

CONTENTS

ACKNOWLEDGMENTS .....	.xiii
INTRODUCTION .....	.I
CHAPTER 1 – EARTH-SHELTERED DESIGN PRINCIPLES .....	.5
Earth as Thermal Mass .....	.5
The Importance of Insulation .....	.7
Insulation in the North .....	.9
Insulation in the South .....	.10
The Earth Roof Factor .....	.11
How Much Does it Weigh? .....	.14
Simplicity of Design .....	.18
Types of Earth-Sheltered Designs .....	.21
Egress and Fenestration Code Considerations .....	.24
The Original Log End Cave Plan .....	.25
The 40 × 40' Log End Cave Plan .....	.26
The Earthwood Plan .....	.26
Using “Marginal” Land .....	.29
Design Around Bargains .....	.30
Plans and Models .....	.32

CHAPTER 2 – SITING AND EXCAVATION	35
Flat Site Excavation Calculations	36
Log End Cave: “A Gentle, South-Facing Slope”	40
Log End Cave: Laying out the Excavation	44
Earthwood: Site Work	48
CHAPTER 3 – FOUNDATIONS	51
Log End Cave: Laying Out the Footings	51
Log End Cave: Insulating the Footings	54
Resisting Lateral Load on the Wall	54
The Frost Wall	55
Earthwood: The Floating Slab	57
The “Monolithic” Floating Slab	59
Earthwood: Laying out and Digging the Footings Tracks	60
Log End Cave: Forming the Footings	61
Reinforcing Bar (Rebar)	65
Earthwood: A Round Footing	66
CHAPTER 4 – THE FLOOR	77
A Wooden Floor	77
The Concrete Floor	78
Earthwood: Insulation	80
In-Floor Radiant Heating	81
Under-Floor Plumbing	82
Under-Floor Electrical	87
Under-Stove Vents	88
Log End Cave: The Fence	89
The Floor Pour: A Final Checklist	90
Log End Cave: Pouring the Floor	91
Earthwood: Preparation for the Floor	94
Earthwood: Forming and Pouring the Buttresses	94
Earthwood: Pouring the Floor	95

CHAPTER 5 – EXTERNAL WALLS .....	.97
Conventionally Mortared Concrete Blocks .....	.97
Stone Masonry .....	.97
Cordwood Masonry .....	.99
Poured Concrete .....	.100
Pressure-Treated Wood Foundations .....	.100
Rammed-earth Tire Walls .....	.101
Mike Oehler’s “PSP” Method .....	.101
Surface-bonded Blocks .....	.102
Log End Cave: The Walls .....	.102
Log End Cave: Finishing the Top of the Block Wall .....	.111
Simultaneous Events at Earthwood .....	.113
CHAPTER 6 – TIMBER FRAMING .....	.117
About Posts and Planks .....	.117
Design Considerations for Rafters .....	.118
Bending and Shear .....	.119
Sources of Timbers .....	.120
Timber Framing for Earth-Sheltered Housing .....	.121
Log End Cave: Timber Framing .....	.122
Installing Posts on Concrete .....	.123
Log End Cave: Plank-and-Beam Roofing .....	.125
Log End Cave: Installing the Planking .....	.129
Earthwood: Timber Framing .....	.133
Earthwood: The Floor Joists .....	.135
Earthwood: Decking .....	.137
Earthwood: Upstairs Post-and-Beam Frame .....	.138
Earthwood: Rafters .....	.139

CHAPTER 7 – WATERPROOFING, INSULATION, & DRAINAGEI4I

- Waterproofing OptionsI4I
- In Search of the Perfect Membrane...I43
- Waterproofing Vertical WallsI44
- Waterproofing Roofs: The Drip EdgeI48
- Earthwood: Waterproofing the RoofI5I
- Sidewall InsulationI53
- Roofing InsulationI54
- Earthwood: Insulating the RoofI56
- DrainageI57
- Footing DrainsI57
- Draining the SidewallsI58
- Drainage Mats (Composites)I59
- Roof DrainageI6I

CHAPTER 8 – THE LIVING ROOFI65

- Stoneview Roof: A Step-by-Step Photo EssayI65
- The Earth RoofI65
- Retaining Earth at the Edge with TimbersI70
- Retaining Earth with SodsI7I
- Log End Cave: The Earth RoofI72
- Earthwood: The Earth RoofI74
- Other Living RoofsI74
- What to Grow on the Roof...I75
- Planting a Lighter-Weight Earth RoofI77
- Maintenance of Living RoofsI78
- Living Roofs on a Commercial ScaleI79
- Chris Dancey: Our Living Roof in OntarioI80

CHAPTER 9 – FINISHING THE EXTERIOR .....	.185
Bracing before Backfilling .....	.185
Retaining Walls .....	.186
Log End Cave: Backfilling and Retaining Walls .....	.187
Other Choices for Retaining Walls .....	.190
Coating Exposed Rigid Foam .....	.191
Log End Cave: Landscaping .....	.192
Earthwood: Landscaping .....	.193
CHAPTER 10 – INTERIOR CONSIDERATIONS .....	.195
Nothing Special .....	.195
Filling the Space between Rafters .....	.196
Log End Cave: Heat Sink .....	.198
Earthwood: Masonry Stove .....	.199
Floor Covering Options .....	.199
Earthwood: The Upstairs Floor .....	.202
Earthwood: Kitchen Cabinets .....	.202
Closing Comments .....	.203
CHAPTER 11 – PERFORMANCE .....	.205
PART ONE: LOG END CAVE .....	.205
Energy Nosebleed – One .....	.205
Energy Nosebleed – Two .....	.206
Livability .....	.208
Heating and Cooling .....	.208
Economy of Construction .....	.210
PART TWO: EARTHWOOD .....	.210
Cost at Earthwood .....	.212
On Big Projects .....	.214

CHAPTER 12 – OUR EARTH-SHELTERED HOME – A CASE STUDY215
by Mark Powers

APPENDIX A: RADON223

APPENDIX B: RESOURCES227

APPENDIX C: STRESS LOAD CALCULATIONS234

APPENDIX D: METRIC CONVERSION TABLES243

ANNOTATED BIBLIOGRAPHY244

INDEX249

ABOUT THE AUTHOR255