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Tree-Ring Analysis of Timbers from Dover Castle Keep, Dover Castle, Dover, Kent

R E Howard, Dr R R Laxton & Dr C D Litton

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Summary

Eight samples from timbers in Henry II's Keep at Dover Castle were analysed by tree-ring dating. This analysis produced a single site chronology of 141 rings spanning the period AD 1101 -AD 1241. Interpretation of the sapwood on the samples indicates that the timbers have an estimated felling date in the range AD 1254 - 74.

Thus the felling of these timbers does not relate to the original construction of the Keep but, as expected, to subsequent works which, on the basis of structural and stylistic evidence, are believed to have been undertaken in the late-thirteenth century.

Keywords

Dendrochronology
Standing Building

Author's addresses

University of Nottingham, University Park, Nottingham, NG7 2RD

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TREE-RING ANALYSIS OF TIMBERS FROM DOVER CASTLE KEEP, DOVER CASTLE, DOVER, KENT

Introduction

Dover, and its Castle on the nearby cliffs (TR 326416; Fig 1) have long been defensive sites. The earliest fortifications on the eastern cliffs appear to consist of an Iron Age hill fort with massive earth ramparts. Both the Romans and the Saxons built within these earthworks, the former constructing a pharos, or lighthouse, and the latter a church. King Harold of England may have had a castle here, this being the first destination of William the Conqueror after victory at the Battle of Hastings. Once here William spent several days organising the reinforcement of this late-English *castrum*.

Expenditure on a new masonry castle was begun under Henry II in AD 1168, commencing with the central structure, the Keep. This is first mentioned as such in AD 1181, and it was manned with troops by AD 1185. The Keep is a large structure by twelfth-century standards, being built of ragstone with Caen stone ashlar dressing in parts. The walls are thick, varying from 17 to 21 feet and are surmounted by battlements.

By AD 1190 the total cost of construction had come to just under £7000 (at a time when, it is estimated, the total annual income of the Crown was about £10,000). For this sum not only was the sturdy and lofty Keep with its forebuilding complete but it was surrounded by a full circuit wall with eleven towers. It is possible that the design of Dover castle had been influenced by that of infidel castles seen by the Crusaders in the Holy Land, and in particularly that at Constantinople. The standard pattern of such forts was of enclosure walls punctuated by square defensible towers, this type having repulsed the Crusaders on many occasions.

Further work on the Castle and improvements to the defenses have been almost continuous since the Norman period. Of especial note are the late thirteenth-century subterranean tunnels, the fortifications constructed during the Napolionic wars, and the arrangements made during and after World War II. A military garrison was stationed here continuously until AD 1958.

It is with part of the later Norman building, however, that this report is concerned, namely the Keep. A programme of archaeological building recording has been undertaken, revealing a mass of information relating to its original form. The subsequent phases of alteration have been provisionally dated by comparing materials used and patterns of usage with structures of known date within the castle.

There remain a number of internal features for which there are no clear comparisons but which contain timbers. These include a timber frame within partition walls of the first floor of the northern hall. The frame is believed to have been erected in the thirteenth century to support a floor above. The brickwork between the timber frame has been provisionally dated to the late-fifteenth century.

In addition to the timbers of the Keep there are timber lintels from a first-floor garderobe. These appear to have been inserted as part of a phase of alteration to enlarge the principal window openings of the main chambers at first- and second-floor level. It is believed that these alterations date to the late-fifteenth century also. A plan of the first floor of the keep, showing the general positions of the timbers under inspection is shown in Figure 2.

Sampling and analysis by tree-ring dating was commissioned by English Heritage. The purpose of this was to provide more precise information on the chronological development of this historic building.

The Laboratory would like to take this opportunity to thank the Kevin Booth, archaeologist, for assisting with access to the site and for providing information used in the introduction above. We would also like to thank English Heritage staff at the Castle who were most helpful and cooperative during sampling

Sampling

The timbers of the Garderobe comprise three horizontal beams acting as lintels. It could be seen on these three that the annual growth-rings were wide, thus not producing enough rings for satisfactory analysis by tree-ring dating. These timbers were therefore not sampled.

The timbers under inspection within the Keep consist of vertical posts in the site west and site east walls (strictly the north-west and the south-east walls), from some of which diagonal braces run up to horizontal longitudinal beams set at wall-top level. There are four such posts in the west wall, but only one in the east. Some of the posts, braces, and longitudinal beams were too deeply set into the brickwork to be accessible for dendrochronological sampling and these consequently could not be cored.

From the timbers available within the Keep a total of eight core samples was taken. Each sample was given the code DOV-C (for Dover, site "C"), and numbered 01 – 08. The positions of these samples are marked on a sketch drawing provided by English Heritage, reproduced here as, Figure 3a/b. In this figure the trusses and other timbers are numbered from site north to site south (strictly north-east to south-west). Details of the samples are given in Table 1.

Analysis

Each of the eight samples was prepared by sanding and polishing. The growth-ring widths of all samples were then measured and compared with each other by the Litton/Zainodin grouping procedure (see appendix). The data of these measurements are given at the end of the report.

At a minimum *t*-value of 5.0 all eight samples cross-matched with each other at relative positions as shown in the bar diagram Figure 4. The growth-ring widths of these eight samples were combined at these relative off-set positions to form DOVCSQ01, a site chronology of 141 rings. Site chronology DOCSQ01 was compared with a series of relevant reference chronologies for oak, giving it a first ring date of AD 1101 and a last measured ring date of AD 1241. Evidence for this dating is given in the *t*-values of Table 2.

The average last heartwood ring date on the samples in this site chronology is AD 1238. Using the Laboratory's 95% confidence limit for the amount of sapwood on mature oaks from southern and eastern England of 15 to 35 rings would give these timbers an estimated felling date in the range AD 1254 – 74.

Interpretation

Analysis by dendrochronology has produced a site chronology of eight samples. For the most part, the timbers have been heavily defrased sometime in the past, and the sapwood removed. However, the heartwood/sapwood boundary remains on three samples and it appears likely that the felling of these timbers took place in the mid to later thirteenth-century. Tree-ring analysis has thus been able to confirm the date expected on the basis of structural or stylistic evidence. It would appear that this work in the Keep took place toward the end of the reign of Henry III, or possibly very early in that of Edward I.

Unfortunately due to the unsuitability of the timbers no dating evidence was produced for the Garderobe lintels.

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Table 1: Details of samples from Dover Castle, Kent

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Last heartwood ring date	Last measured ring date
DOV-C01	South brace to west wall-post, truss 3	128	h/s	AD 1112	AD 1239	AD 1239
DOV-C02	West wall-post, truss 2	58	no h/s	AD 1129	-----	AD 1186
DOV-C03	North brace to west wall-post, truss 2	121	no h/s	AD 1110	-----	AD 1230
DOV-C04	West wall-post, truss 3	109	no h/s	AD 1104	-----	AD 1212
DOV-C05	West wall-plate, truss 1 – 3	135	h/s	AD 1107	AD 1241	AD 1241
DOV-C06	East wall-post, truss 2	77	no h/s	AD 1115	-----	AD 1191
DOV-C07	South brace to west wall-post, truss 2	110	h/s	AD 1126	AD 1235	AD 1235
DOV-C08	West wall-post, truss 1	68	no h/s	AD 1101	-----	AD 1168

*h/s = the heartwood/sapwood boundary is the last ring on the sample

Table 2: Results of the cross-matching of site chronology DOVCSQ01 and relevant reference chronologies when first ring date is AD 1101 and last ring date is AD 1241

Reference chronology	Span of chronology	t-value	
England London	AD 413 – 1728	7.0	(Tyers 1999 unpubl)
East Midlands	AD 882 – 1981	6.2	(Laxton and Litton 1988)
Southern England	AD 1083 – 1589	6.1	(Bridge 1988)
London Billingsgate	AD 611 – 1243	5.6	(Hillam 1992)
London Fennings Wharf	AD 802 – 1345	5.3	(Tyers 1997)
London Bull Wharf	AD 620 – 1181	5.2	(Tyers and Boswijk 1997)
London Fleet Valley	AD 745 – 1226	5.1	(Tyers and Hibbard 1993)

Figure 1: Map to show general location of Dover Castle

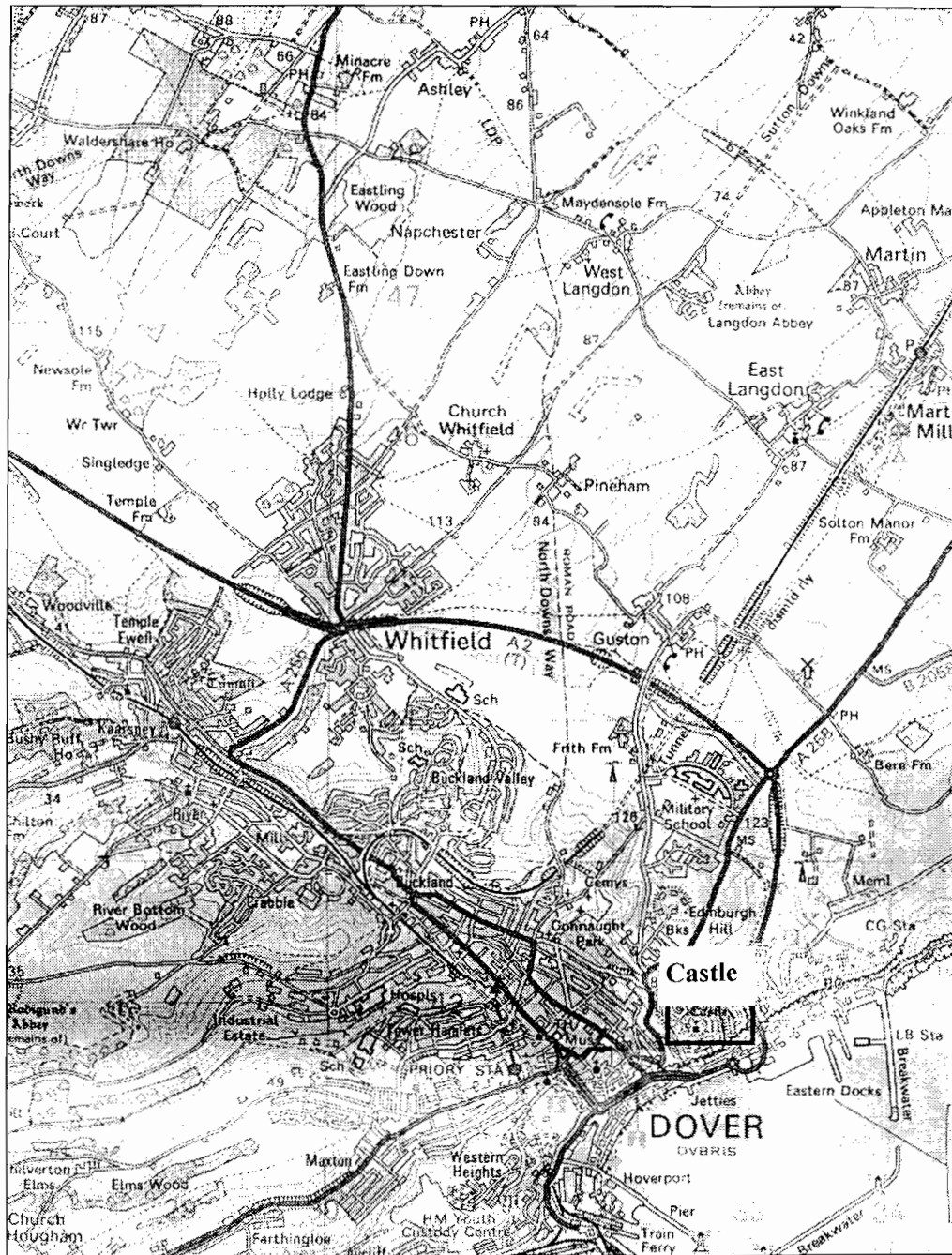


Figure 2: Plan of Dover Castle Keep at the first-floor level to show general position of timbers inspected for tree-ring sampling

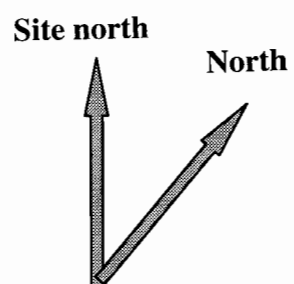
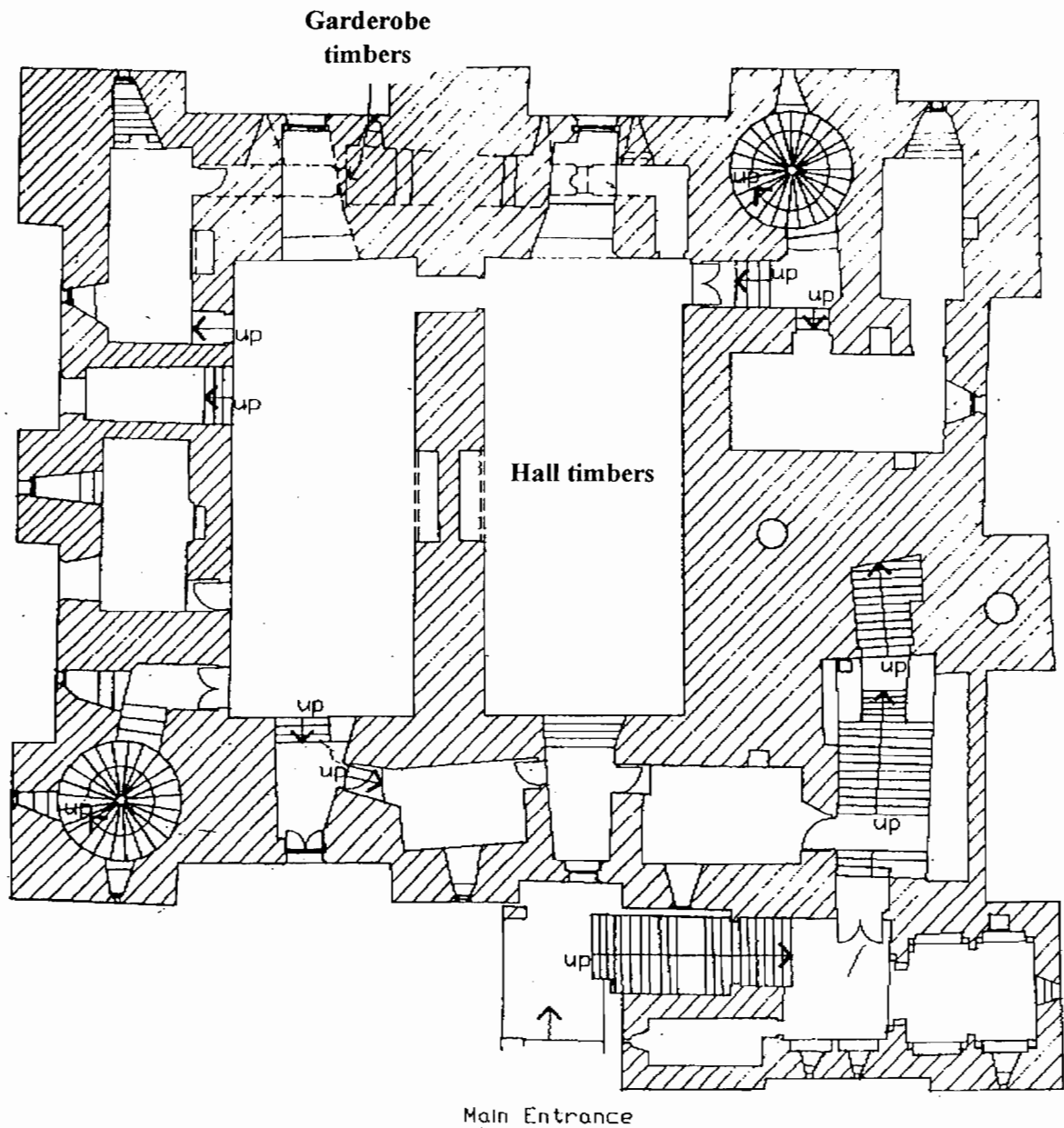


Figure 3a: Sketch drawing of timbers in the west wall of the Keep to show position of samples

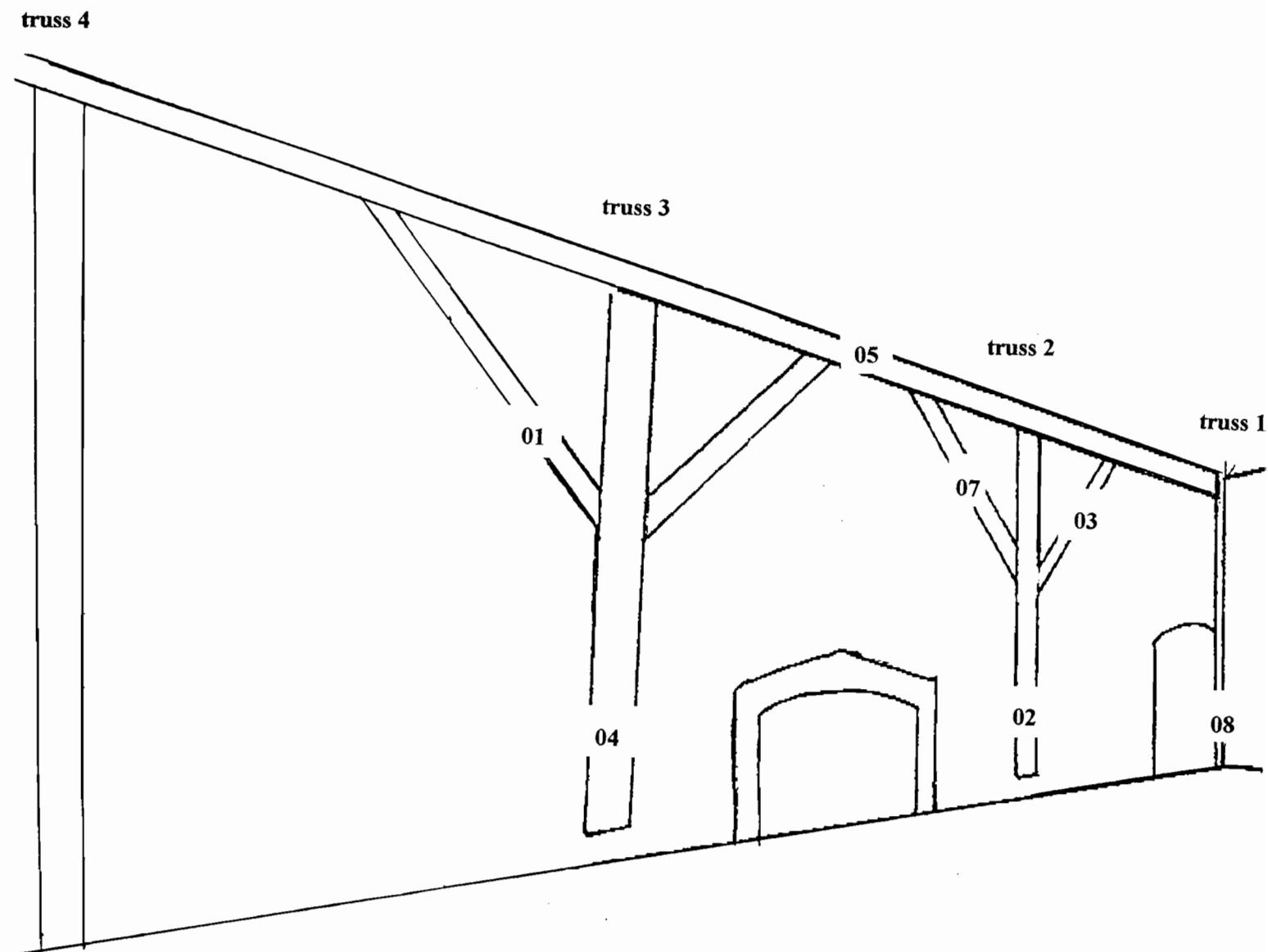


Figure 3b: Sketch drawing of timbers in the east wall of the Keep to show position of samples

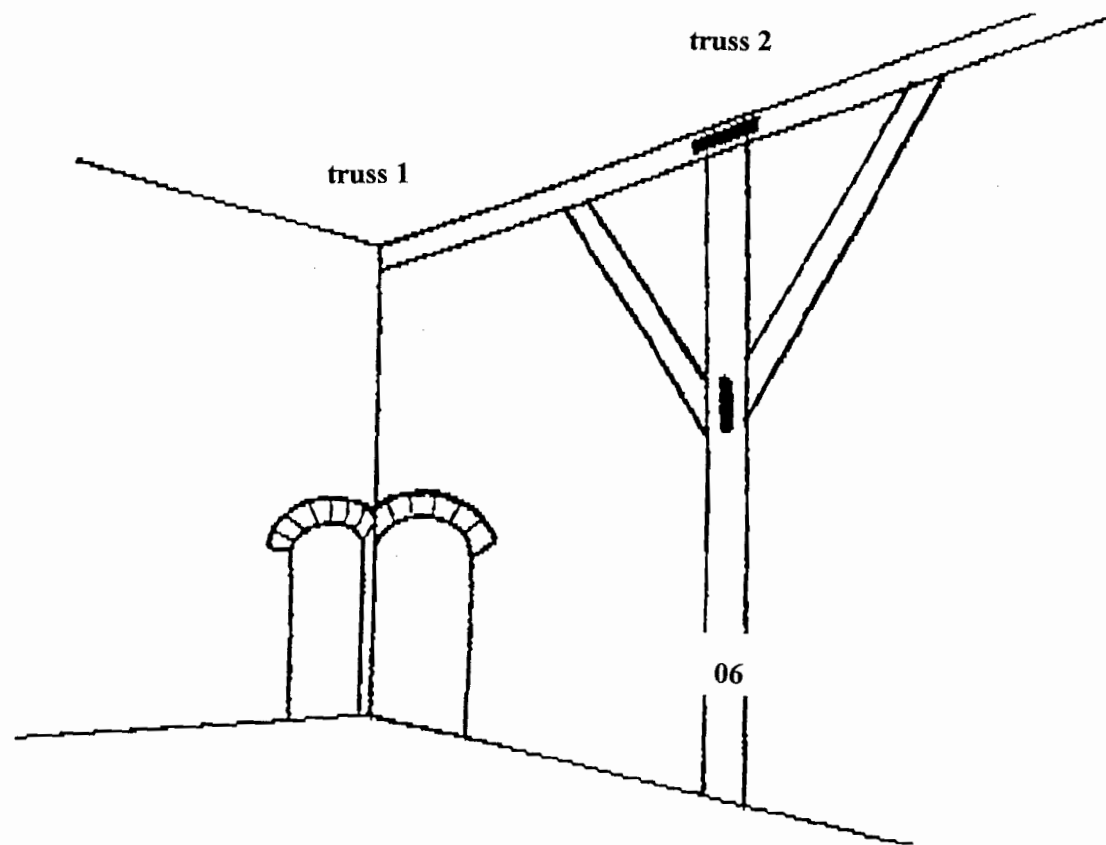
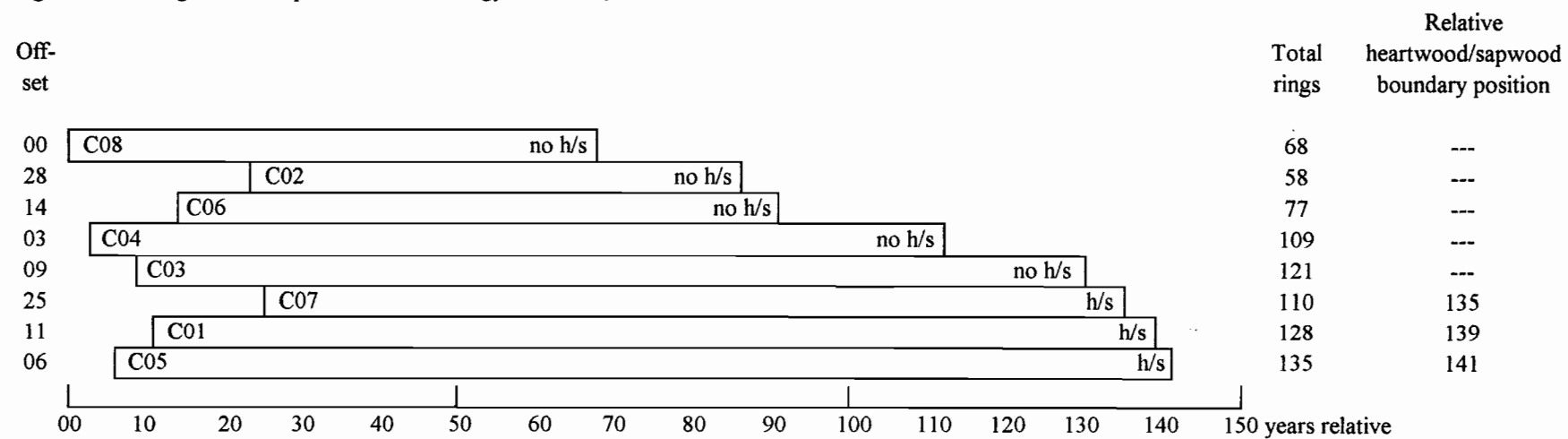


Figure 4: Bar diagram of samples in site chronology DOVCSQ01



White bars = heartwood rings

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

Data of measured samples – measurements in 0.01mm units

DOV-C01A 128

268 331 431 350 388 379 407 351 378 279 248 272 315 185 171 210 212 152 200 168
164 189 191 201 261 125 130 133 253 263 152 134 106 246 275 181 226 170 136 114
137 275 224 147 96 119 95 119 150 172 121 90 76 74 106 154 149 145 142 84
73 60 101 113 130 83 113 152 140 151 229 288 211 183 300 304 194 196 223 168
214 167 158 166 188 182 182 121 111 66 44 64 50 54 56 60 72 53 55 39
49 61 67 92 103 107 50 68 120 185 168 162 179 229 409 291 442 433 450 483
299 444 374 367 263 262 382 370

DOV-C01B 128

248 335 430 357 406 379 404 345 376 279 247 278 290 193 168 210 213 151 198 177
152 188 185 216 251 129 124 138 257 256 159 134 109 244 270 188 220 168 140 118
132 276 230 149 91 124 89 122 155 161 136 85 70 72 110 157 148 142 142 86
67 60 107 111 124 86 102 152 120 165 233 286 207 189 289 293 205 209 213 177
204 181 180 176 188 180 193 115 111 66 58 64 52 51 51 68 67 65 51 60
42 56 58 83 90 117 49 63 130 153 185 166 183 241 403 306 432 392 445 469
307 448 334 410 253 252 385 348

DOV-C02A 58

294 317 252 251 280 259 247 272 157 140 149 379 411 239 144 142 157 177 192 197
255 270 234 252 372 339 169 256 259 266 300 329 274 223 232 217 190 238 218 218
244 225 168 160 202 281 306 226 209 174 181 175 202 183 182 118 124 157

DOV-C02B 58

265 302 259 250 282 284 233 264 150 152 148 372 410 244 125 143 156 183 186 194
243 269 233 257 384 333 201 241 240 254 310 326 282 234 223 228 186 232 212 217
250 220 172 154 208 296 308 234 206 159 209 156 213 193 190 113 130 163

DOV-C03A 121

349 503 363 539 453 400 474 340 485 414 361 262 208 272 364 317 329 328 293 197
257 175 231 214 189 168 255 116 108 121 299 265 133 75 73 93 131 103 154 146
129 119 145 200 215 148 179 235 201 271 282 202 148 118 101 137 147 184 121 108
90 60 66 84 86 82 96 70 101 183 130 166 234 215 139 140 204 204 182 151
183 158 162 138 142 158 186 190 97 81 73 78 65 69 69 83 80 84 93 81
97 78 70 67 87 79 86 186 198 235 241 275 242 283 231 276 355 363 414 430
344

DOV-C03B 121

352 506 375 549 472 401 478 329 461 411 367 256 223 276 355 303 332 318 291 197
253 179 237 204 198 167 235 121 110 115 295 278 128 71 64 98 123 107 151 158
129 129 134 190 198 149 180 237 206 264 294 201 149 114 106 133 144 182 124 101
96 58 67 84 88 80 88 68 108 184 134 166 228 216 143 151 210 200 181 156
186 147 154 140 143 161 184 189 102 75 82 74 65 74 69 86 81 82 101 77
99 77 67 75 84 65 88 194 198 241 243 247 251 289 227 276 355 346 415 396
346

DOV-C04A 109

338 378 350 260 293 310 315 346 329 425 447 386 406 185 265 244 218 181 174 176
175 126 134 112 158 114 174 183 83 121 120 132 132 99 77 77 108 118 102 78

65 91 150 139 109 146 129 92 113 157 79 104 133 95 104 163 200 101 131 77
78 122 128 118 106 177 112 81 80 119 178 122 50 49 68 62 48 69 113 122
95 61 71 113 77 59 60 56 67 79 145 190 204 132 139 111 116 175 157 211
150 215 156 172 167 121 189 151 101

DOV-C04B 109

356 384 341 256 296 307 319 351 339 403 457 392 407 212 259 217 240 204 168 172
194 130 134 121 157 114 181 169 80 120 111 139 125 88 90 75 105 119 107 79
67 84 146 142 106 149 128 98 103 166 82 105 138 89 105 166 204 109 125 87
81 120 120 123 108 171 111 77 88 115 184 111 55 45 66 65 51 60 116 123
98 67 70 106 75 57 62 59 53 89 144 174 212 135 129 105 108 180 171 212
135 215 158 167 166 120 192 147 116

DOV-C05A 135

310 321 329 217 289 360 512 463 303 282 281 187 171 158 152 152 187 240 267 170
195 158 75 69 57 59 94 90 115 172 112 125 121 173 239 125 79 91 98 103
78 97 87 130 111 140 215 203 144 184 96 81 137 175 174 143 120 103 94 154
178 149 197 163 96 72 95 178 170 181 109 153 175 103 134 132 105 48 72 131
178 108 116 124 116 82 101 74 70 95 83 86 80 93 150 85 69 82 86 127
96 137 110 133 100 84 107 94 108 115 135 90 120 125 116 125 102 122 132 202
190 309 296 209 191 154 100 149 252 144 218 299 204 156 134

DOV-C05B 135

341 315 335 214 280 369 518 455 290 286 297 188 175 157 159 147 177 251 265 175
216 145 77 73 59 48 93 107 111 173 117 118 119 164 232 127 82 89 98 105
77 94 88 131 113 133 220 202 151 179 95 76 133 177 173 137 128 101 95 152
169 148 200 173 98 76 90 173 174 182 109 154 174 105 147 127 96 58 69 133
180 111 114 128 111 85 98 77 68 97 84 85 78 93 152 88 66 79 92 119
104 137 114 130 103 79 108 94 107 113 136 83 127 122 115 127 100 126 132 205
200 321 305 204 196 148 111 141 251 145 218 257 214 170 162

DOV-C06A 77

344 344 333 272 232 199 156 174 187 179 159 144 142 141 98 120 98 103 116 97
118 105 87 81 73 94 114 88 62 51 52 93 91 135 177 168 133 166 306 196
138 157 193 195 199 233 148 101 114 108 122 154 175 157 181 181 126 111 161 205
191 149 91 87 135 106 98 108 83 79 80 117 92 91 86 70 64

DOV-C06B 77

326 352 332 271 235 194 158 170 190 183 153 140 149 137 99 121 95 94 123 100
111 99 95 82 62 87 119 77 68 44 54 98 106 134 163 175 131 157 320 190
136 150 191 193 204 222 160 108 114 111 115 162 174 155 180 185 138 125 150 204
174 152 96 94 142 104 100 112 84 79 74 111 84 103 77 69 93

DOV-C07A 110

441 393 397 414 434 451 314 436 566 440 482 324 384 230 477 566 438 226 152 264
291 280 218 276 209 180 253 313 260 130 119 229 231 224 234 195 167 168 129 133
276 310 293 372 501 290 211 415 481 383 371 169 278 345 244 214 297 344 200 278
337 219 215 170 263 310 240 213 142 234 292 225 171 185 179 159 148 248 186 236
193 207 292 250 213 201 156 190 215 190 164 149 172 213 192 153 189 199 202 248
239 190 185 164 181 173 90 134 160 185

DOV-C07B 110

411 408 397 453 424 450 312 452 567 448 489 327 423 232 470 545 466 241 145 264
280 272 211 243 206 191 253 323 242 123 122 221 233 224 237 191 178 159 141 127
267 299 285 389 496 282 193 415 489 398 373 181 275 355 239 217 295 323 215 271
332 213 228 161 255 317 240 227 127 233 302 216 151 183 181 171 148 255 183 255
194 202 283 268 201 209 149 192 227 192 158 151 173 201 215 181 161 193 209 247
234 186 186 161 171 171 108 133 154 201

DOV-C08A 68

362 322 452 322 238 263 405 380 588 462 509 570 797 739 705 723 499 366 411 305
294 333 348 396 260 179 144 180 128 140 118 104 196 177 158 149 136 106 90 148
144 88 66 54 44 53 45 57 76 89 92 80 121 118 92 141 113 72 117 110
104 63 55 40 39 46 41 53

DOV-C08B 68

375 324 448 320 227 274 415 376 604 504 482 574 782 731 686 731 508 348 405 313
313 335 357 380 249 185 149 182 124 138 117 105 192 188 158 147 121 113 85 157
133 92 68 53 38 47 38 63 76 99 93 81 124 123 94 135 123 85 113 109
105 65 54 44 35 48 39 55