TABLE OF CONTENTS

	Page		
ACKNO	ACKNOWLEDGEMENTSiii		
LIST	OF TABLESv		
LIST	OF ILLUSTRATIONSix		
ABSTR	ACTxiv		
Chapt	er		
I.	INTRODUCTION1		
II.	BUILDING FORM AND ITS DETERMINING FACTORS6		
III.	CLIMATIC FORCES14		
IV.	ALGORITHMS FOR BUILDING HEAT GAIN AND HEAT LOSS CALCULATIONS		
V.	HOURLY MODEL WEATHER DATA BASE FOR BUILDING ENERGY CALCULATIONS40		
VI.	BUILDING HEAT GAIN AND HEAT LOSS SIMULATIONS95		
VII.	CONCLUSIONS129		
BIBLIOGRAPHY134			
APPENDIX I COMPUTER PROGRAMS140			
APPEN	DIX II SAMPLES OF HOURLY MODEL WEATHER DATA FOR THE OKLAHOMA CITY AREA172		

LIST OF TABLES

TABLE	Page
1.1.	Differences between Olgyay's work and this study3
5.1.1.	F.S. statistics values for January48
5.1.2.	F.S. statistics values for February48
5.1.3.	F.S. statistics values for March48
5.1.4.	F.S. statistics values for April49
5.1.5.	F.S. statistics values for May49
5.1.6.	F.S. statistics values for June49
5.1.7.	F.S. statistics values for July50
5.1.8.	F.S. statistics values for August50
5.1.9.	F.S. statistics values for September50
5.1.10.	F.S. statistics values for October51
5.1.11.	F.S. statistics values for November51
5.1.12.	F.S. statistics values for December51
5.2.	Relative importance scales between 3 major weather groups52
5.3.	Relative importance scales within temperature group53
5.4.	Relative importance scales within wind velocity group53
5.5.	Relative importance scales within cloud cover group53
5.6.	Weighting factors54
5.7.	Candidates for 12 calendar months54
5.8.1.	Weighted sum of F.S. statistics for January55

5.8.2.	Weighted sum of F.S. statistics for February55
5.8.3.	Weighted sum of F.S. statistics for March55
5.8.4.	Weighted sum of F.S. statistics for April
5.8.5.	Weighted sum of F.S. statistics for May56
5.8.6.	Weighted sum of F.S. statistics for June
5.8.7.	Weighted sum of F.S. statistics for July57
5.8.8.	Weighted sum of F.S. statistics for August57
5.8.9.	Weighted sum of F.S. statistics for September57
5.8.10.	Weighted sum of F.S. statistics for October58
5.8.11.	Weighted sum of F.S. statistics for November58
5.8.12.	Weighted sum of F.S. statistics for December
5.9.	Model weather month/year combinations for 12 calendar months59
5.10.1.	Statistics of Tave and CCss for candidate years60
5.10.2.	Statistics of Tave and CCss for candidate years61
5.11.	Month/Year combinations of 3 hourly combinations67
5.12.	Standard meridians in continental United States
5.13.	Solar constant
5.14.	P, Q and R values91

5.15.	Record formats of Model Weather Data93
5.16.	True wind direction94
6.1.	Input data for heat gain/loss simulations98
6.2.	Actual building widths and lengths98
6.3.1.	March 21. Hourly solar radiation on unit surface area100
6.3.2.	June 21. Hourly solar radiation on unit surface area100
6.3.3.	September 21. Hourly solar radiation on unit surface area101
6.3.4.	December 21. Hourly solar radiation on unit surface area101
6.4.	Average of daily total heat gain through unit surface area in summer105
6.5.	Average of daily total heat gain through unit surface area in winter105
6.6.	An example of average of daily total heat gain and loss in each season107
6.7.1.	Final output data set for winter heat loss and summer heat gain, Orientation $0^{\circ}S$ 108
6.7.2.	Final output data set for winter heat loss and summer heat gain, Orientation 0°S \dots 108
6.8.	Daily average heat gain and heat loss in buildings oriented to the south111
6.9.	Daily average heat gain and heat loss in buildings oriented to the north113
6.10.	Daily average heat gain and heat loss in buildings oriented to the east114
6.11.	Daily average heat gain and heat loss in buildings oriented to the west115
6.12.	Daily average heat gain and heat loss

b.12. Daily average heat gain and heat loss in buildings oriented to the SE117

6.13.	Daily average heat gain and heat loss in buildings oriented to the SW118
6.14.	Daily average heat gain and heat loss in buildings oriented to the NE119
6.15.	Daily average heat gain and heat loss in buildings oriented to the NW120
6.16.	Daily average heat gain and heat loss in buildings oriented to the SSE121
6.17.	Daily average heat gain and heat loss in buildings oriented to the SSW122
6.18.	Daily average heat gain and heat loss in buildings oriented to the ESE123
6.19.	Daily average heat gain and heat loss in buildings oriented to the WSW124
6.20.	Daily average heat gain and heat loss in buildings oriented to the NNE125
6.21.	Daily average heat gain and heat loss in buildings oriented to the NNW126
6.22.	Daily average heat gain and heat loss in buildings oriented to the ENE127
6.23.	Daily average heat gain and heat loss in buildings oriented to the WNW128
7.1.	Optimum width-to-length ratio for each of 16 orientations133

viii

LIST OF ILLUSTRATIONS

FIGURE	Page
1.1.	Procedure of the study5
3.1.	Surface heat exchange at noon on a summer day16
3.2.	The hydrologic cycle20
3.3.	Latitudinal variations of evaporation and precipitation for the earth as a whole and for land and sea areas20
3.4.	Heat exchange between man and surroundings22
3.5.	The body's heat exchange24
4.1.	Unit excitation and unit response functions31
4.2.	Heat flow through window glass33
4.3.	Glass transmission35
5.1.	Procedure for constructing Model Weather Data Base44
5.2.1.	CDFs of January Tave62
5.2.2.	CDFs of January CCss62
5.2.3.	CDFs of February Tave62
5.2.4.	CDFs of February CCss62
5.2.5.	CDFs of March Tave62
5.2.6.	CDFs of March CCss62
5.2.7.	CDFs of April Tave63
5.2.8.	CDFs of April CCss63
5.2.9.	CDFs of May Tave63
5.2.10.	CDFs of May CCss63
5.2.11.	CDFs of June Tave63

5.2.12.	CDFs of June CCss63
5.2.13	CDFs of July Tave64
5.2.14.	CDFs of July CCss64
5.2.15.	CDFs of August Tave64
5.2.16.	CDFs of August CCss64
5.2.17.	CDFs of September Tave64
5.2.18.	CDFs of September CCss64
5.2.19.	CDFs of October Tave65
5.2.20.	CDFs of October CCss65
5.2.21.	CDFs of November Tave65
5.2.22.	CDFs of November CCss65
5.2.23.	CDFs of December Tave65
5.2.24.	CDFs of December CCss65
5.3.1.	Linear interpolation of dry bulb temperature (Tdb)68
5.3.2.	Linear interpolation of dew point temperature (Tdp)69
5.4.1.	Connection case 5 (Original data)72
5.4.2.	Connection case 9 (Original data)72
5.5.1.	Connection case 1 (Original data)73
5.5.2.	Connection case 1 (Cubic Splined)73
5.6.1.	Connection case 2 (Original data)74
5.6.2.	Connection case 2 (Cubic Splined)74
5.7.1.	Connection case 3 (Original data)75
5.7.2.	Connection case 3 (Cubic Splined)75
5.8.1.	Connection case 4 (Original data)76
5.8.2.	Connection case 4 (Cubic Splined)76

5.9.1.	Connection case 6 (Original data)77
5.9.2.	Connection case 6 (Cubic Splined)77
5.10.1.	Connection case 7 (Original data)78
5.10.2.	Connection case 7 (Cubic Splined)78
5.11.1.	Connection case 8 (Original data)79
5.11.2.	Connection case 8 (Cubic Splined)79
5.12.	Procedure for estimating solar radiation81
5.13.	Equation of time by Spencer's equation84
5.14.	Position of the sun85
5.15.	Sky clearness (CN) values
6.1.1.	Solar radiation on unit surface area, March 21, 8:00 a.m., CC = 9102
6.1.2.	Solar radiation on unit surface area, March 21, 12:00 noon, CC = 10102
6.1.3.	Solar radiation on unit surface area, March 21, 3:00 p.m., CC = 10102
6.1.4.	Solar radiation on unit surface area, March 21, 5:00 p.m., CC = 10102
6.2.1.	Solar radiation on unit surface area, June 21, 8:00 a.m., CC = 2103
6.2.2.	Solar radiation on unit surface area, June 21, 12:00 noon, CC = 5103
6.2.3.	Solar radiation on unit surface area, June 21, 3:00 p.m., CC = 5103
6.2.4.	Solar radiation on unit surface area, June 21, 5:00 p.m., CC = 7103
6.3.1.	Solar radiation on unit surface area, September 21, 8:00 a.m., CC = 0104
6.3.2.	Solar radiation on unit surface area, September 21, 12:00 noon, CC = 0104

xi

6.3.3.	Solar radiation on unit surface area, September 21, 3:00 p.m., CC = 0104
6.3.4.	Solar radiation on unit surface area, September 21, 5:00 p.m., CC = 0104
6.4.	Solar radiation on unit surface area, December 21, 12:00 noon, CC = 10105
6.5.1.	Summer heat gain through unit surface area106
6.5.2.	Winter heat loss through unit surface area106
6.6.	Daily average heat gain and heat loss for the south orientation
6.7.	Daily average heat gain and heat loss for the north orientation113
6.8	Daily average heat gain and heat loss for the east orientation114
6.9.	Daily average heat gain and heat loss for the west orientation115
6.10	Daily average heat gain and heat loss for the SE orientation117
6.11.	Daily average heat gain and heat loss for the SW orientation118
6.12	Daily average heat gain and heat loss for the NE orientation119
6.13.	Daily average heat gain and heat loss for the NW orientation120
6.14.	Daily average heat gain and heat loss for the SSE orientation121
6.15.	Daily average heat gain and heat loss for the SSW orientation122
6.16.	Daily average heat gain and heat loss for the ESE orientation123
6.17.	Daily average heat gain and heat loss for the WSW orientation124

6.18.	Daily average heat gain and heat loss for the NNE orientation125
6.19.	Daily average heat gain and heat loss for the NNW orientation126
6.20.	Daily average heat gain and heat loss for the ENE orientation127
6.21.	Daily average heat gain and heat loss for the WNW orientation128
7.1.	Daily average heat gain and heat loss through unit surface area
7.2.	Daily total heat gain and heat loss through walls and roof132
7.3.	Optimum building shape for a building oriented to 0° south