. Components of (a) flexible and (b) rigid pavements	11
Figure 2.9. Basic flexible pavement structure.....	14
Figure 2.10. Load distributions on flexible pavement	15
Figure 2.11. Basic Rigid pavement structure	16
Figure 2.12. Spreading load from the Rigid Pavement to the Subgrade.....	17
Figure 2.13. Aircraft Dimensions	19
Figure 2.14. Basic landing gear configuration	21
Figure 2.15. Complex landing gear configuration	22
Figure 3.1. Flowchart of research design and methodology	25
Figure 3.2. Curve determines the value of the reduction factor for dual wheel aircraft.....	27
Figure 3.3. Curve determines the value of the reduction factor for tandem dual wheel aircraft.....	28
Figure 3.4. Airbus A319 General aircraft dimension.....	30
Figure 3.5. Airbus A319 Landing gear footprint	31
Figure 3.6. Airbus A320 General aircraft dimension.....	32
Figure 3.7. Airbus A320 Landing gear footprint	33
Figure 3.8. Boeing B737-300 General aircraft dimension.....	34
Figure 3.9. Boeing B737-300 Landing gear footprint	35
Figure 3.10. Flowchart CBR method for flexible runway pavements design.....	40
Figure 3.11. Curve determining LCN value.....	41

Figure 3.12. Curve determined runway flexible pavement thickness LCN method	42
Figure 3.13. Flow chart LCN method for flexible runway pavements design.....	43
Figure 3.14. Curve of flexible pavement design for critical area (dual wheel gear)	46
Figure 3.15. Flowchart FAA method for flexible runway pavements design.....	47
Figure 3.16. Curve determined pavement thickness LCN method	49
Figure 3.17. Flowchart LCN method for rigid runway pavements design	50
Figure 3.18. Curve determine of rigid pavement thickness Airbus A319 aircraft the PCA method.....	54
Figure 3.19. Flowchart PCA method for rigid runway pavements design.....	55
Figure 3.20. A curve that determined of rigid pavement thickness using FAA method	36
Figure 3.21. Flowchart FAA method for rigid runway pavements design	57
Figure 4.1. Acurve determined reduction factor valuefor dual wheel airplane	60
Figure 4.2. Curve determining LCN value for aircraft Airbus A319.....	73
Figure 4.3. Curve determining LCN value for aircraft Airbus A320.....	78
Figure 4.4. Curve determining LCN value for aircraft Boeing B737-300.....	83
Figure 4.5. Curve of flexible pavement design for aircraft Airbus A319 FAA method.....	93
Figure 4.6. Curve of flexible pavement design for aircraft Airbus A320 FAA method.....	98
Figure 4.7. Curve of flexible pavement design for aircraft Boeing B737-300 FAA method.....	104
Figure 4.8. Curve determined rigid pavement thickness aircraft Airbus A319 LCN method.....	108
Figure 4.9. Curve determined rigid pavement thickness aircraft Airbus A320 LCN method.....	109
Figure 4.10. Curve determined rigid pavement thickness aircraft Boeing B737-300 LCN method	110

Figure 4.11 Curve Conversion CBR to K Value for rigid pavements	112
Figure 4.12. Curve determine of rigid pavement thickness Airbus A319 PCA method.....	113
Figure 4.13. Curve determine of rigid pavement thickness Airbus A320 PCA method.....	114
Figure 4.14. Curve determine of rigid pavement thickness Boeing B737-300 PCA method.....	115
Figure 4.15. Curve determine of rigid pavement thickness Airbus A319 FAA method.....	118
Figure 4.16. Curve determine of rigid pavement thickness Airbus A320 FAA method.....	120
Figure 4.17. Curve determine of rigid pavement thickness Boeing B737-300 FAA method	122
Figure 5.1. Result of runway flexible pavement design thickness using CBR, LCN and FAA method at Abdulrachman Saleh Airport of Malang...	126
Figure 5.2. Result of runway flexible pavement design thickness using CBR, LCN and FAA method at Ahmad Yani International Airport of Semarang	127
Figure 5.3. Result of runway flexible pavement design thickness using CBR, LCN and FAA method at Sultan Syarif Kasim International Airport of Pekanbaru Riau	128
Figure 5.4. Chart Result of calculation rigid pavement runway design (Airbus A319).....	129
Figure 5.5. Chart Result of calculation rigid pavement runway design (Airbus A319).....	129
Figure 5.6. Chart Result of calculation flexible pavement runway design (Boeing B737)	130
Figure 5.7. Result of runway rigid pavement design thickness using CBR, LCN and FAA method at Abdulrachman Saleh Airport of Malang...	132

Figure 5.8. Result of runway rigid pavement design thickness using CBR, LCN and FAA method at Ahmad Yani International Airport of Semarang	133
Figure 5.9. Result of runway rigid pavement design thickness using CBR, LCN and FAA method at Sultan Syarif Kasim International Airport of Pekanbaru Riau	134
Figure 5.10. Chart Result of calculation rigid pavement runway design (Airbus A319).....	135
Figure 5.11. Chart Result of calculation rigid pavement runway design (Airbus A319).....	135
Figure 5.12. Chart Result of calculation rigid pavement runway design (Boeing B737-300).....	136

ABBREVIATIONS

CBR	California Bearing Ratio
FAA	Federal Aviation Administration
LCN	Load Classification Number
PCA	Portland Cement Association
ATCT	Air Traffic Control Tower
MSA	Metropolitan Statistical Area
NPIAS	National Plan of Integrated Airport Systems
L/TO	Landing or Takeoff
GW	Well Grade
GP	Poor Grade
ESWL	Equivalent Single Wheel Load
MTOW	Maximum takeoff weight
RF	Reduction Factor
ft	Feet
in	Inch
lbs	pounds
AASHTO	American Association of State Highway and Transportation Officials
MPa	mega Pascal
LL	Liquid Limit
PI	Plasticity index.
LCG	Load Classification Group
MR	Resilient Modulus
Psi	pounds per square inch
Pci	pounds per cubic inch