

Table of Contents

Title Page	i
Abstract	ii
Acknowledgements	iii
Table of Contents	iv
List of Figures	vii
List of Nomenclature	x
1 Introduction	1
1.1 Motivation of Project	1
1.2 Original Computer Code of T_{min}	3
1.3 Scope of this Thesis: Modifications to T_{min}	4
1.4 Outline	5
2 Research Review	6
2.1 Background of Piping Stresses	7
2.1.1 Differential Stress Element Analysis	7
2.1.2 Mohr Circle Analysis	8
2.1.3 Maximum-Shear-Stress Theory.....	10
2.1.4 Pipe-Wall Theory	11
2.2 Piping Codes and Standards Requirements	16
2.2.1 Unfired Piping and Pressure Vessel Code	17
2.2.2 Criteria Document	20
3 Development of a Fatigue Curve Database and Implementation.....	30
3.1 Stress-Based Fatigue Analysis and Stress States.....	31
3.2 Creation of an Stress-Cycle Curve	34
3.3 Strain-Based Fatigue Analysis.....	38
3.4 Fatigue Data Obtained for T_{min}	41
3.5 Calculation of Piping Fatigue Information and Implementation	47
4 Two-Axis Piping Span Stress Analysis Through T_{min}	54
4.1 Shear and Moment Analysis	54

4.2	Shear and Moment Diagrams	57
4.3	Stress-Intensity Factors	59
4.4	Differential Stress Element Analysis of Piping Span	61
4.5	False-Position Root Solver	73
5	Modifications Applied to T_{min}	76
5.1	User-Input Additions	76
5.2	Creation of 2-D Vertical Piping Span Output Form	82
5.3	Other T_{min} Additions	87
6	Numerical Examples	88
6.1	First Vertical Span Example—Basic Piping Configuration	89
6.2	Second Piping Span Example—Shear Dominates	99
7	Conclusions and Future Recommendations	107
7.1	Conclusions	107
7.2	Recommendations.....	109
	References	112
	Appendix A – Shear Analysis for Vertical Piping	117
	Appendix B – Fatigue Data Obtained for T_{min}	136
	Aluminum 1100	137
	Aluminum 3003-0	139
	Aluminum 6061-T6	141
	Nickel 200	143
	Appendix C – Matlab Code	145
	Aluminum 1100	146
	Aluminum 3003-0	156
	Aluminum 6061-T6	161
	Nickel 200	166
	2-D Vertical Piping Span	171
	Appendix D – Visual Basic Code Additions	179
	2-D Vertical Piping Span Calculation Module Sub-Set.....	180
	Span Choose Code and Form	211
	Valve Connection Code and Form	213
	2-D Vertical Analysis Form and Code	215
	Bookmark Code	223
	Copy Image Code	226

Call Macro Computer Code	235
Appendix E – Help File Creation and Output Documents.....	236
Creation of a Help file.....	237
Microsoft Word Document® Printouts	239
<i>Mathematica</i> ® Solutions	242
Vita	