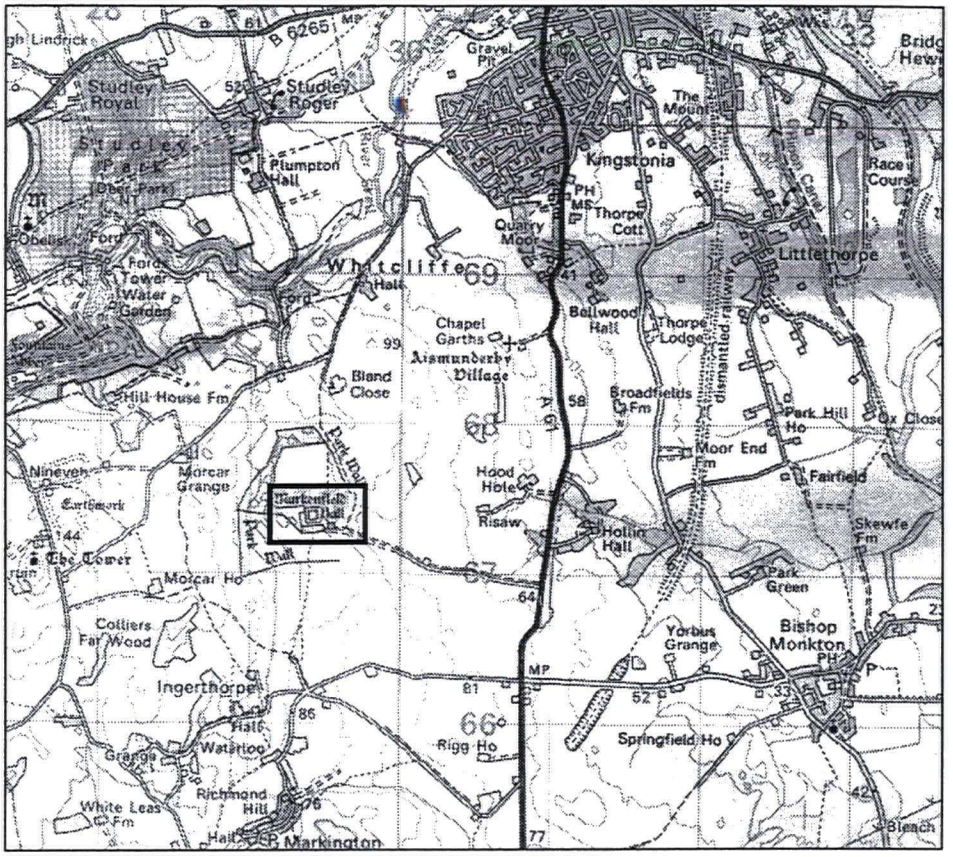
Figure 1: Map to show general location of Markenfield Hall



(based upon the Ordnance Survey 1:50000 map with permission of the Controller of Her Majesty's Stationery Office, ©Crown Copyright)

Figure 2: General plan of Markenfield Hall

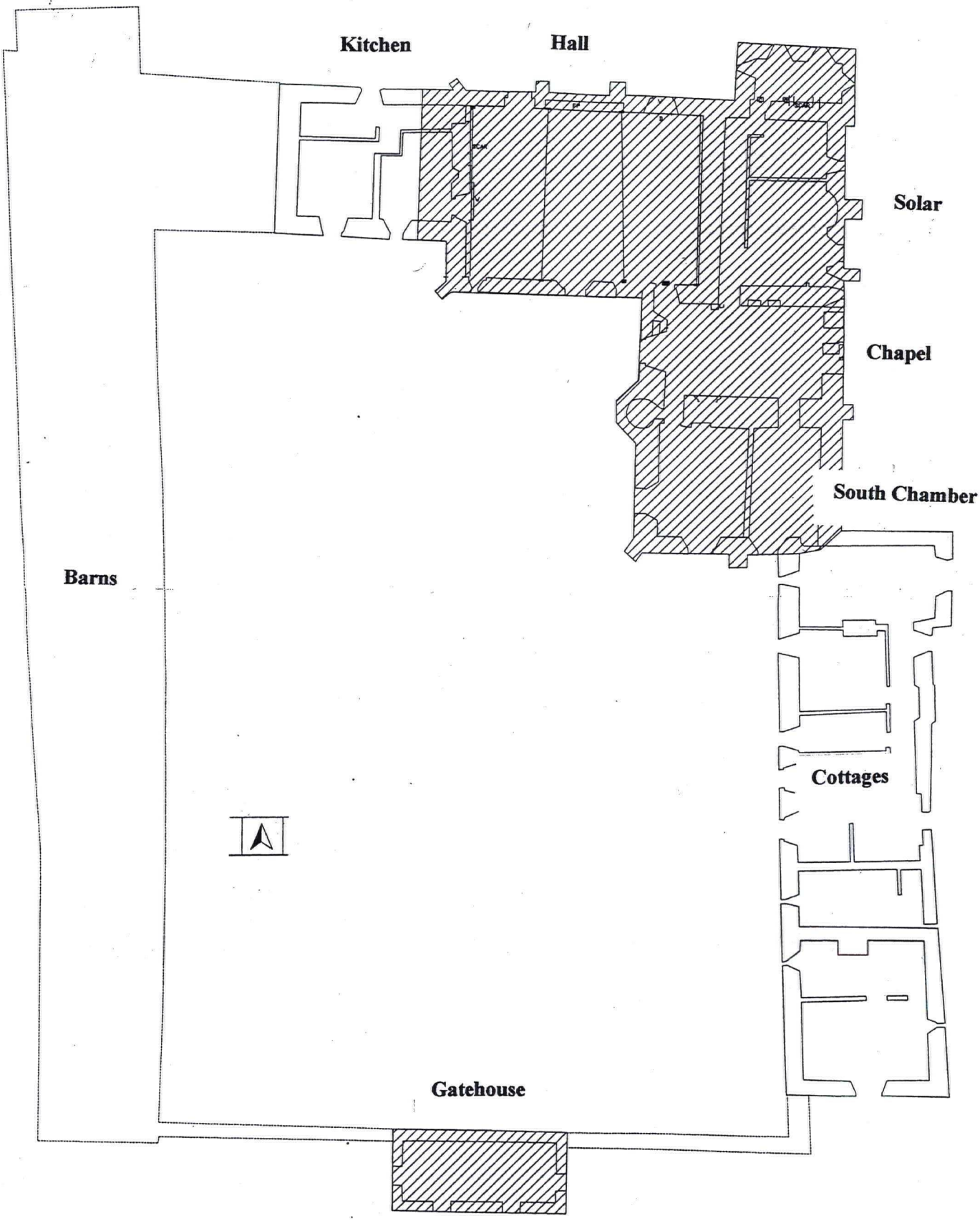


Figure 3: Photograph of the gatehouse, looking north across the moat

Figure 4: Drawing to show location of samples from the gatehouse

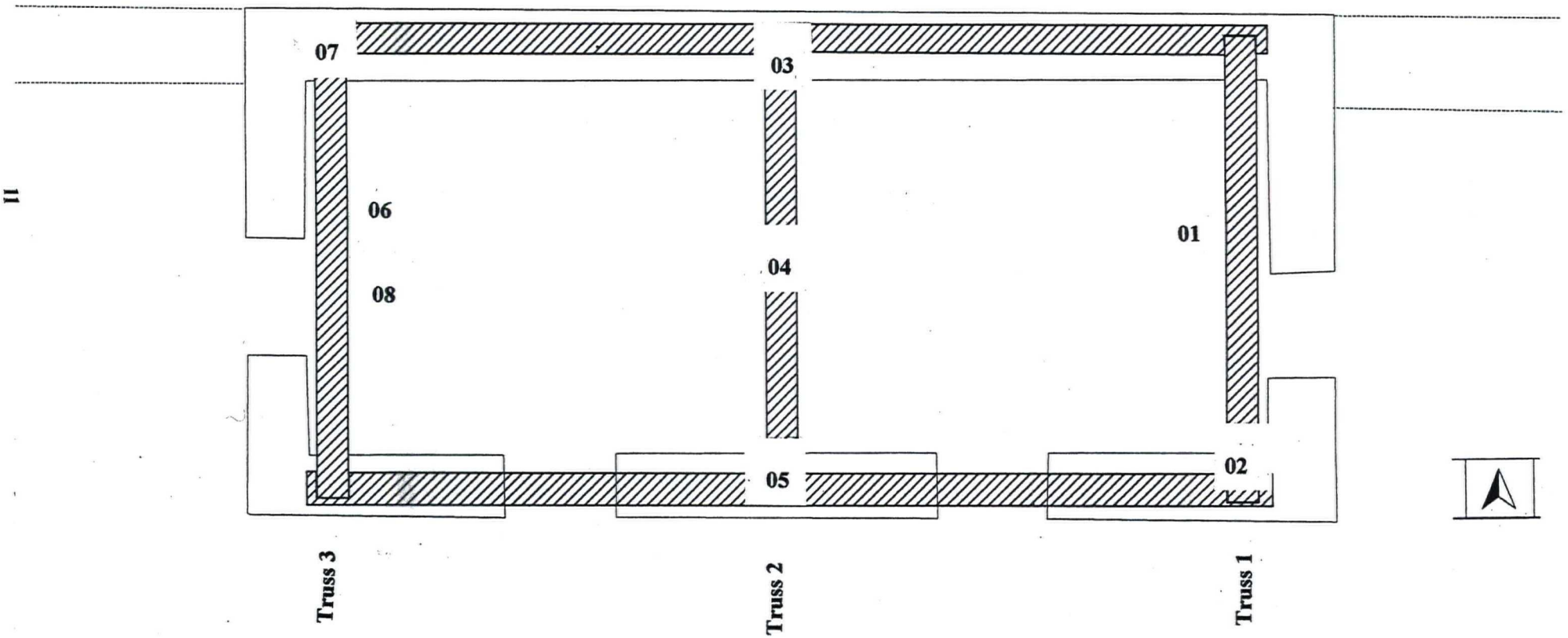


Figure 5a: Drawing to show location of samples from truss 1 (viewed from the west)

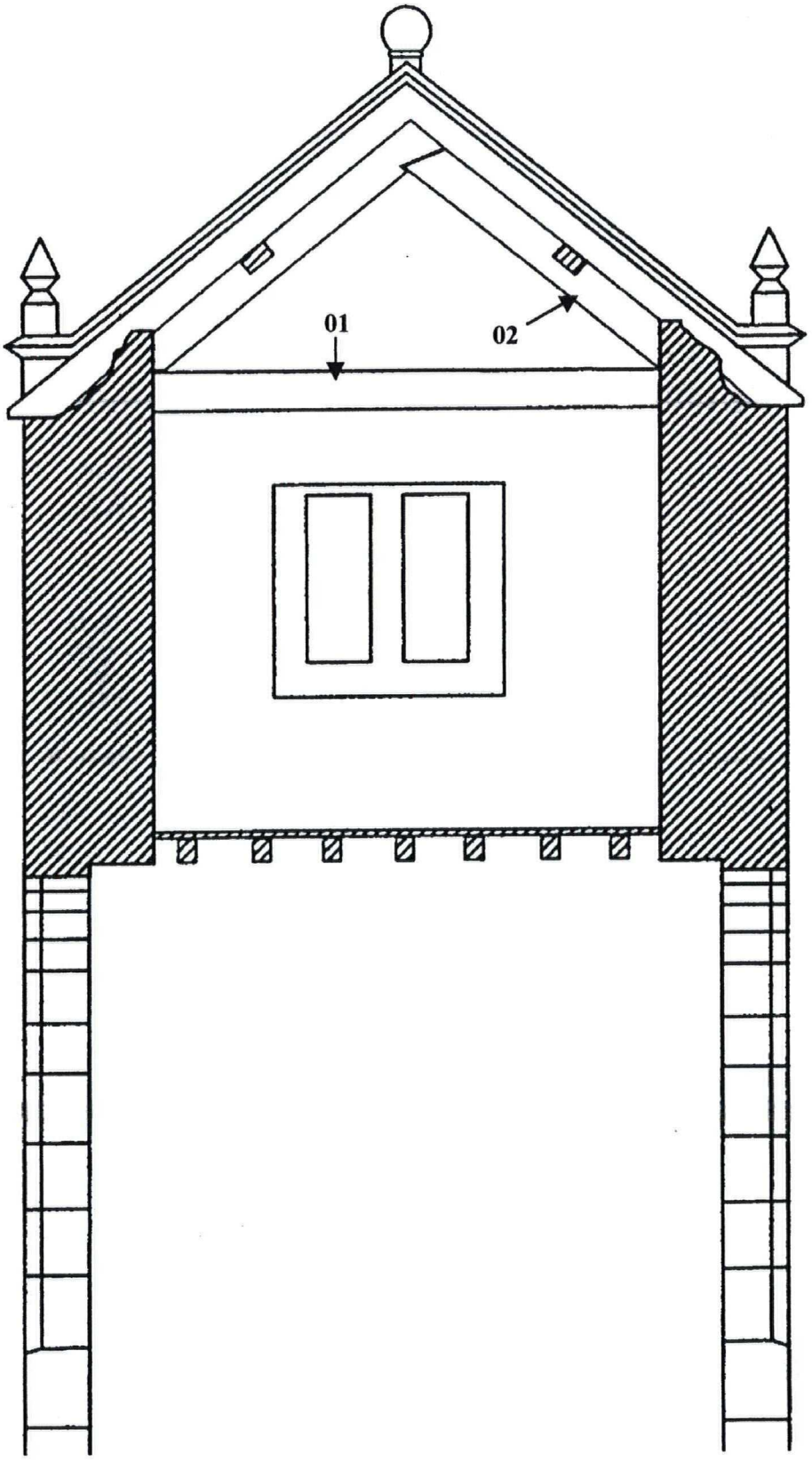


Figure 5b: Drawing to show location of samples from truss 2 (viewed from the east)

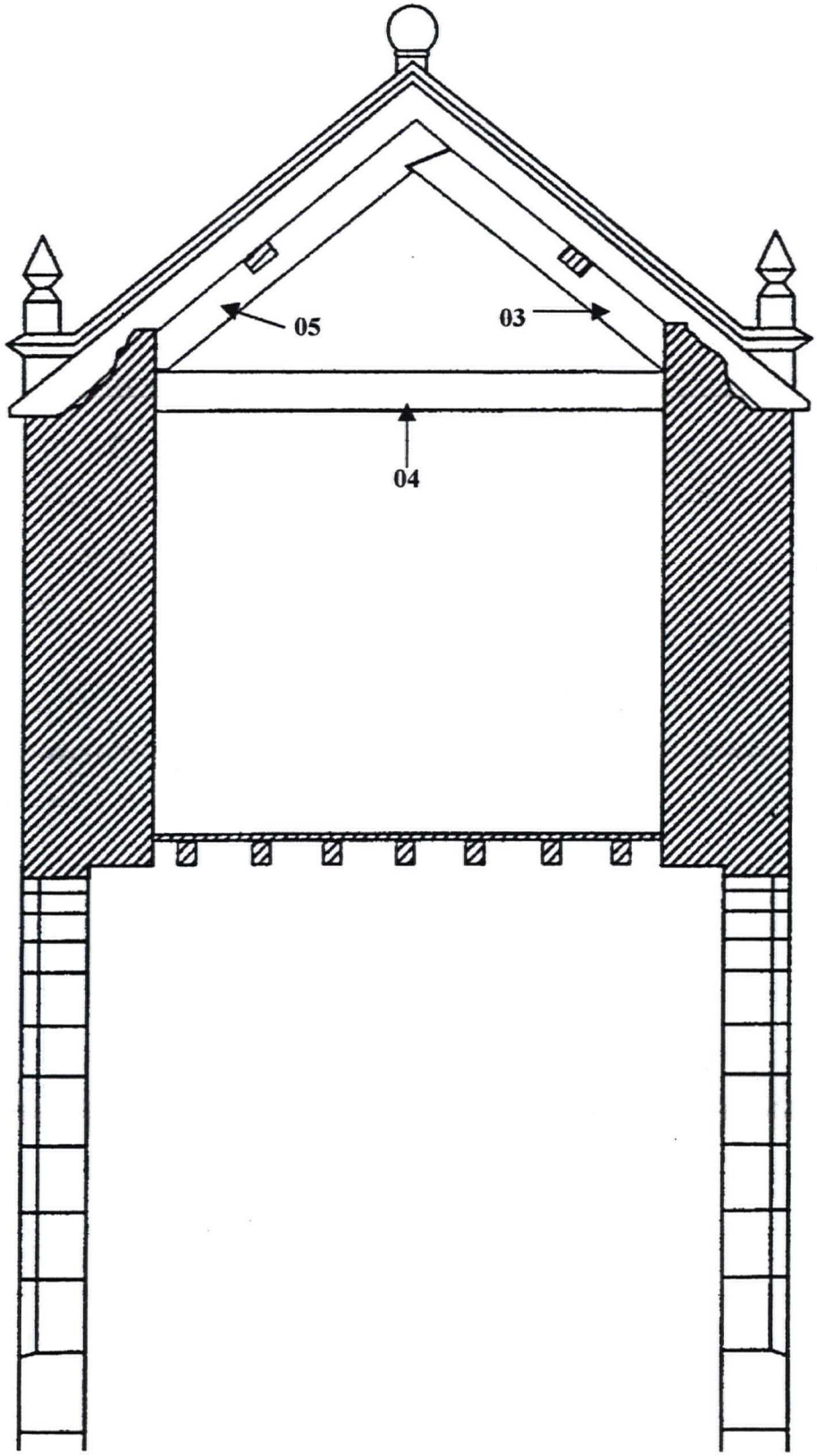


Figure 5c: Drawing to show location of sample from truss 3 (viewed from the east)

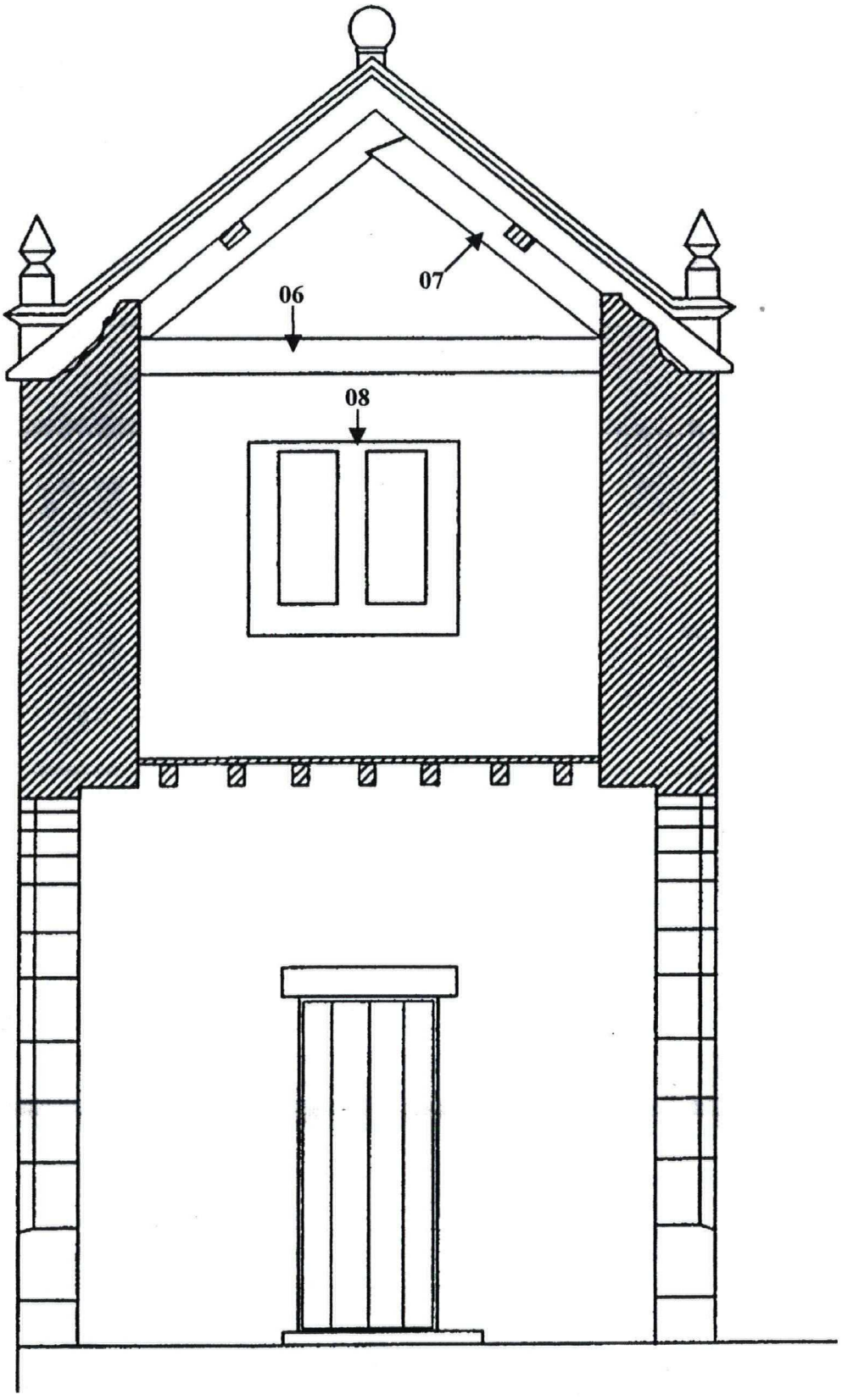
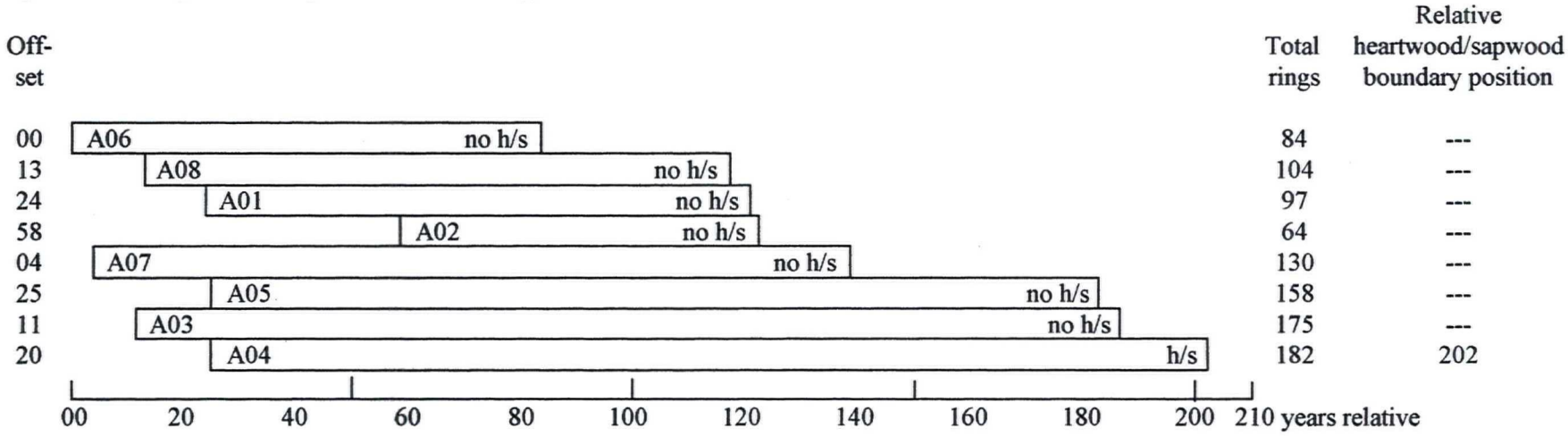


Figure 6: Bar diagram of samples in site chronology MKFASQ01



White bars = heartwood rings
h/s = heartwood/sapwood boundary is last ring on sample

Data of measured samples – measurements in 0.01mm units

MKF-A01A 97
120 138 197 282 185 143 217 175 108 148 144 191 115 111 151 180 124 144 150 145
121 76 145 119 93 104 76 73 78 72 94 99 99 68 58 64 76 93 104 90
96 89 92 95 86 84 60 81 71 86 101 78 75 85 106 135 89 109 122 120
142 98 115 160 129 140 112 108 112 157 127 114 96 104 100 82 85 122 112 73
82 105 83 74 121 52 69 74 98 60 83 78 74 103 99 72 98
MKF-A01B 97
131 135 197 279 188 141 225 163 114 149 134 178 122 113 146 182 132 152 145 156
119 74 144 126 93 101 72 76 84 69 91 109 90 72 61 68 74 92 103 97
94 95 92 94 85 87 61 78 76 86 96 80 77 90 100 145 88 104 118 111
137 100 125 148 135 136 114 108 104 160 117 115 97 106 101 82 84 124 123 77
88 105 84 69 132 64 76 62 95 65 81 77 86 97 103 67 95
MKF-A02A 64
73 55 81 91 102 93 103 98 93 83 83 88 61 68 71 88 107 87 87 101
118 156 110 130 140 149 145 106 143 156 133 148 121 115 107 135 108 131 111 114
120 110 104 103 128 94 99 103 79 84 111 71 53 84 86 79 80 79 80 103
83 97 106 125
MKF-A02B 64
61 62 77 91 106 94 98 104 88 92 76 94 66 65 69 88 105 85 88 94
129 153 116 126 137 141 146 109 143 162 128 144 124 116 108 145 117 128 107 125
106 115 103 102 143 84 110 101 67 94 93 84 60 70 95 71 102 72 88 107
71 97 102 154
MKF-A03A 175
297 366 280 179 289 320 219 206 186 164 393 711 424 311 266 281 314 218 159 261
225 216 227 233 228 263 155 178 231 223 213 129 145 142 105 115 144 155 100 86
43 74 54 84 99 87 69 67 70 108 110 87 93 114 112 122 116 104 98 95
87 91 106 92 90 74 90 94 110 109 82 96 126 108 124 133 204 172 119 112
77 109 148 153 120 96 98 109 119 95 106 84 90 89 85 76 95 140 77 71
93 117 95 105 99 130 106 130 85 101 115 99 98 98 106 103 93 92 82 89
105 100 138 102 110 117 81 78 82 103 108 107 101 60 69 70 79 108 91 79
83 97 71 74 83 77 76 87 60 66 68 83 98 82 84 112 113 90 74 73
104 80 84 80 69 117 92 83 70 70 105 121 93 123 98
MKF-A03B 175
280 404 298 203 307 286 211 229 181 145 404 732 370 330 274 289 325 204 141 243
218 217 239 234 230 266 162 170 233 234 185 130 132 145 114 117 146 146 108 78
64 68 59 79 100 80 70 68 78 95 101 86 104 116 120 123 113 97 104 89
96 99 100 92 93 73 93 96 104 105 90 98 122 102 131 120 202 173 115 109
91 105 152 144 126 98 96 104 124 88 97 95 85 102 77 81 96 142 85 74
89 126 92 100 111 133 105 133 82 108 112 98 102 85 108 105 97 91 78 89
92 97 143 97 106 118 85 78 82 97 119 114 85 62 67 75 82 101 97 75
84 83 87 70 80 80 79 78 66 66 70 75 99 80 80 111 105 100 70 81
103 91 83 81 69 104 107 93 58 70 112 114 101 120 97
MKF-A04A 182
185 258 353 280 249 238 195 277 198 176 289 190 231 207 182 190 209 156 149 188
216 208 129 129 138 104 120 126 154 81 53 45 42 48 49 66 73 49 51 67
79 87 84 82 101 113 110 99 93 102 83 93 81 103 106 85 92 109 104 114
108 97 97 123 92 113 99 121 116 88 91 71 86 118 99 113 109 92 119 143
92 103 93 84 122 119 90 102 134 118 101 108 107 103 130 144 157 137 151 110

122 140 112 92 90 117 121 124 99 105 123 127 144 237 170 145 165 119 118 122
126 140 159 150 101 93 97 102 143 149 113 140 126 129 94 136 100 110 101 92
83 106 167 185 142 119 148 187 166 107 102 193 163 183 135 121 175 134 144 96
115 162 172 156 167 126 96 109 140 132 104 127 159 107 117 88 149 163 178 200
107 121
MKF-A04B 182
207 250 345 285 244 232 196 280 198 173 299 185 234 210 179 182 221 164 150 173
226 198 130 126 141 103 126 123 134 79 57 45 49 48 50 58 73 50 53 65
75 86 85 78 104 115 109 98 93 101 84 82 89 104 92 95 87 101 105 112
115 97 103 124 92 119 85 133 128 86 87 75 84 127 93 108 114 94 117 147
92 97 95 80 126 125 97 92 128 103 100 113 113 100 124 138 154 143 150 100
118 141 115 88 90 118 121 126 97 108 116 131 138 235 181 142 163 111 121 120
121 141 161 147 89 99 95 107 135 151 126 146 131 134 97 124 108 106 101 97
86 110 162 190 150 98 137 185 148 121 105 188 170 175 142 113 173 144 138 107
107 151 178 178 154 126 94 117 125 128 111 138 144 109 113 97 150 164 157 147
101 124
MKF-A05A 158
238 255 363 216 197 294 247 354 289 291 257 304 202 217 290 260 253 129 129 130
86 132 142 128 105 66 41 54 42 53 81 75 51 54 72 76 96 95 79 87
109 116 104 108 96 81 91 97 101 103 87 77 88 88 100 101 87 141 131 107
135 117 207 168 105 96 92 112 165 159 134 105 92 104 119 96 106 84 76 88
97 77 88 160 76 88 98 131 94 140 113 126 109 147 96 119 126 115 100 122
145 133 120 96 93 107 114 100 130 122 124 120 67 82 89 103 120 135 135 80
64 78 101 133 121 89 88 97 85 73 93 96 93 82 84 70 82 85 109 92
92 123 145 137 88 85 130 98 122 96 78 115 111 101 94 93 151 110
MKF-A05B 158
249 257 358 253 176 286 245 350 303 266 257 305 193 203 284 260 236 136 134 134
88 137 142 147 97 68 48 54 46 55 90 76 67 50 73 77 99 94 90 87
110 118 109 113 96 79 94 102 107 94 82 81 86 91 96 101 89 140 129 111
138 116 193 172 104 95 92 111 158 165 131 107 100 100 120 85 111 79 75 95
92 74 92 160 85 85 107 129 92 128 120 132 115 129 98 122 132 111 101 120
137 144 120 94 96 102 115 100 128 117 126 124 70 76 96 105 126 142 128 70
80 84 102 132 124 92 97 86 99 71 92 86 83 88 76 72 69 93 107 91
94 131 136 129 89 83 132 102 106 97 81 111 109 106 86 96 136 138
MKF-A06A 84
157 115 273 290 253 151 115 209 217 138 141 106 84 101 146 205 164 186 106 132
112 290 559 389 242 178 288 346 160 170 309 218 190 201 179 289 178 138 155 135
153 141 186 187 125 72 99 104 90 65 64 62 74 80 83 118 90 44 61 62
78 90 104 86 115 102 109 102 93 87 64 64 84 86 77 68 59 77 92 91
83 89 106 115
MKF-A06B 84
161 112 225 299 242 141 125 213 216 134 133 109 82 99 149 206 143 170 110 152
131 315 566 389 250 188 287 379 169 163 311 216 192 209 183 289 173 141 173 134
158 137 187 193 121 68 102 95 97 82 57 67 64 80 76 153 86 54 51 58
81 93 102 86 111 111 106 110 90 86 59 68 83 82 77 81 55 70 86 103
76 91 96 87
MKF-A07A 130
335 324 232 225 283 263 350 306 338 251 226 303 239 179 171 173 124 196 293 174
212 178 159 164 135 109 188 140 194 202 177 168 196 159 184 225 252 267 183 226
207 100 129 123 143 89 34 40 51 61 51 63 70 47 52 59 70 83 94 98
90 110 116 105 109 94 83 83 97 113 90 92 86 107 110 84 103 83 81 116

122 111 112 136 101 82 88 80 87 121 115 111 92 118 95 105 63 85 91 97
75 72 83 87 122 80 61 99 136 90 98 107 108 115 134 95 124 98 84 116
111 112 119 118 92 84 79 122 130 102
MKF-A07B 130
367 324 227 227 261 258 346 305 347 232 205 286 227 196 147 157 131 210 297 225
176 168 145 162 132 101 181 139 170 190 152 180 190 174 193 221 250 252 194 219
207 105 125 122 141 89 26 44 51 54 51 66 70 51 52 52 77 79 100 96
93 102 115 110 98 101 89 86 98 98 99 83 89 124 98 89 89 83 88 115
122 114 111 138 101 77 83 86 106 119 122 107 99 116 110 120 72 84 105 76
95 68 80 93 144 73 66 101 133 90 109 98 108 102 147 87 127 111 101 95
130 136 107 107 111 80 100 106 139 107
MKF-A08A 104
242 295 318 298 228 178 172 187 209 314 197 226 209 168 197 139 106 187 145 209
181 196 182 209 181 186 228 227 193 187 178 168 106 125 123 145 88 49 30 38
36 65 69 59 49 49 58 77 91 106 108 114 115 130 109 121 112 84 105 90
118 118 103 96 112 123 114 123 108 98 159 135 148 126 157 139 113 117 116 141
146 145 151 127 145 141 127 93 106 120 98 113 93 94 136 151 74 73 108 141
92 109 112 103
MKF-A08B 104
245 289 313 291 222 197 172 176 213 305 201 240 214 157 191 141 116 193 144 206
189 194 177 210 185 179 233 220 212 177 177 163 111 118 132 146 76 51 30 36
36 66 69 73 38 47 59 79 87 113 99 118 110 148 98 122 107 97 89 101
126 100 110 93 110 124 114 126 107 97 144 145 148 124 162 132 112 128 121 128
160 145 145 118 151 140 130 92 109 123 88 112 97 90 134 148 89 74 100 141
81 115 104 104

APPENDIX

Tree-Ring Dating

The Principles of Tree-Ring Dating

Tree-ring dating, or *dendrochronology* as it is known, is discussed in some detail in the Laboratory's Monograph, '*An East Midlands Master Tree-Ring Chronology and its uses for dating Vernacular Buildings*' (Laxton and Litton 1988b) and, for example, in *Tree-Ring Dating and Archaeology* (Baillie 1982) or *A Slice Through Time* (Baillie 1995). Here we will give the bare outlines. Each year an oak tree grows an extra ring on the outside of its trunk and all its branches just inside its bark. The *width* of this annual ring depends largely on the weather during the growing season, about April to October, and possibly also on the weather during the previous year. Good growing seasons give rise to relatively wide rings, poor ones to very narrow rings and average ones to relatively average ring widths. Since the climate is so variable from year to year, almost random-like, the widths of these rings will also appear random-like in sequence, reflecting the seasons. This is illustrated in Figure1 where, for example, the widest rings appear at irregular intervals. This is the key to dating by tree rings, or rather, by their widths. Records of the average ring widths, one for each year for the last 1000 years or more, are available for different areas. These are called master chronologies. Because of the random-like nature of these sequences of widths, there is usually only one position at which a sequence of ring widths from a sample of timber with at least 70 rings will match a master. This will date the timber and, in particular, the last ring..

If the bark is still on the sample, as in Figure 1, then the date of the last ring will be the date of felling of the oak from which it was cut. There is much evidence that in medieval times oaks cut down for building purposes were used almost immediately, usually within the year or so (Rackham 1976). Hence if bark is present on several main timbers in a building, none of which appear reused or are later insertions, and if they all have the same date for their last ring, then we can be quite confident that this is the date of construction. If there is no bark on the sample, then we have to make an estimate of the felling date; how this is done is explained below.

The Practice of Tree-Ring Dating at the University of Nottingham Tree-Ring dating Laboratory

1. ***Inspecting the Building and Sampling the Timbers.*** Together with a building historian we inspect the timbers in a building to try to ensure that those sampled are not reused or later insertions. Sampling is almost always done by coring into the timber, which has the great advantage that we can sample *in situ* timbers and those judged best to give the date of construction, or phase of construction if there is more than one in the building. The timbers to be sampled are also inspected to see how many rings they have. We normally look for timbers with at least 70 rings, and preferably more. With fewer rings than this, 50 for example, sequences of widths become difficult to match to a unique position within a master sequence of ring widths and so are difficult to date (Litton and Zainodin 1991). The cross-section of the rafter shown in Figure 2 has about 120 rings; about 20 of which are sapwood rings. Similarly the core has just over 100 rings.

   To ensure that we are getting the date of the building as a whole, or the whole of a phase of construction if there is more than one, about 8 to 10 samples per phase are usually taken. Sometimes we take many more, especially if the construction is complicated. One reason for taking so many samples is that, in general, some will fail to give a date. There may be many reasons why a particular sequence of ring widths from a sample of timber fails to give a date even though others from the same building do. For example, a particular tree may have grown in an odd ecological niche, so odd indeed that the widths of its rings were determined by factors other than the local climate! In such circumstances it will be impossible to date a timber from this tree using the master sequence whose widths, we can assume, were predominantly determined by the local climate at the time.