

Contents

1	Introduction	1
	References	4
2	Background to Australian House Energy Rating	7
2.1	Historical and Human Perspective	7
2.2	Climate Change and Global Warming	12
2.3	Greenhouse Gas Reduction	13
2.4	Australian Thermal Performance Regulations	17
2.4.1	BCA Compliance	19
2.4.2	House Energy Star Rating	20
2.5	Industry Reaction	21
	References	23
3	Background to HER Program Validation	31
3.1	What to Validate?	31
3.2	Methods of Validation	33
3.3	Is ‘AccuRate’ Accurate?—A Historical Context	35
3.4	Key Elements of Empirical Validation	41
3.5	Previous Australian Validation Research	42
3.6	Previous International Validation Research	45
3.7	Background to Test Buildings for Empirical Validation	50
3.8	Conclusion	55
	References	56
4	Methodology	65
4.1	Introduction	65
4.1.1	The Research Methodology	65
4.1.2	Empirical Data	67
4.2	The Thermal Performance Test Cells	68
4.2.1	Introduction	68
4.2.2	Objectives of the Thermal Performance Test Cells	69

4.2.3	The Design of the Thermal Performance Test Cells. . .	69
4.2.4	Other Fabric Considerations	81
4.2.5	Test Cell Placement and Orientation	89
4.2.6	University and Council Approvals.	90
4.2.7	Test Cell Construction.	91
4.2.8	Summary of the Thermal Performance Test Cells Construction.	118
4.3	Empirical Data	120
4.3.1	Introduction	120
4.3.2	Objectives	120
4.3.3	Environmental Conditions Requiring Measurement . . .	121
4.3.4	Parameters Requiring Measurement.	124
4.3.5	Additional Environmental Measurements (or Supporting Data)	124
4.3.6	Platforms for Environmental Measurement.	132
4.3.7	Building and Site Environmental Measurement.	134
4.3.8	Infiltration	136
4.3.9	Infra-red Camera Imagery	136
4.3.10	Defining Room Temperature	138
4.3.11	The Fabrication, Installation and Calibration of Environmental Measuring Equipment	142
4.3.12	DT500 DataTaker Data Loggers	144
4.3.13	Data Logger Programming.	146
4.3.14	Calibration of Environmental Measuring Equipment	151
4.3.15	Operational Control of the Thermal Performance Test Cells	152
4.3.16	Thermal Performance Test Cell Data.	155
4.3.17	Empirical Data Summary.	160
4.4	Detailed Thermal Simulation by AccuRate.	161
4.4.1	Introduction	161
4.4.2	Objectives of the AccuRate Detailed Thermal Simulation	161
4.4.3	The AccuRate House Energy Rating Software	163
4.4.4	AccuRate—Standard Inputs	164
4.4.5	AccuRate—Non-standard Inputs	171
4.4.6	The AccuRate Simulations.	181
4.4.7	Summary of the Detailed Thermal Simulation by AccuRate	184
4.5	Methods of Analysis	185
4.5.1	Graphical Analysis	186
4.5.2	Statistical Analysis	187
4.6	Conclusion to Methodology	189
	References.	190

5	Results, Analysis and Discussion of Empirical Validation	199
5.1	Introduction	199
5.2	Climate Data	200
5.2.1	Air Temperature	202
5.2.2	Global Solar Radiation	204
5.2.3	Diffuse Solar Radiation	205
5.2.4	Summary	207
5.3	Variation Between Simulation Types	207
5.3.1	Test Cell Subfloor	208
5.3.2	Test Cell Room	210
5.3.3	Test Cell Roof Space	212
5.3.4	Summary	214
5.4	Empirical Validation Graphs	214
5.4.1	Unenclosed-Perimeter Platform-Floored Test Cell	214
5.4.2	Enclosed-Perimeter Platform-Floored Test Cell	223
5.4.3	Concrete Slab-on-Ground Floored Test Cell	232
5.4.4	Summary for Empirical Validation Graphs	238
5.5	Statistical Analyses	239
5.5.1	Scatter Plot of Measured and Simulated Temperatures	240
5.5.2	Residual Histograms	252
5.5.3	Residual Value Time Series Plots	263
5.5.4	Correlation of Adjoining Zone Residual Values	269
5.5.5	Correlation of External Air Temperature and Zone Residuals	277
5.5.6	Correlation of Wind Speed and Test Cell Residuals	290
5.5.7	Correlation of Wind Direction and Test Cell Residuals	300
5.5.8	Correlation of Global Solar Radiation and Test Cell Residuals	307
5.5.9	Correlation of Diffuse Solar Radiation and Test Cell Residuals	320
5.6	Summary for Results, Analysis and Discussion	330
5.6.1	Climate Data Analysis (Sect. 5.2)	331
5.6.2	Detailed Envelope Simulation (Sect. 5.3)	331
5.6.3	Empirical Validation Graphs (Sect. 5.4)	331
5.6.4	Statistical Analysis (Sect. 5.5)	332
5.6.5	Linking of Specific Analyses	333
	References	335
6	Conclusion	339
6.1	Areas for Future Research	342
	References	344

The Empirical Validation of House Energy Rating (HER)
Software for Lightweight Housing in Cool Temperate
Climates

Dewsbury, M.A.

2015, XIX, 344 p. 296 illus., 60 illus. in color., Hardcover

ISBN: 978-3-319-14336-1