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The Tree-Ring Dating of the Nave Roof at Salisbury Cathedral, Wiltshire

D W H Miles

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Keywords

Dendrochronology
Standing Building

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Introduction:

Salisbury Cathedral (SU 143 295) is one of the country's finest ecclesiastical buildings, built principally during the mid-thirteenth century, but with one major later addition – the early fourteenth-century tower and spire (Figs 1 and 2; Cocke and Kidson 1993). In addition to the exceptional quality of the stonework, Salisbury is noted for its outstanding timber roofs, a number of which survive largely unaltered (Tatton-Brown 2001). Since 1998 the Cathedral has been the subject of an ongoing phased programme of roof repairs grant-aided by English Heritage. As part of the associated archaeological recording of the timber fabric within the affected areas, English Heritage has commissioned a series of extensive dendrochronological surveys of the timberwork. The first area to be studied was the roofs over the Trinity, or eastern chapels, which was the first part of the cathedral to be completed. Felling dates of spring AD 1222 accorded well with the documented dedication of these chapels in September AD 1225. The dendrochronology here revealed that the majority of the structural timber of these roofs was imported from the Dublin area of Ireland, lending credence to a single documentary reference of timber being bought from William of Dublin (Miles 2002a).

The second phase of dendrochronological research commenced during 2000 in the north nave triforium and the north porch roof above the Parvis Chamber. Here felling dates of AD 1251/2 and AD 1254/5 were found from timbers of English origin, and a series of under-lead sarking boards at the west end of north nave triforium was discovered to have been imported, again from the south-east area of Ireland. Four well-replicated reference chronologies were created from these previous studies, two of English provenance and two from Ireland (Miles 2002b). Also studied were the two great doors at the west end of the nave as well as two associated doors to the Parvis Chamber and north nave triforium. The west end was presumed to have been completed by AD 1266, if not by AD 1258, even though on stylistic grounds the niche statues were put in from the last decade of the thirteenth century (Ayres 2000). The results of the dating of the boards from the doors show that they are all primary thirteenth-century fabric; the west doors' material originating again from Ireland, whilst the majority of the timber in the other two doors was of English origin.

The third phase of research covered 33 timbers which were sampled from the tower and spire during 1990, and a further 32 timbers from the same areas sampled during 2003 and 2004. Four major elements were sampled and dated: the reset floor structure at the base of the clock chamber with felling dates of spring and summer AD 1242, the Baltic oak ceiling boards to this floor structure with a felling date range of AD 1358–74, the spire scaffold with a felling date range of AD 1344–76, and the timber support tower in the bell chamber underneath the spire with a felling date range of AD 1687–1719. A number of thirteenth- and seventeenth-century reused timbers were also found in the timber support tower and spire scaffold itself. The dating of the spire scaffold to the third quarter of the fourteenth century is contrary to most established theories on the architectural development of the tower and spire, and debate continues (Miles *et al* 2004).

The present report covers the nave high roof (Fig 3). Repairs to this roof between 2000 and 2002 allowed access to certain areas of the upper reaches of the roof, as well as along the eaves. Three major construction phases had been identified stylistically in the nave roof – rafters consisting of reset thirteenth-century timbers, the trusses covering the east half of the roof thought to have been reconstructed about AD 1600, and the trusses over the west half of the roof thought to date from the late-eighteenth century (Jones 2002 *unpubl*).

Description of the nave roof:

The nave is 200ft (61m) long and extends for 10 double bays from the central crossing to the west front (Fig 3). The roof originally comprised about 100 rafter couples with every fourth having a tiebeam, giving 25 bays approximately 8ft (2.4m) wide (Fig 4). Each of these tiebeam trusses had a pair of hangers giving an appearance not dissimilar to the surviving thirteenth-century high roof over the north-east transept (Fig 5). These rafter-couples originally comprised a full-length rafter, double wall plates, ashlars pieces, collars, and scissor braces in line with the soulaces below. Although this roof has been reconstructed, most of the original rafters have been reused in the existing roof. Interestingly, the original thirteenth-century rafters retain a large group of assembly marks: those nearest the central tower at the east end are in Roman numerals (Fig 6), whilst those in the western half of the roof are in Arabic (Fig 7). These numbers run to at least 100, and have an 'N' to differentiate between north and south roof slopes, although this is unlikely to signify north. Given the AD 1242 dates for the central tower, AD 1251/52 and AD 1254/5 felling dates from the north nave triforium, and the AD 1258 date for the consecration of the Cathedral, the date of the primary nave roof is thought to lie between AD 1240 and AD 1258.

The present nave roof comprises 20 trusses more or less evenly distributed along the nave, except for a narrow bay between trusses 6 and 7, numbering from the west. These two trusses are thought to lie on the line of the original tiebeam trusses of the thirteenth century. The carpentry of the roof is similar in respect that each truss is 42ft (12.8m) wide at the base, with a clear span of over 33ft (10m), rising 31ft (9.5m) high, with principal rafters 37ft (11.3m) long but scarfed above the main collar, which is halfway up, with a smaller collar three-quarters of the way up. Each collar has a pair of queen struts below, with a pair of subsidiary cranked or curved raking struts from the tiebeam to the principal rafters. There are also raking ashlars, but these appear to be later insertions of mainly second-hand material.

There are several structural differences between the trusses and bays which are thought to signify phasing. The most obvious is the absence of tiebeams in trusses 19 and 20; these are instead replaced by another lower collar 6ft 6ins (2m) above the wall head. It is possible that these tiebeams have been raised simply to avoid the later buttresses to the west side of the tower. Each bay has four pairs of butt-purlins with windbraces to the second and fourth tiers. The windbraces in bays 1 to 11 are predominantly straight, whilst those in bays 12 to 19 are more curved. Finally, bays 1 to 5 have five common rafters, bay 6 has four, and the remaining bays 7 to 19 have six. The last eight bays also have ashlars, whereas the other preceding bays to the west do not. This phasing is reinforced through a study of the wall plates. Differences in jointing between each section suggest several different phases: bays 1 to 4 have bridled joints, bays 5 to 11 have awkward lapped joints, and bays 12 to 19 have shorter bridled joints. Each of these three sections also have different methods of joining the inner and outer plates together, with small tenoned stub-ties in the western section, larger planks nailed across the plates in the middle section, and double tenoned stub-ties in the eastern section.

Most useful in revealing the various phases of the roof is the study of the carpenter's assembly marks. A single consecutive sequence of numbers on trusses 12 to 20 runs from I to VIIII, suggesting that these nine trusses are coeval. The remaining roof trusses to the west do not have any discernible numbering system, with the trusses having a variety of chiselled straight and curved marks.

The present roof has undergone a number of repairs. In AD 1668, Sir Christopher Wren conducted a survey of the Cathedral and wrote:

'*The south ende of ye greater Crosse* [ie south transept] *and halfe the maine body from the Tower to ye West* [ie nave] *hath been wholly made new, I suppose within 100 yeares and after a better form with principalls braces and purloynes, and the beames tucked up. A little more time will necessitate the continuance of this work till ye whole Church be so covered for most of the rafters of ye olde timbering are rotten at foot and ye Wall Plates decayed because the gutters lie as high as ye Feet of ye rafters.*' (Wren 1668).

This suggests that the eastern eight bays of the roof referred to in Wren's report dated between *circa* AD 1568 to about AD 1650, and that the original thirteenth-century trusses still survived over the remaining western part of the roof as of AD 1668. He also recommended using long passing braces from the western gable end, tenoned into an inserted purlin extending 16 – 20ft (4.9 – 6.1m) from the gable end (Fig 8). Any such repairs to this section of the roof have been removed by the subsequent replacement of the western half of the roof. The present softwood braces rising up and extending eastward from trusses 5, 11, and 16 were not inserted in Wren's work, and were probably inserted some 50 years or so later. The theory that they are reused ship's masts is also unsupported, as is the notion that the whole of the nave roof is an upturned medieval ship, both theories being related to tourists on a regular basis.

The date of trusses 1 to 11 at the west end of nave are thus after the AD 1668 Wren survey. However, a survey of the Cathedral roofs in AD 1737 by Francis Price following his major restoration of the structure, shows that the entire nave roof had already been replaced and needed only minor repairs. This in effect gives a *terminus ante quem* of AD 1737 for the western half of the roof (Price 1753).

The present roofs have undergone various minor repairs in the nineteenth century. The tiebeam to truss 3 has been repaired with iron at the north end, and the south end of the tiebeam to truss 4 has been scarfed, with a date of 1816 is inscribed on the top of the original timber, which coincides with the re-leading of the northern side of the nave roof by H Lawrence (Tatton-Brown 1995). In the twentieth century, the tiebeams to trusses 5, 12, 13, and 14 were replaced in dry-laminated oak (about 1937). Wall plates on the north side of bays 12 and 13 were also repaired at this time, the joints onto the medieval plates being effected by long splayed joints.

Objectives of Dating:

Four phases of construction have been identified for tree-ring dating. Among the specific objectives of the dendrochronology were:

- to determine a date for the primary construction of the nave roof, understand its relationship with the other building phases of the Cathedral, and how it relates to the subsequent history of the nave roof
- through the determination of precise felling dates for the primary reused rafters, and correlation with the original carpenter's assembly marks, attempt to discern any subsidiary phases within the original construction
- to provide a precise date for the construction of trusses 12 to 18 in the eastern half of the roof, in order to place it in context of the development of the subsequent carpentry of the Cathedral
- to date the easternmost trusses 19 and 20 against the central tower wall to confirm that they are of the same phase of construction as trusses 12 to 18 to the west
- to determine precise felling dates for the western, post-Wren, trusses 1 to 11, in order to place them in the chronology of the Cathedral roof development, and to see if there are any subsidiary phases of construction within this section
- to produce further replicated tree-ring chronologies for the Cathedral and for the county of Wiltshire, and to determine through dendro-provenancing whether any of the material from the primary construction phase originated from Ireland
- to see whether any of the precise felling dates produced correlate with documentary sources relating to the construction or repair of the timberwork.

Assessment:

All of the accessible timbers were assessed for their suitability for dendrochronology. Most of the reused primary-phase rafters had between 50 and 100 rings or more, but only a very few had sapwood remaining. Although some of these had less than 50 rings, they were considered important to sample in order to maximise any chance of producing precise felling dates.

The timbers from the eastern half of the roof had slightly more rings with between 50 and 150 years growth. However, very few retained complete sapwood, and the sapwood which did remain was generally in a very poor condition. Access to trusses 19 and 20 was extremely difficult, and only the lower collars could be sampled from a ladder safely. These two timbers did retain some sapwood, but as with the other timbers from this end of the roof, this was extremely friable.

At the western end of the roof, many of the timbers retained complete sapwood and had between 75 and 125 rings, making them suitable for tree-ring analysis. As in the other areas, safe access was an issue, with only a small percentage of the roof structure being accessible from higher scaffold platforms. However, it was noted that higher up in the roof the sapwood tended to be much more friable, perhaps due to being subjected to centuries of extreme heat. At wall-head level the sapwood was generally more sound, but again the vault pockets made sampling difficult apart from where the crown of the vaults coincided with the trusses. At Salisbury, more sapwood was accessible on the lower parts of the trusses than might normally be found in most other cathedrals due primarily to their having been reconstructed during the seventeenth and eighteenth centuries, allowing less time for the sapwood to degrade as on the primary-phase reused timbers which were two or three times older. Conversely, the north-east transept had more sapwood surviving on the upper sections of the rafters, due mainly to there being more sapwood left on the timbers as a consequence of the trees' natural taper.

All of the northern queen struts could be accessed by the boarded walkway, and some boarded areas to the east gave access to a good number of trusses throughout the roof. Rafter ends and wall plates could additionally be accessed through the use of movable scaffold platforms.

Sampling strategy:

The primary objective in sampling was to obtain complete sapwood wherever possible. This was especially important with the reused primary-phase rafters, as there appeared to be some with Arabic assembly marks and others with Roman numbers. Determining precise dates would be essential in identifying any minor construction phases, and to phase the nave roof correctly in the development of the Cathedral.

Similarly, complete sapwood was essential in helping to identify any subsidiary construction phases in the western half of the roof, where carpentry details suggests breaks in the construction process. In addition, it was important to have a good number of complete sapwood samples in order to identify stock-piled timbers and so to avoid suggesting a construction period which might be too early.

It was also important to obtain at least 10 or 15 samples from each phase of construction to allow a well-replicated chronology to be produced: timbers with good ring counts and only the heartwood/ sapwood boundaries surviving could be selected on this basis. Section drawings of all timbers sampled are shown in Figure 9.

Methodology:

All samples were taken from what appeared to be primary first-use oak (*Quercus* spp.) timbers, or similar timbers reused, with reasonably long ring sequences, or with some indication of sapwood. All *in situ* timbers were sampled using a 16mm hollow coring bit. Many of the timbers had multiple samples, the first being from core samples, with later slices from subsequent repairs being used to obtain well-replicated ring sequences. Details of the samples taken, together with dates produced, are shown in Table 1, and located on the drawings in Appendix 1.

The samples were sanded on a linisher using 60 to 1200 grit abrasive paper, and were cleaned with compressed air, to allow the ring boundaries to be clearly distinguished. They were then measured under a x10/x30 microscope using a travelling stage electronically displaying displacement to a precision of 0.001mm, rounded to the nearest 0.01mm.

After measurement, the ring-width series for each sample was plotted as a graph of width against year on log-linear graph paper. The graphs of each of the samples in the phase under study are then compared visually at the positions indicated by the computer matching and, if found satisfactory and consistent, are averaged to form a mean curve for the site or phase. These mean curves, together with the individual ring sequences, are then compared against dated reference chronologies to obtain an absolute calendar date for each sequence.

In comparing one sequence or site sequence against another, *t*-values over 3.5 are considered significant, although in reality it is common to find *t*-values of 4 and 5 which are demonstrably spurious because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some *t*-values of 5, 6, and higher, and for these to be well replicated from different, independent chronologies and with local and regional chronologies well represented. Where two individual sequences match with a *t*-value of 10 or above, and visually exhibit exceptionally close ring patterns, they most likely came from the same parent tree. Same-tree matches can also sometimes be identified through the external characteristics of the timber itself, such as knots and shake patterns. For shorter ring sequences from the same tree, lower *t*-values are often encountered (English Heritage 1998).

Here dating was accomplished by using a combination of visual matching and a process of qualified statistical comparison by computer. The tree-ring curves were first matched visually, and then independently matched by computer. The ring-width series were compared on an IBM-compatible computer for statistical cross-matching using a variant of the Belfast CROS program (Baillie and Pilcher 1973). A version of this and other programmes were written in BASIC by D Haddon-Reece, and latterly rewritten in Microsoft Visual Basic by M R Allwright and P A Parker.

A methodical approach is taken in dealing with the individual samples. First, all duplicate radii from a single timber are cross-matched and compared, and if the matches are satisfactory, they are combined to form a single-timber mean. These multiple radii are generally identified by using an 'a', 'b', etc after the timber sample number. Cores which have broken into one or more segments are further identified by a '1', '2', or 'i', or 'ii', after the radius suffix. Once a single mean sequence for each timber has been produced, then the next step in the analysis is to check for same-tree matches. Generally, this is identified through *t*-values of 10 or more, but sometimes this is identified through the external characteristics of the timber itself, such as knots and shake patterns. Again, all samples clearly identified as having originated from the same parent tree are combined to form a mean sequence for each tree. It is not until this preliminary analysis stage is completed that individual samples / trees are then compared with others from the site and combined into larger site masters.

All individual sequences and components of same-timber means and same-tree means are presented in Table 1. Because this is the primary summary of all material on which the dendrochronological analysis has been based, both actual samples and averaged sequences are presented here. The means of individual radii, as well as same-tree means, are differentiated in the table by the use of italic text. To avoid confusion, felling seasons and dates, or date ranges, are presented in the final column only for the mean of the individual sequences comprising a single timber. Where two or more timbers have been found to originate from the same parent tree, each timber has been given a felling date or date range, but this would be the same as that of the mean sequence for the tree. Where one of the components making up a same-tree mean has complete sapwood, and another only partial or no sapwood, then the latter would be given the precise date in brackets, even though it would have only produced a *terminus post quem*, or at best a felling date range, on its own. Where all the individual same-tree components have incomplete sapwood, then a felling date range for the mean is produced by taking the average heartwood/sapwood boundary date, from which the appropriate 95% sapwood estimate is used to work out the felling date range. This range, in brackets, would then be used for the individual timbers comprising the mean. Similarly, where one or more radii or timbers make up a same-timber or same-tree mean have complete sapwood, the average sapwood ring count is presented for the mean.

Ascribing Felling Dates and Date Ranges

Once a tree-ring sequence has been firmly dated, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of, or including bark, this process is relatively straightforward and a *precise felling date and season* can be given. The latter depends on the completeness of the final ring, and whether it has only the spring vessels or early wood formed, or also includes the latewood or summer growth. If the sapwood is partially missing, or if only a heartwood/sapwood boundary survives, then only an *estimated felling date range* can be given for each sample. The number of sapwood rings can be estimated by using an empirically derived sapwood estimate with a given confidence limit. If no sapwood or heartwood/sapwood boundary survives, then the minimum number of sapwood rings from the appropriate regional sapwood estimate is added to the last measured ring to give a *terminus post quem* (*tpq*) or *felled after* date.

A recent review of the geographical distribution of dated sapwood data from historic building timbers has shown that a 95% range of 9 – 41 rings is appropriate for the southern part of England, and 11 – 41 for Wales and the Border counties (Miles 1997a).

Irish imports apart, documentary sources suggest that timber used in the construction of Salisbury Cathedral was imported from woodlands as far to the north-west as Trivelle and the Forest of Dean in Herefordshire, as well as from more southern counties such as Wiltshire and Hampshire (Simpson 1996; Fig 26). However, it is difficult to distinguish the Herefordshire timber from the other southern English material, as dendro-provenancing has a limited geographical application (Bridge 2000). Although the ranges are remarkably similar, the correct identification of the source of the timber could affect the *terminus post quem* dates by two years. Given these difficulties, the sapwood estimate of 9 to 41 years was used for all English material in this present study.

It must be emphasised that dendrochronology can only date when a tree was felled, not when the timber was used to construct the structure under study. However, it was common practice in the Middle Ages to build timber-framed structures with green or unseasoned timber, and construction usually took place within twelve months of felling (Miles 1997a). Given the protracted nature of cathedral building campaigns, more caution must be shown in interpreting construction dates, especially in subsequent phases of work, as has been shown at Lincoln Cathedral (Laxton *et al* 2001), and at Exeter (Howard *et al* 2001; 2002). However, interpretations of felling dates may be informed by complementary documentary evidence, as exists at Salisbury.

Cross-matching and site chronologies:

Primary Phase Reused Rafters

Forty samples (**scn1** – **scn27**; Table 1) were taken from 27 original rafters reset in the present roofs.

Two samples (**scn3a** and **scn3b**) were taken from the north lower rafter 3 in bay 1; both retained a heartwood/sapwood boundary. The first core fractured with the loss of one or more rings. A second core was therefore taken to cross-match between the two segments, as shown in Table 2, and combined to form the same-timber mean **scn3**. Samples **scn4a**, **scn4b**, and **scn4c** were taken from the fifth lower rafter in the same bay, which retained complete sapwood. These were similarly combined to form the same-timber mean **scn4** (Table 3). Two samples (**scn9a** and **scn9b**) were taken from the north lower rafter 2 in bay 4. The first core fractured and the second core was taken to cross-match between the two segments, as shown in Table 4, and combined to form the same-timber mean **scn9**.

Four samples were taken from the north lower rafter 4 in bay 10 (**scn16a** – **scn16d**). This timber retained complete sapwood, but the samples fractured during extraction, hence the number of multiple cores. Four of the fragmented sections were cross-matched as shown in Table 5, and were combined to form the mean **scn16**.

Four other timbers were each sampled twice to maximise the length of the resulting mean, and/or to retain complete sapwood. These include the north rafter 3 in bay 11 (**scn17x**), the north rafter 4 in bay 11 (**scn18**), the north ashlar 5 in bay 14 (**scn21**), and the north ashlar 6 in bay 15 (**scn26**), all as shown in Table 6.

After individual sample data were combined to form same-timber means, these were cross-matched with the remaining individual samples. Sixteen sequences were found to match together with respectable *t*-values, as shown in Table 7.

All sixteen sequences were then combined to form the 194-year site master **SARUM10** (Table 8). This was compared to over 1300 local and regional reference chronologies and was dated to the period AD 1057 – 1250 (Table 9). The matches were excellent with local and regional chronologies, suggesting that the timber originated from southern England or Wales.

Second Phase Reconstruction: Trusses 12 – 20

Fourteen samples (**scn28** – **scn39**; Table 1) were taken from twelve timbers from trusses 12 to 20, and the bays in between. Two samples, **scn34a** and **scn34b**, were taken from the tiebeam of truss 17, the second retaining complete sapwood. These were matched together as shown in Table 6 and combined to form the mean **scn34**.

Of the twelve timbers sampled, ten were found to match, as shown in Table 10. These were combined to form the 133-ring site master **SARUM11** (Table 11). This was compared with the regional reference chronologies and was dated to the period AD 1409 – 1541 (Table 12). Again, the matches were excellent with local and regional chronologies, suggesting that the timber originated from southern England or Wales.

Third Phase Reconstruction: Trusses 7 – 11

Twenty samples were taken from 18 timbers in the bays between and including trusses 7 and 11 (**scn40** – **scn57**; Table 1). Two timbers had secondary samples taken in order to recover complete sapwood: samples **scn44a** and **scn44b** from the north queen strut of truss 8, and samples **scn49a** and **scn49b** from the south raking strut of truss 9. These were combined to form the same-timber means **scn44** and **scn49** respectively (Table 6).

The 18 resulting sequences were then compared with each other and two were found to match so well as to be considered to have originated from the same tree. These were the north raking strut of truss 8 (**scn42**) and the south raking strut from the same truss (**scn43**). These were combined to form the same-tree mean **scn423**, which was used in the subsequent analysis (Table 6).

This reduced the number of sequences representing individual trees to 17, and these were all compared, with 13 matching as shown in Table 13. These were combined to form the site master **SARUM12** with 148 rings (Table 14). This site master was compared to the reference chronologies and was found to match, spanning the years AD 1556 – 1703 (Table 15). Again, a southern English source near to Salisbury is suggested.

Fourth Phase Reconstruction: Trusses 1 – 6

Twenty-nine samples (**scn58** – **scn81**; Table 1) were taken from 24 timbers from trusses 1 to 6, and the bays in between.

Initially, multiple samples from the same timbers were combined to form same-timber means. Samples **scn59a** and **scn59b** were combined to form the same-timber mean **scn59**, samples **scn65a** and **scn65b** were combined to form the mean **scn65**, **scn73a** and **scn73b** formed the mean **scn73**, samples **scn76a** and **scn76b** formed the mean **scn76**, and **scn77a** and **scn77b** formed the mean **scn77** (Table 6).

Next, during the preliminary analysis stage, the resulting 24 sequences were combined at their relative offsets to give same-tree means. Same-tree matches were determined either by *t*-values over 10, or clear visual evidence on the inner face of the timbers that they originated either side of the same saw cut by the mirrored disposition of features such as shakes, knots, and angle of saw-kerfs. Thus samples **scn66**, **scn67a1**, and **scn67a2** were combined to form the same-tree mean **scn667** (Table 16), **scn71** and **scn72** formed the mean **scn712** (Table 6), **scn73** and **scn75** formed the mean **scn735** (Table 6), and samples **scn60**, **scn78**, and **scn79** were all combined to form the mean **scn60789** (Table 17).

This reduced the number of sequences from 24 to 19 individual sequences representing different trees. These were cross-matched with each other and 17 were found to match together as shown in Table 18, and were combined to form the 143-year site master **SARUM13** (Table 19). This was compared to the reference chronologies and was found to span the years AD 1577 – 1719 (Table 20).

The remaining undated sequences from all phases of the nave roof which did not cross-match with the other samples were compared with all four new site-masters, but no conclusive matches were found. They were then compared individually with chronologies from Ireland as well as from Britain, but again no conclusive matches were to be had.

Interpretation and discussion:

Primary Phase Reused Rafters

Of the 27 reused primary-phase timbers sampled, 16 dated. However, only three retained complete sapwood, resulting in precise felling dates. Two of these were from the summer/autumn of AD 1244 (samples **scn17x** and **scn18**), and the third was from spring of AD 1251 (sample **scn4**).

Significantly, the two timbers with the summer AD 1244 felling dates were from the third and fourth rafters on the north side of bay 11, whilst the spring AD 1251 date came from a rafter on the north side of bay 1, at the other end of the roof. Even more significantly, the AD 1244 timbers had Roman assembly marks of XXV N (25) and XXVII (27), whilst the AD 1251 timber was closely associated with a group of rafters with Arabic numbers. This suggests that the nave roof was built in two different construction periods.

There is some evidence in the masonry that the nave clerestory walls were constructed in at least two phases, with a possible break in the plain ashlar walling in the middle of the second bay (of ten) along from the east on the south side. However changes in details of the stop chamfers to the clerestory windows were noted between the third and fourth bays along from the east on the south elevation, and between the fourth and fifth bays along on the north side wall. Another possible change in masonry was noted in the presence of voussoirs to the blind arcading on the parapet in the last three bays on the south, and the corresponding last two and a half bays on the north (Jones 2003). If any of these three possible changes indicate a construction break, then it would be logical to assume that the first phase of the nave roof would have been erected at the east end, and would have comprised either 15, 30, or 70 trusses approximately. Given that tree-ring dates of spring and summer of AD 1242 were found for the reset upper floor structure of the adjoining central tower (Miles *et al* 2004), the AD 1244 dates for the nave roof timbers would strongly suggest that this section of the nave was roofed immediately afterwards. The Roman assembly marks of XXV and XXVII for the precisely-dated timbers show that at least 27 trusses were erected, and other Roman assembly marks ranging from I to XXXVII confirm that this section of roof extended to at least this number of trusses. The first possible break noted in Jones' (2003) study of the masonry would require an initial phase of roof construction comprising only 15 trusses. Carpenters' marks on the roof timbers, however, indicate that a more extensive initial construction phase, suggesting that work on the nave may have stopped at the point where the window base stop chamfers change.

Assuming that the original AD 1244 trusses were numbered and positioned consecutively, similar to the trusses in the north and south lesser transept high roofs, and that these rafters were set at approximately 2ft (0.6m) centres, then the construction of the present second phase roof in about AD 1542 between trusses 12 and 20 (see below) would have involved the removal of the first 45 rafter couples, numbered from the tower. However, reused timbers with Roman assembly marks I up to XXVIII (28) are found throughout bays 10 to 15. This suggests that the AD 1542 reconstruction affected more than half the roof, and that bays 10 and 11 were simply repaired using salvageable trusses or individual members from bays 12 to 19, which were entirely demolished. This might explain why reused timbers with these assembly marks are found outside the area replaced about AD 1542. The fact that the two reused AD 1244 rafters (samples **scn17x** and **scn18**), presently located in bay 11, were marked XXVII and XXV respectively, would suggest that these were removed from the original roof in the area of bay 15, and were reused in their original form with others in bays 10 and 11.

The second phase of the original nave roof seems to be identifiable through the use of Arabic numbers, which are seen to range from 66 to 100. Although the single sample (**scn4**) which dated precisely to spring AD 1251 did not have an assembly mark visible, it was in a group of timbers with numbers ranging in the 90s, found in bays 1 and 4. Assuming that the original roof had 101 rafters set at 2ft (0.6m) centres, this date probably represents the second phase of roof construction, in which the western half of the original roof was built. On this premise, **scn4** would have to have come from the group of rafters numbered 74 to 101, the area affected by the fourth phase of reconstruction in AD 1720 encompassing bays 1 to 6 (see below).

The remaining 13 dated primary-phase timbers included six with heartwood/sapwood boundaries which produced estimated felling date ranges. The earliest of these were from those rafters with Roman numerals: AD 1219 – 51, 1224 – 56, 1227 – 59, and 1231 – 63. These are entirely consistent with the AD 1244 felling dates of the other two associated timbers. Two other felling date ranges were derived from timbers associated with the timbers with Arabic numbers: AD 1244 – 76 and 1245 – 77, again both entirely consistent with the AD 1251 felling date of the associated reused rafter. Generally the felling date range is too broad to be of much use in distinguishing different phases so close together, but it is interesting to note that these two felling date ranges associated with the AD 1251 date are just beyond the AD 1244 felling date of the earlier group (Figure 10).

Seven other timbers without any evidence of heartwood/sapwood transition also dated, giving *termini post quem* or felled-after dates ranging from after AD 1168 to after AD 1215, again entirely consistent with the AD 1244 and AD 1251 felling dates of the two groups of timbers.

Interestingly, there is a documentary reference in the Cathedral Close Rolls dating to 24 June AD 1251, in which '20 oaks from 4 forests (5 from each) from Melksham, Chippenham, and Doiley and Finkley, both in Chute Forest, were given for making 20 rafter couples (*copulas inde faciendas*)' (Tatton-Brown *pers comm*; Simpson 1996). This ties up very closely with the rafter from the western end of the nave roof which was felled in spring AD 1251. If the oaks mentioned in this document were the source of the timbers in this area of the nave roof, the dendrochronology would suggest that the rafters were actually felled a month or two in advance of the 24 June grant. However, there has not been enough comparative analysis of grants of timber directly relating to precise felling dates to decide whether this is a plausible interpretation of this document.

Second Phase Reconstruction: Trusses 12 – 20

All but two of the 14 samples from this phase of building dated. The correlation between samples was variable, suggesting that some of the timber might have originated from different sources. This is supported by the fact that the tiebeam to truss 17 (**scn34**) was felled in the winter of AD 1533/4, some eight years earlier than a principal rafter in the same truss (**scn33**), and a common rafter from bay 14 (**scn29**), which were felled in the winter of AD 1541/2 and spring AD 1542 respectively. Clearly timber was being stockpiled, the larger items such as tiebeams with lengths of over 40ft (12.2m) being the most difficult timbers to obtain.

Although it is difficult to interpret a construction date from three disparate felling dates, construction would not have begun before AD 1542, and it may have taken place one or more years later, although the date of spring AD 1542 for a common rafter suggest that construction might have begun in that year.

The felling date ranges of AD 1521 – 53 and 1523 – 55 for the two lower collars to trusses 19 and 20 (**scn38** and **scn39**) are consistent with the AD 1533/4 to 1541/2 felling dates of the other timbers from truss 17, confirming the architectural observations of the consecutive assembly mark sequences (Fig 11). However, there was no structural evidence that these collars had been repositioned higher up as later alteration as had previously been thought (Jones 2002). The queen struts are positioned further apart in these latter two trusses, in line with the lower position of the upper collar.

Third Phase Reconstruction: Trusses 7 – 11

Of the 18 timbers sampled, 14 dated. Of these, eight produced precise felling dates. One of these, sample **scn43**, did not retain complete sapwood, but as it had been determined in the analysis that it originated from the same tree as **scn42** which did have complete sapwood, both were therefore felled in the winter of AD 1703/4. Two other timbers, the north and south queen struts to truss 8 (**scn44** and **scn45**), had the same felling date, and the north inner wallplate in bay 8 (**scn48**) was felled in the spring of AD 1704. Earlier felling dates ranged from winter AD 1697/8 for the tiebeam of truss 8 (**scn46**), winter AD 1701/2 for a lower purlin in bay 9 (**scn52**), and spring AD 1702 for a raking strut in truss 9 (**scn49**). Significantly, the earliest felling date of AD 1697/8 was for a tiebeam, again one of the most difficult timbers to source. Given that the latest felling date is spring AD 1704, and that four others were felled the previous winter, a construction period commencing in AD 1704 is most likely.

Five other timbers retained incomplete sapwood, or a heartwood/sapwood transition, which produced felling date ranges consistent with the AD 1697/8 to AD 1704 felling dates (Fig 11). One other timber had no heartwood/sapwood transition and produced a *terminus post quem* or felled after date of after AD 1666.

Fourth Phase Reconstruction: Trusses 1 – 6

Of the 24 timbers sampled, only two (which each had about 50 rings) failed to date. Fifteen of these dated timbers retained complete sapwood. Two other pairs of timbers were determined to have originated from the same tree and therefore two additional precise felling dates could be ascribed to (**scn67**) and (**scn75**), giving precise felling dates for 17 timbers. These ranged from winter AD 1710/11 to the spring of AD 1720, and are distributed as follows:

(**scn58**)	T1	N queen strut	Summer/autumn AD 1719
(**scn60**)	T1	N raking strut	Summer/autumn AD 1719
(**scn61**)	Bay 1	N lower purlin	Winter AD 1719/20
(**scn62**)	Bay 1	S lower purlin	Summer/autumn AD 1719
(**scn63**)	T2	N queen strut	Winter AD 1719/20
(**scn64**)	T2	Tiebeam	Winter AD 1710/11
(**scn65**)	T3	Tiebeam	Spring AD 1715
(**scn66**)	T3	S raking strut	Winter AD 1719/20
(**scn66**)	T3	N raking strut	(Winter AD 1719/20)
(**scn70**)	T4	N lower principal rafter	Winter AD 1713/14
(**scn73**)	T4	S raking strut	Spring AD1720
(**scn75**)	T5	S raking strut	(Spring AD 1720)
(**scn76**)	T5	N lower principal rafter	Winter AD1713/14
(**scn77**)	Bay 5	N lower purlin	Winter AD 1719/20
(**scn78**)	T6	N raking strut	Summer/autumn AD 1719
(**scn79**)	T6	S raking strut	Summer/autumn AD 1719
(**scn81**)	T6	Tiebeam	?Winter AD 1715/16

As can be seen in the distribution above, the latest felling dates of AD 1719 and AD 1720 are throughout all six trusses and bays. However, as was noted in the earlier phases discussed above, tiebeams particularly have been stockpiled, with felling dates of winter AD 1710/11 for **scn64**, spring AD 1715 for **scn65**, and most likely winter AD 1715/16 for **scn81**. The outer surface of this latter timber had been slightly abraded, and whilst the sapwood appeared to be complete at the point of sampling, this could not be determined with absolute confidence. Stockpiling was also noted in two of the lower principal rafters, the second largest member used in the truss construction. These were samples **scn70** and **scn76** and were found to be felled during the winter of AD 1713/14.

Of the remaining five dated timbers in this section of the roof without complete sapwood, all retained either incomplete sapwood or the clear heartwood/sapwood boundary. The estimated felling dates ranges produced for these five timbers ranged from AD 1706 – 38 to AD 1713 – 45, again entirely consistent with the range of felling dates derived above (Fig 11).

With such a good clustering of precise felling dates in AD 1719 and AD 1720, it is clear that construction would have started in framing the trusses during the spring and summer of AD 1720. Unfortunately, documentary research in the Cathedral archives has revealed that the Fabric Accounts for the periods including AD 1542, AD 1704, and AD 1720 are missing (Suzanne Eward *pers comm*).

Conclusions:

Originally, the nave roof was probably constructed in two phases, the first, represented by reused rafters with Roman assembly marks at the eastern end of the nave roof, shortly after AD 1244. The western part of the roof was constructed in or shortly after AD 1251 with timbers using Arabic assembly marks. As only three timbers produced precise felling dates, the construction periods suggested might have been a few years later due to timber stockpiling. The sequence of dates proceeding westwards show that the eastern end of the nave roof would have been constructed immediately after the central crossing, which has produced precise felling dates of AD 1242 (Miles *et al* 2004).

The location of the break in the roof carpentry as distinguished by the assembly marks does not coincide with the first break in the stone walls below identified by Howard Jones, but may align with the second change in detailing after the third bay from the east end (Jones 2003). This may mean that the trusses with Roman-numeral assembly marks were pre-assembled shortly after AD 1244, but might have been erected in two phases, as the stonework was extended to the west front.

It is significant that there are Arabic assembly marks on the trusses at the western end of the nave, associated with the spring AD 1251 felling date. This date coincides almost exactly with the AD 1251/2 felling dates of the junction of the north porch roof with the centre part of the north nave triforium, also with similar Arabic assembly marks, suggesting that the nave roof was completed first, with the triforium roofs finished immediately thereafter. The western end of the north nave triforium roof had a felling date of AD 1254/5, suggesting this was probably the final phase of construction (Miles 2002a).

The nave roof was substantially reconstructed over a period of nearly two centuries. Most of the original rafters were retained and reset on a series of trusses and purlins. The eastern third of the nave roof was rebuilt in AD 1542 or several years later if the timber was stock-piled, as only three timbers produced precise dates. The discovery of primary-phase rafters with Roman assembly marks associated the AD 1244 date in the two bays beyond the area reconstructed in about AD 1542 suggest that the area affected was greater than the present extent of the trusses assembled in the AD 1540s. The middle third of the roof was reconstructed in AD 1704 or shortly thereafter. The large number of felling dates of AD 1703/4 or shortly before strongly suggests that the construction would have started in AD 1704 or within a year or two at most of this date. Finally, the western third of the roof was reconstructed in AD 1720. Again a good group of precise felling dates, the majority clustering at AD 1719–20 suggest that the construction period was during AD 1720 or within a year of this date.

There is clear evidence of stockpiling, primarily of tiebeams in all three major phases of reconstruction, with some timbers felled between five and eight years prior to the latest felling dates. Given that these timbers would have been at least 40ft (12.2m) in length, obtaining them clearly was going to be difficult, and presumably the Cathedral purchased them, or brought them in from their own woodlands, as and when they became available. It is significant that all of the tiebeams which produced precise felling dates were found to have been stockpiled. Five other tiebeams without complete sapwood also dated – the fact that the sapwood was in a poorer condition than the other timbers comprising the roof suggest that these too may have been stockpiled.

None of the dated timbers appeared to have been imported, as had been found in the eastern chapel roofs and the north nave triforium (Miles 2002a). The matches with reference chronologies show that the timber was grown relatively close to Salisbury, although there are references to timbers being obtained from as far as the Forest of Dean (Simpson 1996). However, any attempt at dendro-provenancing the site masters would be subjective at best, as they include multiple timbers which might be from different sources.

Provenancing notwithstanding, the analysis here has provided four new site chronologies which will help in dating other phases within the Cathedral as well as other buildings in southern Britain.

Further recommendations:

Apart from research in the Cathedral archives for complementary documentary building accounts, a careful study should be made of the assembly marks to help plot the extent of the two phases of primary roof construction. Locating their present location in relation to the present reconstructed roof would be of additional interest in helping to understand the nature and extent of each phase of re-roofing.

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Table 1: Summary of tree-ring dating

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
Primary Phase Reused Rafters										
* **scn1**	c	S middle rafter 1 Bay 1	1137–1205		–	69	1.78	1.07	0.240	After 1214
* **scn2**	c	S middle rafter 2 Bay 1	1085–1168		–	84	1.86	0.56	0.227	After 1177
scn3a1	c	N lower rafter 3 Bay 1 (Arabic 99)	*1115–1176*			*62*	*1.58*	*0.57*	*0.225*	
scn3a2	c	ditto	*1178–1235*	*1235*	*H/S*	*58*	*1.00*	*0.42*	*0.293*	
scn3b	c	ditto	*1142–1235*	*1235*	*H/S*	*94*	*1.13*	*0.47*	*0.257*	
* **scn3**		Mean of **scn3a1** + **scn3a2** + **scn3b**	1115–1235	1235	H/S	121	1.29	0.56	0.243	1244–76
scn4a	c	N lower rafter 5 Bay 1	*1172–1231*	*1215*	*16*	*60*	*1.73*	*0.41*	*0.244*	
scn4b	c	ditto	*1180–1231*	*1214*	*17*	*52*	*1.79*	*0.39*	*0.226*	
scn4c	s	ditto	*1222–1250*		*+29¼C*	*29*	*1.62*	*0.36*	*0.252*	
* **scn4**		Mean of **scn4a** + **scn4b** + **scn4c**	1172–1250	1215	35¼C	79	1.74	0.40	0.241	Spring 1251
scn5	c	S lower rafter 1 Bay 2	–		H/S	58	1.93	0.96	0.252	
* **scn6**	c	S lower rafter 3 Bay 2	1145–1206		–	62	1.54	0.63	0.232	After 1215
scn7	c	N lower rafter 5 Bay 2 (Arabic 93 N)	–		H/S	51	1.56	0.85	0.245	
scn8	c	S ashlar T4	–		H/S	63	1.91	1.03	0.267	
scn9a1	c	N lower rafter 2 Bay 4 (Arabic 99 N)	*1059–1107*		–	*49*	*1.21*	*0.69*	*0.250*	
scn9a2	c	ditto	*1112–1149*		–	*38*	*1.97*	*0.87*	*0.248*	
scn9b	c	ditto	*1057–1161*		–	*105*	*1.48*	*0.80*	*0.253*	
* **scn9**		Mean of **scn9a1** + **scn9a2** + **scn9b**	1057–1161		–	105	1.52	0.74	0.246	After 1170
* **scn10**	c	N lower rafter 5 Bay 4	1142–1236	1236	H/S	95	1.55	0.66	0.242	1245–77
scn11	c	N lower rafter 1 Bay 6	–		H/S	67	1.24	0.59	0.210	
* **scn12**	c	S ashlar T8	1086–1215	1215	H/S	130	1.22	0.40	0.214	1224–56
* **scn13**	c	N lower rafter 4 Bay 8	1075–1167		–	93	1.40	0.42	0.204	After 1176
scn14	c	N ashlar T9	–		H/S	72	1.67	0.90	0.243	
scn15a1	c	N ashlar T10			5	54	1.92	0.63	0.269	
scn15a2	c	ditto	–		12+	12	1.11	0.40	0.207	
scn15a3	c	ditto	–		16+	16	1.13	0.34	0.261	
scn15b1	c	ditto			1	22	3.89	0.97	0.225	
scn15b2	c	ditto	–		9+	9	2.51	0.63	0.226	

Table 1 (continued): Summary of tree-ring dating

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
scn16a	c	N lower rafter 4 Bay 10 (Roman XVIII)	–		–	*38*	*3.53*	*1.49*	*0.189*	
scn16b	c	ditto	–		*H/S*	*36*	*1.21*	*0.49*	*0.318*	
scn16c1	c	ditto	–		*H/S*	*44*	*2.14*	*1.04*	*0.234*	
scn16c2	c	ditto	–		*+19C*	*19*	*0.95*	*0.29*	*0.227*	
scn16d1	c	ditto	–		*H/S*	*32*	*1.80*	*0.89*	*0.267*	
scn16d2	c	ditto	–		*+11*	*11*	*1.02*	*0.25*	*0.146*	
scn16d3	c	ditto	–		*+9C*	*9*	*1.03*	*0.40*	*0.352*	
scn16		Mean of **scn16a** + **16b** + **16c1** + **16d1**	–		H/S	47	2.30	1.14	0.219	
scn17a	c	N rafter 3 Bay 11 (Roman XVII)	*1172–1226*	*1226*	*H/S*	*55*	*2.32*	*0.75*	*0.250*	
scn17bx	s	ditto	*1200–1243*	*1225*	*18½C*	*44*	*1.74*	*0.96*	*0.257*	
* **scn17x**		Mean of **scn17a** + **scn17bx**	1172–1243	1225	18½C	72	2.00	0.83	0.251	Summer/autumn 1244
scn18a	c	N rafter 4 Bay 11 (Roman XV N)	*1137–1220*	*1220*	*H/S*	*84*	*2.34*	*1.42*	*0.146*	
scn18b	s	ditto	*1175–1243*	*1221*	*22½C*	*69*	*1.23*	*0.39*	*0.141*	
* **scn18**		Mean of **scn18a** + **scn18b**	1137–1243	1221	22½C	107	2.07	1.36	0.135	Summer/autumn 1244
* **scn19**	c	N ashlar 3 Bay 14 (Roman N XVI)	1114–1197		–	84	2.39	0.79	0.237	After 1206
* **scn20**	c	N ashlar 4 Bay 14 (Roman N II)	1133–1210	1210	H/S	78	2.21	0.61	0.176	1219–51
scn21a	c	N ashlar 6 Bay 14 (Roman V N)	–		*3*	*83*	*1.97*	*0.83*	*0.207*	
scn21b	s	ditto	–		*20*	*51*	*1.52*	*0.54*	*0.224*	
scn21		Mean of **scn21a** + **scn21b**	–		20	101	1.84	0.82	0.207	
* **scn22**	c	N ashlar T15 (Roman I V)	1081–1159		–	79	1.42	0.55	0.245	After 1168
scn23	c	N ashlar 1 Bay 15	–		H/S	122	1.30	0.97	0.240	
* **scn24**	c	N ashlar 3 Bay 15 (Roman VII)	1141–1222	1222	H/S	82	1.22	0.73	0.292	1231–63
* **scn25**	c	N ashlar 4 Bay 15 (Roman X N)	1142–1218	1218	H/S	77	2.26	0.89	0.202	1227–59
scn26a	c	N ashlar 6 Bay 15 (Roman X N)	–		*H/S*	*59*	*2.72*	*1.29*	*0.188*	
scn26b	s	ditto	–		*16C*	*33*	*1.37*	*0.57*	*0.205*	
scn26		Mean of **sc26a** + **scn26b**	–		16C	76	2.38	1.32	0.187	
scn27a	c	N lower rafter 1 Bay 16	–		4	53	1.94	0.62	0.260	
scn27b	c	ditto	–		1	22	3.96	1.03	0.221	
* = **SARUM10**		Site Master	1057–1250			194	1.68	0.48	0.166	

Table 1 (continued): Summary of tree-ring dating

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
Second Phase Reconstruction: Trusses 12 – 20										
† **scn28**	c	N raking strut T14	1454–1509	1509	H/S	56	1.97	0.51	0.193	1518–50
† **scn29**	c	N lower rafter 3 Bay 14	1482–1541	1521	20¼C	60	2.23	0.67	0.158	Spring 1542
† **scn30**	c	Tiebeam T15	1438–1530	1530	H/S	93	1.75	0.89	0.179	1539–71
scn31	c	S middle rafter 5 Bay 15	–		H/S	46	2.57	1.32	0.329	
† **scn32**	c	Tiebeam T16	1425–1519	1519	H/S	95	1.84	0.92	0.164	1528–60
† **scn33**	c	S lower principal rafter T17	1454–1541	1514	27C	88	1.84	0.45	0.220	Winter 1541/2
scn34a	c	Tiebeam T17	*1419–1522*	*1514*	*8*	*104*	*1.93*	*0.99*	*0.202*	
scn34b	c	ditto	*1481–1533*	*1514*	*19C*	*53*	*1.21*	*0.31*	*0.218*	
† **scn34**		Mean of **scn34a** + **scn34b**	1419–1533	1514	19C	115	1.85	0.97	0.187	Winter 1533/4
scn35a	c	N raking strut T17	–		*H/S*	*79*	*1.83*	*0.44*	*0.146*	
scn35b	c	ditto	–		*10+*	*10*	*1.19*	*0.28*	*0.154*	
† **scn36**	c	N lower principal rafter T18	1409–1508	1508	H/S	100	2.27	0.57	0.149	1517–49
† **scn37**	c	Tiebeam T18	1439–1529	1514	15	91	1.91	0.60	0.162	1530–55
† **scn38**	c	Lower collar T19	1420–1514	1514	H/S	95	2.39	0.90	0.172	1523–55
† **scn39**	c	Lower collar T20	1421–1512	1512	H/S	92	2.20	0.58	0.186	1521–53
† = **SARUM11** Site Master			1409–1541			133	2.15	0.70	0.130	

Table 1 (continued): Summary of tree-ring dating

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
Third Phase Reconstruction: Trusses 7 – 11										
scn40	c	N queen strut T7	–		25¼C	55	2.06	1.50	0.214	
scn41	c	S queen strut T7	–		21¼C	57	2.36	1.57	0.203	
scn42	c	N raking strut T8	1582–1703	1676	27C	122	1.23	0.41	0.182	Winter 1703/4
scn43	c	S raking strut T8	1576–1702	1674	28	127	0.92	0.48	0.216	(Winter 1703/4)
§ **scn423**		Mean of **scn42** + **scn43**	1576–1703	1675	28C	128	1.10	0.47	0.185	
scn44a	c	N queen strut T8	*1581–1676*	*1675*	*1+22 NM*	*96*	*1.52*	*0.72*	*0.213*	
scn44b	c	ditto	*1616–1703*	*1681*	*22C*	*88*	*1.18*	*0.52*	*0.171*	
§ **scn44**		Mean of **scn44a** + **scn44b**	1581–1703	1678	25C	123	1.40	0.71	0.183	Winter 1703/4
§ **scn45**	c	S queen strut T8	1583–1703	1674	29C	121	1.32	0.82	0.188	Winter 1703/4
§ **scn46**	c	Tiebeam T8	1588–1697	1677	20C	110	1.48	0.57	0.177	Winter 1697/8
§ **scn47**	c	S lower purlin Bay 8	1593–1668	1668	H/S	76	1.78	1.14	0.198	1677–1709
§ **scn48**	c	N Inner wallplate Bay 8	1582–1703	1664	39¼C	122	1.37	0.79	0.164	Spring 1704
scn49a	c	S raking strut T9	*1606–76*	*1668*	*8+19¼C NM*	*71*	*1.30*	*0.48*	*0.232*	
scn49b	c	ditto	*1619–1701*	*1678*	*23¼C*	*83*	*1.08*	*0.57*	*0.223*	
§ **scn49**		Mean of **scn49a** + **scn49b**	1606–1701	1673	28¼C	96	1.13	0.56	0.217	Spring 1702
§ **scn50**	c	Tiebeam T9	1559–1698	1677	21	140	1.36	0.75	0.223	1699–1718
§ **scn51**	c	N raking strut T9	1594–1675	1675	H/S	82	1.37	0.55	0.167	1684–1716
§ **scn52**	c	S lower purlin Bay 9	1583–1701	1665	36C	119	1.40	1.24	0.231	Winter 1701/2
§ **scn53**	c	N lower principal rafter T10	1556–1657		–	102	2.22	0.89	0.211	After 1666
§ **scn54**	c	S 2nd purlin Bay 10	1623–81	1681	H/S	59	2.44	1.17	0.200	1690–1722
§ **scn55**	c	N inner wall plate Bay 10	1580–1672	1670	2	93	1.40	0.76	0.226	1679–1711
scn56	c	S lower purlin Bay 10	–		7	97	1.32	0.70	0.206	
scn57	c	S raking strut T11	–		28C	104	1.21	0.50	0.216	
§ = **SARUM12** Site Master			1556–1703			148	1.61	0.83	0.155	

Table 1 (continued): Summary of tree-ring dating

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
Fourth Phase Reconstruction: Trusses 1 – 6										
‡ **scn58**	c	N queen strut T1	1640–1718	1700	18½C	79	1.88	0.50	0.188	Summer/autumn 1719
scn59a	c	Tiebeam T1	*1629–1703*	*1690*	*13*	*75*	*2.36*	*1.42*	*0.188*	
scn59b	c	ditto	*1665–1705*	*1690*	*15*	*41*	*1.35*	*0.30*	*0.226*	
‡ **scn59**		Mean of **scn59a** + **scn59b**	1629–1705	1690	15	77	2.34	1.40	0.189	1706–31
scn60	c	N raking strut T1	1602–1718	1692	26½C	117	1.38	0.79	0.182	Summer/autumn 1719
‡ **scn61**	c	N lower purlin Bay 1	1607–1719	1690	29C	113	1.74	0.58	0.187	Winter 1719/20
‡ **scn62**	c	S lower purlin Bay 1	1633–1718	1704	15½C	86	2.08	0.55	0.211	Summer/autumn 1719
‡ **scn63**	c	N queen strut T2	1665–1719	1702	17C	55	3.32	1.42	0.204	Winter 1719/20
‡ **scn64**	c	Tiebeam T2	1622–1710	1694	16C	89	2.04	0.72	0.217	Winter 1710/11
scn65a	c	Tiebeam T3	*1615–1714*	*1692*	*22*	*100*	*1.72*	*0.99*	*0.187*	
scn65b	c	ditto	*1654–1714*	*1692*	*22¼C*	*61*	*1.30*	*0.35*	*0.186*	
‡ **scn65**		Mean of **scn65a** + **scn65b**	1615–1714	1692	22¼C	100	1.74	0.98	0.185	Spring 1715
scn66	c	S raking strut T3	1603–1719	1693	26C	117	1.39	0.79	0.199	Winter 1719/20
scn67a1	c	N raking strut T3	1623–94	1688	6	72	0.86	0.47	0.246	
scn67a2	c	ditto	1700–19		+20C	20	0.77	0.16	0.170	(Winter 1719/20)
‡ **scn667**		Mean of **scn66** + **scn67a1** + **scn67a2**	1603–1719	1691	28C	117	1.26	0.78	0.194	
‡ **scn68a1**	c	S lower purlin Bay 3	1588–1690	1688	2	103	2.02	0.77	0.170	1719–29
scn68a2	c	ditto	–		+28C	28	1.44	0.26	0.202	
scn69	c	Tiebeam T4	–		H/S	50	3.19	0.62	0.188	
‡ **scn70**	c	N lower principal rafter T4	1626–1713	1697	16C	88	2.51	1.21	0.217	Winter 1713/14
scn71	c	N queen strut T4	1615–97	1697	H/S + 8 NM	83	1.35	0.70	0.228	1706–38
scn72	c	S queen strut T4	1620–96	1696	H/S	77	1.96	0.88	0.267	(1706–38)
‡ **scn712**		Mean of **scn71** + **scn72**	1615–97	1697	H/S	83	1.66	0.73	0.242	
scn73a	c	S raking strut T4	1634–99	1699	H/S	66	3.29	1.88	0.184	
scn73b	c	ditto	1677–1719	1700	19¼C	43	1.64	0.40	0.197	
scn73		Mean of **scn73a** + **scn73b**	1634–1719	1700	19¼C	86	2.87	1.82	0.188	Spring 1720
‡ **scn74**	c	N lower purlin Bay 4	1626–1704	1704	H/S	79	2.08	0.69	0.199	1713–45
scn75	c	S raking strut T5	1656–1716	1699	17	61	1.95	0.72	0.184	(Spring 1720)
‡ **scn735**		Mean of **scn73** + **scn75**	1634–1719	1700	19¼C	86	2.88	1.83	0.177	

Table 1 (continued): Summary of tree-ring dating

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
scn76a	c	N lower principal rafter T5	1636–96	1696	H/S	61	1.93	1.05	0.250	
scn76b	c	ditto	1645–1713	1698	15C	69	2.22	0.62	0.264	
‡ **scn76**		Mean of **scn76a** + **scn76b**	1636–1713	1697	16C	78	2.20	0.85	0.249	Winter 1713/14
scn77a	c	N lower purlin Bay 5	*1614–1719*	*1699*	*20C*	*106*	*2.30*	*1.05*	*0.181*	
scn77b	c	ditto	*1706–19*		*+14C*	*14*	*1.48*	*0.29*	*0.184*	
‡ **scn77**		Mean of **scn77a** + **scn77b**	1614–1719	1699	20C	106	2.30	1.05	0.175	Winter 1719/20
scn78	c	N raking strut T6	1577–1718	1692	26½C	142	1.78	1.23	0.184	Summer/autumn 1719
scn79	c	S raking strut T6	1602–1718	1692	26½C	117	1.55	0.99	0.188	Summer/autumn 1719
‡ **scn60789**		Mean of **scn60** + **scn78** + **scn79**	1577–1718	1692	26½C	142	1.77	1.13	0.174	
scn80	c	S queen strut T6	–		H/S	52	3.21	0.89	0.185	
‡ **scn81**	c	Tiebeam T6	1617–1715	1697	18 ?C	99	1.96	0.95	0.194	?Winter 1715/16
‡ = **SARUM13**		Site Master	1577–1719			143	2.27	0.69	0.127	

Key: *, †, §, ‡ = sample included in site-masters; c = core; s = section; ¼C,½C,C = bark edge present, partial or complete ring: ¼C = spring (ring not measured), ½C = summer/autumn, or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary – last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity. Sapwood estimate (95% confidence) of 9 – 41 used for English timbers (Miles 1997a)

Table 2: Matrix of *t* -values and overlaps for components of **scn3**

Sample:	**scn3a2**	**scn3b**
Last ring date AD:	1235	1235
scn3a1	0.00 0	10.59 35
scn3a2		8.49 58

Table 3: Matrix of *t* -values and overlaps for components of **scn4**

Sample:	**scn4b**	**scn4c**
Last ring date AD:	1060	1079
scn4a	18.91 52	4.40 10
scn4b		4.99 10

Table 4: Matrix of *t* -values and overlaps for components of **scn9**

Sample:	**scn9b1**	**scn9b2**
Last ring date AD:	1107	1149
scn9a	10.81 49	8.46 38
scn9b1		0.00 0

Table 5: Matrix of *t* -values and overlaps for components of **scn16**

Sample:	**scn16b**	**scn16c1**	**scn16d1**
Last ring date AD:	1047	1044	1044
scn16a	3.96 30	4.45 38	3.85 29
scn16b		9.53 33	9.77 32
scn16c1			13.93 32

Table 6: Combining of individual samples to form same-tree means

Samples:	*t - value:*	*overlap:*	*combined mean:*
scn17a + **scn17bx**	6.40	27	**scn17x**
scn18a + **scn18b**	8.70	46	**scn18**
scn21a + **scn21b**	6.90	33	**scn21**
scn26a + **scn26b**	8.42	16	**scn26**
scn34a + **scn34b**	6.58	42	**scn34**
scn44a + **scn44b**	5.12	61	**scn44**
scn49a + **scn49b**	14.34	58	**scn49**
scn42 + **scn43**	10.70	121	**scn423**
scn59a + **scn59b**	13.65	39	**scn59**
scn65a + **scn65b**	21.04	61	**scn65**
scn73a + **scn73b**	19.58	23	**scn73**
scn76a + **scn76b**	11.60	52	**scn76**
scn77a + **scn77b**	10.47	14	**scn77**
scn71 + **scn72**	11.63	77	**scn712**
scn73 + **scn75**	10.63	61	**scn735**

Table 7: Matrix of *t* -values and overlaps for components of **SARUM10**

Sample:	**scn2**	**scn3**	**scn4**	**scn6**	**scn9**	**scn10**	**scn12**	**scn13**	**scn17x**	**scn18**	**scn19**	**scn20**	**scn22**	**scn24**	**scn25**
Last ring date AD:	1168	1235	1250	1206	1161	1236	1215	1167	1243	1243	1197	1210	1159	1222	1218
scn1	0.59 32	2.43 69	10.02 34	5.07 61	1.87 25	0.79 64	4.92 69	0.00 31	0.54 34	2.84 69	1.85 61	2.59 69	2.50 23	2.42 65	4.77 64
scn2		1.63 54	0.00 0	0.75 24	3.22 77	0.07 27	3.83 83	4.36 83	0.00 0	2.11 32	3.15 55	0.00 36	4.72 75	0.00 28	1.16 27
scn3			4.60 64	2.98 62	3.44 47	3.89 94	4.80 101	0.00 53	1.69 64	3.99 99	3.80 83	3.07 78	1.78 45	3.73 82	2.51 77
scn4				4.85 35	0.00 0	1.26 65	7.95 44	0.00 0	1.16 72	2.45 72	1.24 26	3.06 39	0.00 0	2.23 51	4.23 47
scn6					1.77 17	1.63 62	4.38 62	1.32 23	1.34 35	1.81 62	2.05 53	3.58 62	0.01 15	1.20 62	4.06 62
scn9						1.45 20	2.58 76	1.76 87	0.00 0	1.43 25	3.60 48	0.45 29	1.22 79	0.02 21	2.64 20
scn10							1.42 74	0.00 26	4.33 65	3.47 95	2.19 56	3.23 69	0.00 18	4.93 81	3.38 77
scn12								2.46 82	1.14 44	2.31 79	1.56 84	3.84 78	1.31 74	1.54 75	6.40 74
scn13									0.00 0	2.56 31	1.94 54	0.00 35	2.28 79	0.00 27	0.38 26
scn17x										0.93 72	1.46 26	1.75 39	0.00 0	2.62 51	3.22 47
scn18											4.29 61	2.89 74	1.15 23	2.37 82	2.97 77
scn19												2.32 65	0.61 46	1.76 57	2.19 56
scn20													0.77 27	2.44 70	5.27 69
scn22														0.00 19	0.97 18
scn24															3.26 77

Table 8: Ring-width data for site master curve

SARUM10 AD 1057–1250 Salisbury Cathedral Nave: Thirteenth-century reused timbers 16-timber mean

194 rings, starting date AD 1057

ring widths (0.01mm)

252	383	175	212	196	234	352	253	172	206
308	297	205	254	142	133	193	137	183	262
251	191	211	190	142	192	213	138	198	163
125	171	162	119	162	197	193	140	137	138
145	154	143	126	114	133	141	122	143	136
131	151	118	93	98	117	135	177	206	159
151	180	150	143	141	168	202	191	171	155
156	187	125	160	160	194	185	190	184	148
184	249	225	331	277	270	231	241	246	208
185	188	199	186	220	177	216	192	188	217
235	203	228	245	179	183	174	180	187	161
131	170	191	176	177	166	201	191	178	225
132	151	183	133	142	161	152	115	133	137
185	124	164	196	147	144	185	163	183	172
145	116	130	142	150	121	109	98	113	104
90	138	124	147	137	111	98	100	122	142
129	127	174	159	161	137	167	174	180	196
141	153	167	159	111	102	116	98	122	88
123	98	107	111	125	141	157	151	119	137
139	197	168	118						

number of samples in master

1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	2	2
2	2	2	2	3	3	3	3	4	5
5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5	5	6	7	7
7	7	7	7	7	7	7	7	7	7
7	7	7	7	7	7	8	8	8	8
10	10	10	10	11	13	13	13	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	13	13	12	12	12	12	12
12	11	10	10	10	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	11	11	11	11	11	11	11	11	10
9	9	9	9	8	8	8	8	8	7
7	7	6	6	6	6	5	5	5	5
5	5	5	5	5	5	5	5	5	4
3	3	3	3	3	3	3	1	1	1
1	1	1	1						

Table 9: Dating of **SARUM10** (AD 1057–1250) against reference chronologies at AD 1250

	Reference chronology	Spanning	Overlap	t-value
	SARUM2 *(Miles 2002a)*	1106–1213	108	7.91
	HANTS02 *(Miles 2003)*	443–1972	194	10.21
*	GLAST *(Bridge 1983)*	1095–1334	156	10.33
	WALES97 *(Miles 1997b)*	404–1981	194	10.36
	SENG98 *(Bridge 1998a)*	944–1790	194	10.48
	SARUM14 *(Miles et al 2004)*	1053–1241	185	11.85
	LONDON *(Tyers pers comm)*	413–1728	194	11.69
	MASTERAL *(Haddon-Reece and Miles 1993)*	404–1987	194	11.89
	SARUM3X *(Miles 2002a)*	1035–1254	194	12.23
	GLOUCBLF *(Hillam and Groves 1993)*	1076–1219	144	13.02

* Component of MASTERAL

Chronologies in **bold** denote regional masters

Table 10: Matrix of *t* -values and overlaps for components of **SARUM11**

Sample: *Last ring date AD:*	**scn29** 1541	**scn30** 1530	**scn32** 1519	**scn33** 1541	**scn34** 1533	**scn36** 1508	**scn37** 1529	**scn38** 1514	**scn39** 1512
scn28	1.32 28	4.59 56	2.24 56	1.95 56	6.88 56	1.29 55	3.81 56	5.58 56	3.38 56
	scn29	2.46 49	1.99 38	2.30 60	4.79 52	0.40 27	2.03 48	2.26 33	1.27 31
		scn30	3.90 82	2.70 77	4.56 93	1.21 71	3.46 91	5.37 77	4.08 75
			scn32	3.22 66	1.19 95	1.73 84	4.18 81	3.47 90	4.98 88
				scn33	2.46 80	0.50 55	2.26 76	4.06 61	4.10 59
					scn34	0.50 90	4.79 91	3.72 95	1.81 92
						scn36	3.84 70	2.14 89	2.02 88
							scn37	3.34 76	3.14 74
								scn38	9.28 92

Table 11: Ring-width data for site master curve

SARUM11 AD 1409–1541 Salisbury Cathedral Nave: Phase 2 reconstruction 10-timber mean

133 rings, starting date AD 1409

ring widths (0.01mm)

344	345	328	354	373	301	311	183	275	298
316	450	399	294	415	376	371	335	317	317
260	211	261	299	260	275	321	287	227	237
232	244	283	253	279	276	242	209	254	241
277	256	271	239	246	254	255	258	231	215
186	187	148	167	205	154	204	228	204	229
209	230	191	188	183	189	209	149	146	173
212	208	241	240	227	220	189	170	199	180
178	183	175	149	149	171	170	237	188	155
164	138	153	164	165	164	152	128	123	116
139	115	169	158	140	157	138	124	106	135
189	164	178	203	151	141	132	165	159	169
127	117	192	129	153	142	173	159	158	216
215	164	178							

number of samples in master

1	1	1	1	1	1	1	1	1	1
2	3	4	4	4	4	5	5	5	5
5	5	5	5	5	5	5	5	5	6
7	7	7	7	7	7	7	7	7	7
7	7	7	7	7	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10
10	10	10	10	10	10	10	10	10	10
9	8	8	8	7	7	6	6	6	6
6	5	5	5	5	5	5	5	5	5
5	4	3	3	3	2	2	2	2	2
2	2	2							

Table 12: Dating of **SARUM11** (AD 1409–1541) against reference chronologies at AD 1541

	Reference chronology	Spanning	Overlap	t-value
	SARUMBP5 *(Miles and Worthington 2000)*	1387–1540	132	7.86
	WALES97 *(Miles 1997b)*	404–1981	133	8.08
‡	MOTISFNT *(Miles 1996)*	1388–1538	130	9.77
‡	EXTON *(Miles and Haddon-Reece 1995)*	1376–1546	133	9.84
	OXON93 *(Haddon-Reece et al 1993)*	632–1987	133	9.84
‡	OVERTON3 *(Miles and Worthington 1997)*	1397–1543	133	10.10
	MASTERAL *(Haddon-Reece and Miles 1993)*	404–1987	133	10.55
	SENG98 *(Bridge 1998a)*	944–1790	133	10.61
	SOUTH *(Hillam and Groves 1994)*	406–1594	133	12.26
	HANTS02 *(Miles 2003)*	443–1972	133	12.34

‡ Component of HANTS97
Chronologies in **bold** denote regional masters

Table 13: Matrix of *t* -values and overlaps for components of **SARUM12**

Sample:	**scn44**	**scn45**	**scn46**	**scn47**	**scn48**	**scn49**	**scn50**	**scn51**	**scn52**	**scn53**	**scn54**	**scn55**
Last ring date AD:	1703	1703	1697	1668	1703	1701	1698	1675	1701	1657	1681	1672
scn423	5.64 123	3.43 121	3.23 110	4.28 76	5.69 122	5.53 96	2.32 123	5.13 82	4.24 119	2.35 82	1.62 59	6.79 93
	scn44	7.20 121	4.37 110	4.22 76	4.75 122	4.70 96	3.40 118	3.88 82	5.51 119	3.06 77	3.14 59	5.13 92
		scn45	1.92 110	2.53 76	3.70 121	6.70 96	3.16 116	6.01 82	2.94 119	1.95 75	2.77 59	3.08 90
			scn46	4.49 76	5.85 110	2.82 92	8.05 110	2.61 82	5.89 110	5.34 70	3.09 59	4.30 85
				scn47	2.79 76	3.51 63	5.10 76	2.89 75	9.51 76	3.41 65	2.53 46	4.92 76
					scn48	4.75 96	4.15 117	4.52 82	3.58 119	2.58 76	3.30 59	6.72 91
						scn49	3.49 93	6.50 70	3.32 96	2.62 52	3.66 59	5.15 67
							scn50	2.91 82	6.38 116	8.36 99	4.04 59	4.01 93
								scn51	2.13 82	3.25 64	2.32 53	3.69 79
									scn52	5.84 75	4.41 59	6.14 90
										scn53	2.56 35	3.37 78
											scn54	1.59 50

Table 14: Ring-width data for site master curve

SARUM12 AD 1556–1703 Salisbury Cathedral Nave: Phase 3 reconstruction 14-timber / 13-tree mean

148 rings, starting date AD 1556

ring widths (0.01mm)

245	297	371	312	466	265	329	216	258	245
166	192	170	251	290	316	204	244	219	212
189	209	185	214	369	262	253	291	287	342
279	288	256	305	202	249	260	230	300	262
267	252	261	186	216	192	213	226	216	180
215	201	182	170	171	189	157	199	162	138
134	136	154	139	145	155	156	175	152	202
176	162	194	188	165	141	183	195	132	161
144	148	167	142	152	147	137	128	106	118
119	100	148	122	111	84	83	69	91	124
104	95	115	77	94	83	90	100	95	98
85	74	85	82	88	73	74	83	70	69
57	87	75	58	75	66	77	60	62	54
77	83	63	78	72	67	62	65	71	64
76	87	75	56	57	59	45	60		

number of samples in master

1	1	1	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	2	2
3	3	3	3	4	5	6	8	8	8
8	8	9	9	9	9	9	10	11	11
11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	13	13	13
13	13	13	13	13	13	13	13	13	13
13	13	13	13	13	13	13	13	13	13
13	13	13	13	13	13	13	13	13	13
13	13	12	12	12	12	12	12	12	12
12	12	12	11	11	11	11	10	10	10
9	9	9	9	9	9	8	8	8	8
8	8	8	8	8	8	8	8	8	8
8	8	7	6	6	6	4	4		

Table 15: Dating of **SARUM12** (AD 1556–1703) against reference chronologies at AD 1703

Reference chronology	Spanning	Overlap	t-value
SARUM6 *(Miles and Worthington 2000; Miles 2002a)*	1604–68	65	6.23
SARUM17 *(Miles et al 2004)*	1556–1684	129	6.34
SARUMBP8 *(Miles and Worthington 2000)*	1616–1735	88	6.54
SARUM5 *(Miles and Worthington 2000; Miles 2002a)*	1558–1662	105	7.38
WALES97 *(Miles 1997b)*	404–1981	148	7.69
SARUMBP7 *(Miles and Worthington 2000)*	1562–1661	100	8.28
CHAWTON5 *(Miles and Worthington 1998)*	1559–1665	107	8.62
SENG98 *(Bridge 1998a)*	944–1790	148	8.71
MASTERAL *(Haddon-Reece and Miles 1993)*	404–1987	148	10.08
HANTS02 *(Miles 2003)*	443–1972	148	10.20

Chronologies in **bold** denote regional masters

Table 16: Matrix of *t* -values and overlaps for components of **scn667**

Sample:	**scn67a1**	**scn67a2**
Last ring date AD:	1694	1719
scn66	9.28 72	5.61 20
	scn67a1	0.00 0

Table 17: Matrix of *t* -values and overlaps for components of **scn60789**

Sample:	**scn78**	**scn79**
Last ring date AD:	1718	1718
scn60	12.17 117	11.18 117
	scn78	14.88 117

Table 18: Matrix of *t* -values and overlaps for components of **SARUM13**

Sample:	**scn59**	**scn61**	**scn62**	**scn63**	**scn64**	**scn65**	**scn667**	**scn68a1**	**scn70**	**scn712**	**scn74**	**scn735**	**scn76**	**scn77**	**scn60789**	**scn81**
Last ring date AD:	1705	1719	1718	1719	1710	1714	1719	1690	1713	1697	1704	1719	1713	1719	1718	1715
scn58	0.63 66	4.36 79	7.63 79	2.20 54	0.33 71	0.00 75	2.83 79	1.89 51	2.49 74	1.58 58	5.89 65	4.10 79	1.99 74	6.09 79	2.68 79	0.71 76
scn59		3.71 77	1.96 73	0.98 41	5.58 77	3.05 77	1.95 77	1.97 62	5.07 77	4.21 69	0.52 76	3.85 72	3.17 70	0.81 77	5.21 77	6.26 77
scn61			5.12 86	1.83 55	2.19 89	1.36 100	5.28 113	7.10 84	2.72 88	4.31 83	3.37 79	4.71 86	1.67 78	3.37 106	3.80 112	4.57 99
scn62				1.62 54	1.25 78	1.14 82	3.96 86	3.05 58	1.79 81	3.66 65	7.10 72	2.94 85	1.41 78	6.79 86	3.71 86	2.38 83
scn63					0.58 46	1.53 50	1.25 55	2.40 26	3.42 49	1.73 33	0.00 40	5.30 55	2.80 49	2.69 55	2.85 54	2.20 51
scn64						6.07 89	2.44 89	2.40 69	4.72 85	3.60 76	0.73 79	2.24 77	3.10 75	0.58 89	1.83 89	5.96 89
scn65							0.44 100	1.93 76	3.76 88	1.95 83	0.24 79	1.49 81	3.15 78	0.24 100	0.00 100	7.57 98
scn667								1.76 88	1.46 88	6.23 83	4.30 79	2.97 86	0.00 78	5.04 106	3.59 116	1.44 99
scn68a1									2.56 65	2.28 76	1.69 65	4.00 57	2.59 55	2.03 77	2.21 103	2.99 74
scn70										2.91 72	1.44 79	3.47 80	7.27 78	1.92 88	1.75 88	6.52 88
scn712											4.00 72	3.22 64	1.28 62	5.13 83	3.91 83	2.70 81
scn74												1.83 71	1.25 69	8.38 79	1.57 79	1.09 79
scn735													2.78 78	3.17 86	5.96 85	3.05 82
scn76														1.34 78	0.98 78	4.47 78
scn77															2.54 105	0.00 99
scn60789																1.66 99

Table 19: Ring-width data for site master curve

SARUM13 AD 1577–1719 Salisbury Cathedral Nave: Phase 4 reconstruction 22-timber / 17-tree mean

143 rings, starting date AD 1577

ring widths (0.01mm)

270	173	191	301	221	210	238	273	385	277
334	254	314	195	248	221	298	325	323	339
343	333	308	307	330	437	390	357	305	296
331	318	306	296	243	243	322	299	276	308
268	267	278	292	286	299	306	296	314	345
284	282	309	250	242	281	299	230	286	278
270	288	219	245	264	257	251	211	209	216
203	270	245	209	203	181	155	195	219	212
192	221	161	182	139	146	159	165	210	210
203	218	232	237	220	193	201	175	156	161
196	160	168	210	174	196	166	163	119	170
170	145	163	171	196	162	158	156	140	155
187	193	151	157	147	122	166	198	131	144
146	148	141	110	135	146	162	116	130	151
154	125	114							

number of samples in master

1	1	1	1	1	1	1	1	1	1
1	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	3	3	3	3
4	4	4	4	4	4	4	5	7	7
8	8	8	8	8	9	9	9	9	11
11	11	12	12	12	12	13	14	14	15
15	15	15	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	17	17
17	17	17	17	17	17	17	17	17	17
17	17	17	17	17	17	17	17	17	17
17	17	17	17	16	16	16	16	16	16
16	15	15	15	15	15	15	15	14	13
13	13	13	13	12	12	12	10	9	8
8	8	5							

Table 20: Dating of **SARUM13** (AD 1577–1719) against reference chronologies at AD 1719

	Reference chronology	Spanning	Overlap	t-value
	SARUM17 *(Miles et al 2004)*	1556–1684	108	4.73
	SARUM5 *(Miles and Worthington 2000; Miles 2002a)*	1558–1662	86	6.88
	SARUMBP7 *(Miles and Worthington 2000)*	1562–1661	85	7.53
	SENG98 *(Bridge 1998a)*	944–1790	143	7.86
	OXON93 *(Haddon-Reece et al 1993)*	632–1987	143	7.95
*	**EASTMID** *(Laxton and Litton 1988)*	882–1981	143	8.19
	SARUMBP8 *(Miles and Worthington 2000)*	1616–1735	104	8.26
	SARUM7 *(Miles and Worthington 2000; Miles 2002a)*	1672–1735	48	8.38
	MASTERAL *(Haddon-Reece and Miles 1993)*	404–1987	143	8.98
	HANTS02 *(Miles 2003)*	443–1972	143	9.21

* Component of MASTERAL

Chronologies in **bold** denote regional masters

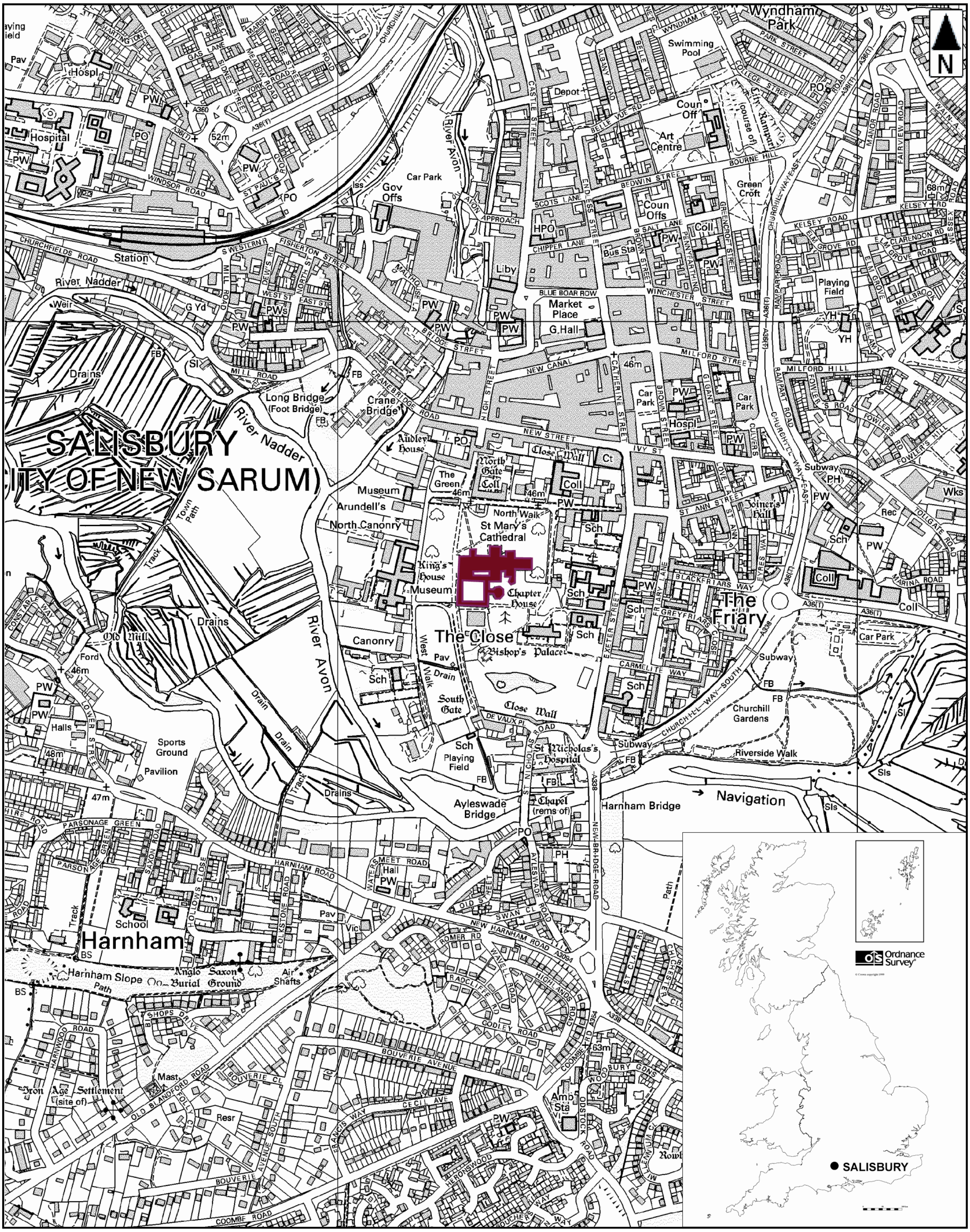


Figure 1: Plan of Salisbury with inset map of the United Kingdom. This map is based upon Ordnance Survey

Figure 6: Roman assembly marks from reused nave roof timbers (AD 1244)

Figure 7: Arabic assembly marks from reused nave roof timbers (AD 1251)

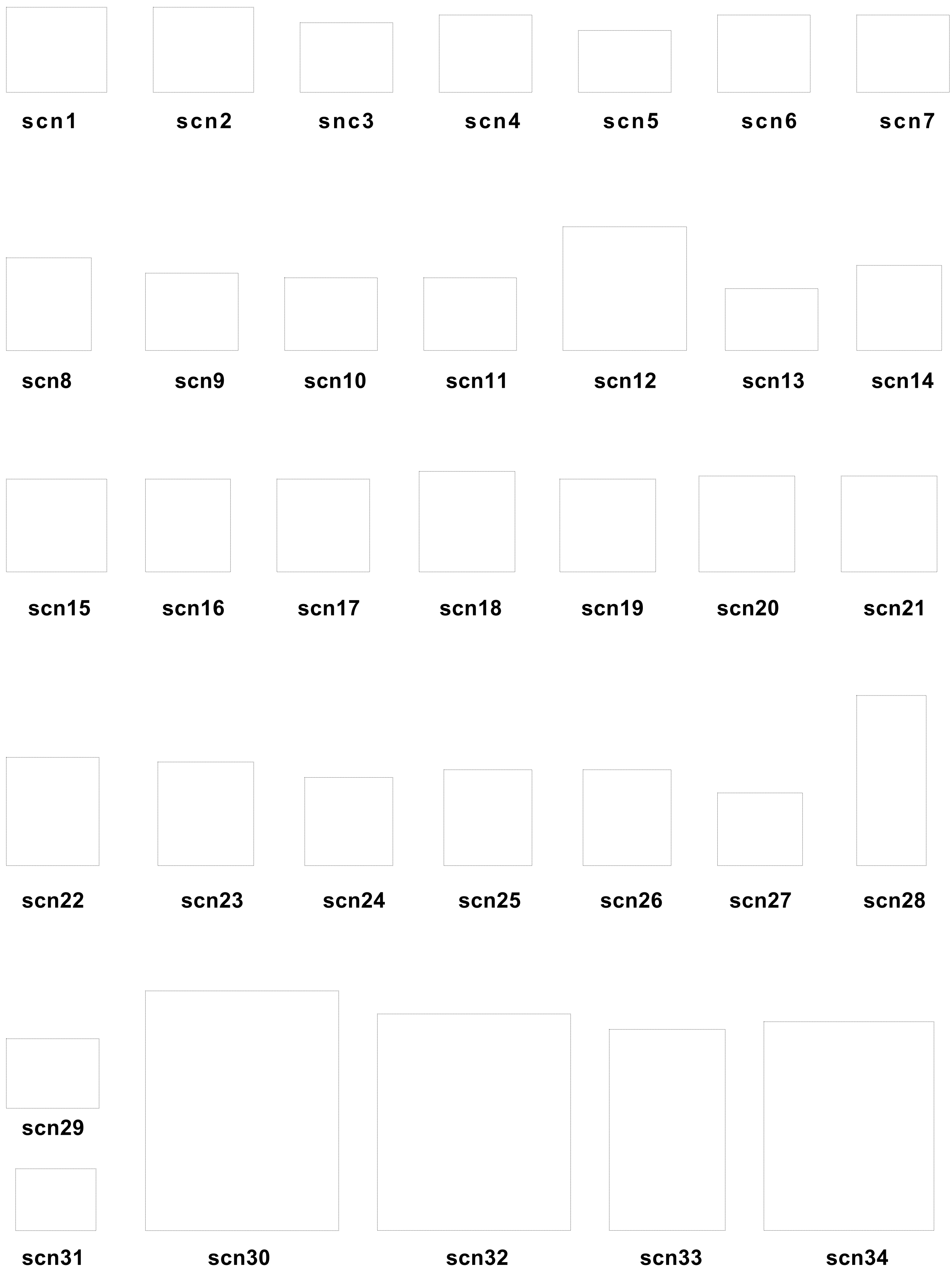


Figure 9: Scale section drawings of timbers sampled (scale 1:10)

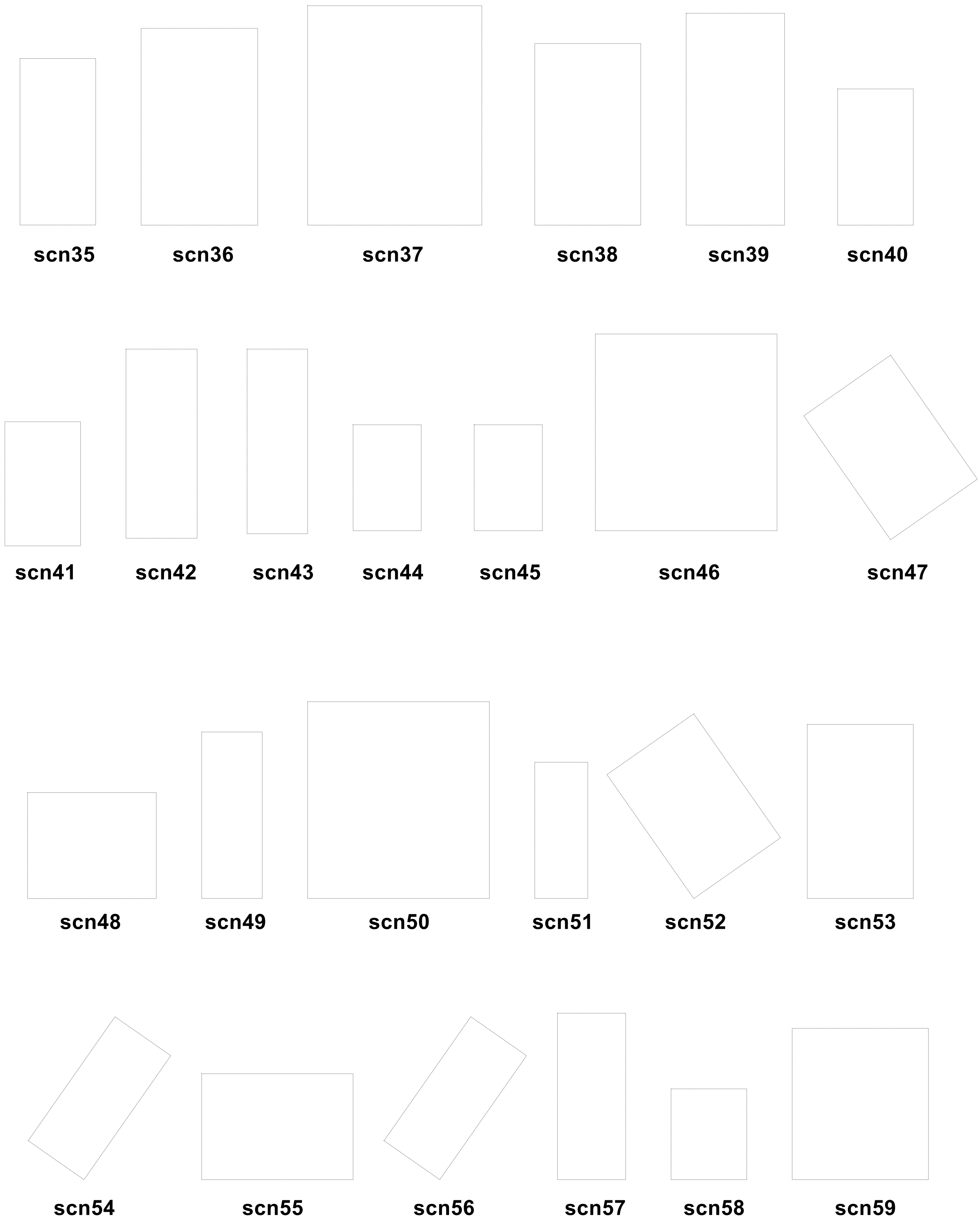


Figure 9 (cont): Scale section drawings of timbers sampled (scale 1:10)

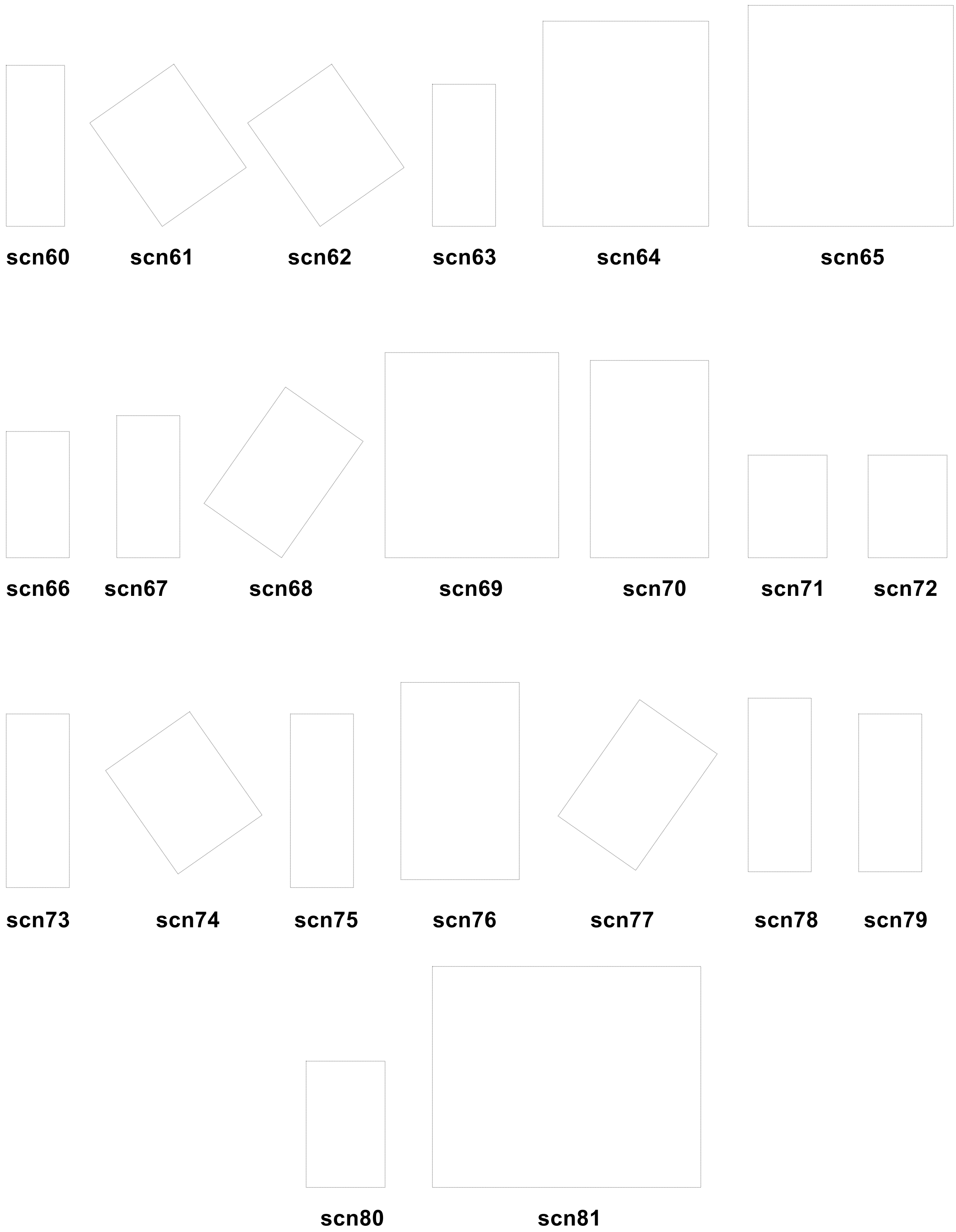


Figure 9 (cont): Scale section drawings of timbers sampled (scale 1:10)

APPENDIX 1: Drawings showing location of samples (after Jones)

page 50	Truss No. 1 west face	Samples **scn58**, **59**, **60**
page 51	Truss No. 2 west face	Samples **scn61**, **62**, **63**, **64**
page 52	Truss No. 3 west face	Samples **scn65**, **66**, **67**
page 53	Truss No. 4 west face	Samples **scn8**, **68**, **69**, **70**, **71**, **72**, **73**
page 54	Truss No. 5 west face	Samples **scn74**, **75**, **76**
page 55	Truss No. 6 west face	Samples **scn77**, **78**, **79**, **70**, **80**, **81**
page 56	Truss No. 7 west face	Samples **scn40**, **41**
page 57	Truss No. 8 west face	Samples **scn12**, **42**, **43**, **44**, **45**, **46**
page 58	Truss No. 9 west face	Samples **scn14**, **47**, **48**, **49**, **50**, **51**
page 59	Truss No. 10 west face	Samples **scn15**, **52**, **53**
page 60	Truss No. 11 west face	Samples **scn54**, **55**, **56**, **57**
page 61	Truss No. 12 west face	
page 62	Truss No. 13 west face	
page 63	Truss No. 14 west face	Sample **scn28**
page 64	Truss No. 15 west face	Samples **scn22**, **30**
page 65	Truss No. 16 west face	Sample **scn32**
page 66	Truss No. 17 west face	Samples **scn33**, **34**, **35**
page 67	Truss No. 18 west face	Samples **scn36**, **37**
page 68	Truss No. 19 west face	Sample **scn38**
page 69	Truss No. 20 west face	Sample **scn39**
pages 70 & 71	Longitudinal section North elevation	Samples **scn3**, **4**, **7**, **9**, **10**, **11**, **13**, **14**, **15**, **16**, **17**, **18**, **19**, **20**, **21**, **23**, **24**, **25**, **26**, **27**, **28**, **29**, **30**, **32**, **34**, **35**, **36**, **37**, **38**, **39**, **42**, **46**, **48**, **50**, **51**, **53**, **55**, **59**, **60**, **61**, **64**, **65**, **67**, **69**, **70**, **74**, **76**, **77**, **78**, **81**
pages 72 & 73	Longitudinal section South elevation	Samples **scn1**, **2**, **5**, **6**, **8**, **12**, **30**, **31**, **32**, **33**, **34**, **37**, **38**, **39**, **43**, **46**, **47**, **49**, **50**, **52**, **54**, **56**, **57**, **59**, **62**, **64**, **65**, **66**, **68**, **69**, **73**, **75**, **79**, **81**

The nave roof of Salisbury Cathedral from the west. ©Crown copyright. NMR. BB69/5187

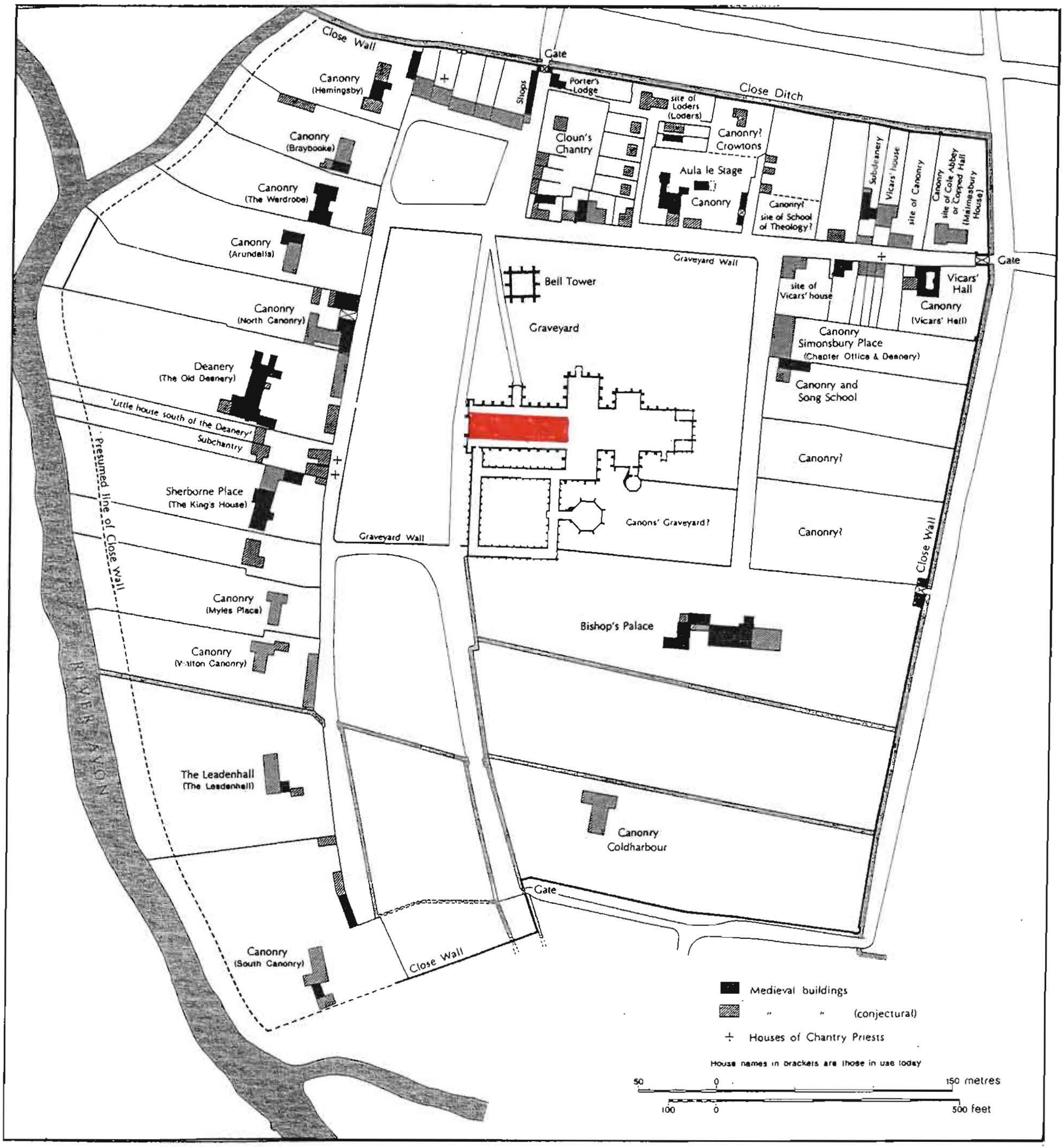


Figure 2: Reconstructed plan of the close in the late medieval period (RCHME 1993)

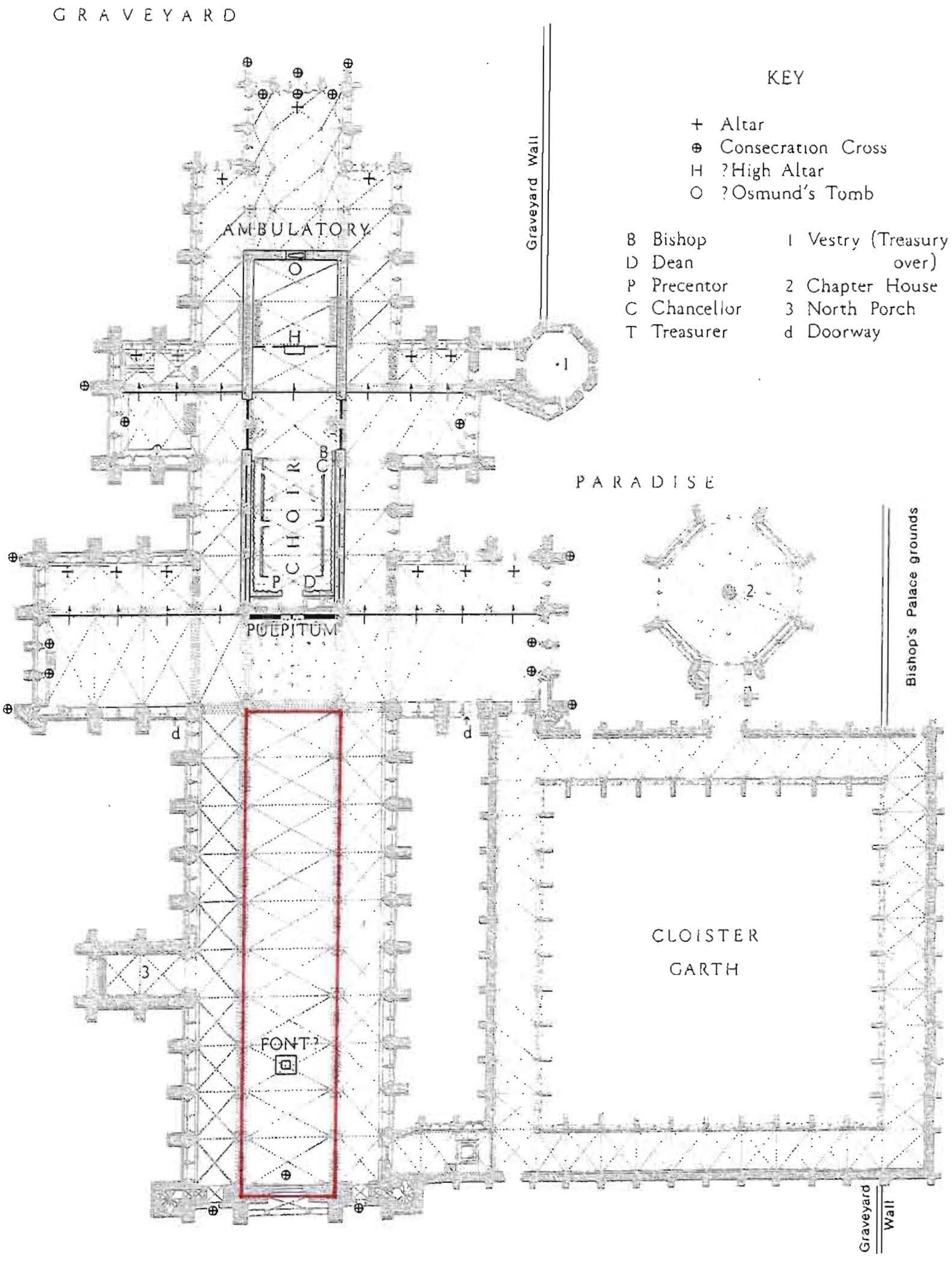
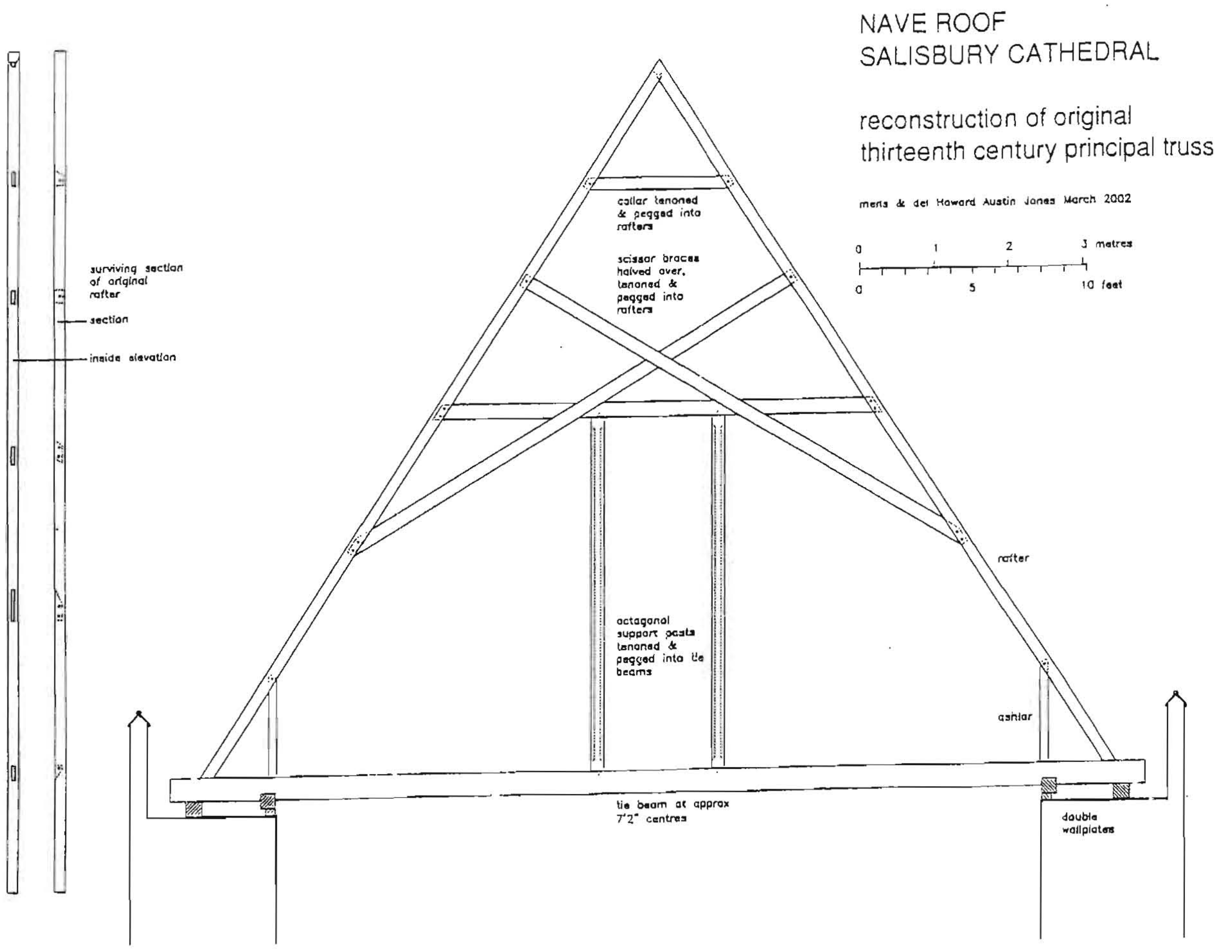


Figure 3: Plan of Salisbury Cathedral showing areas sampled (after Cocke and Kidson 1993)



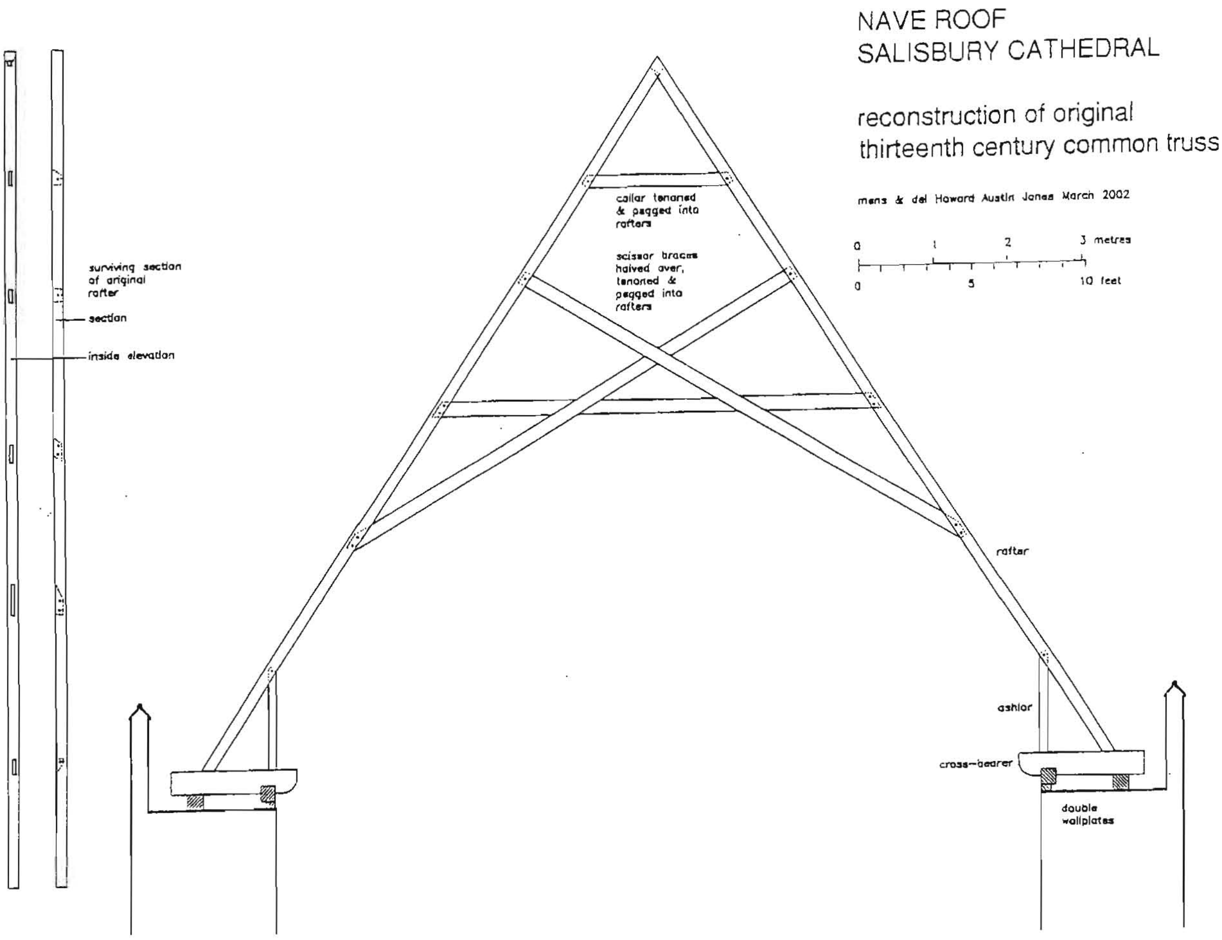


Figure 4: Conjectural layout of nave roof trusses (Jones 2002 *unpubl*)

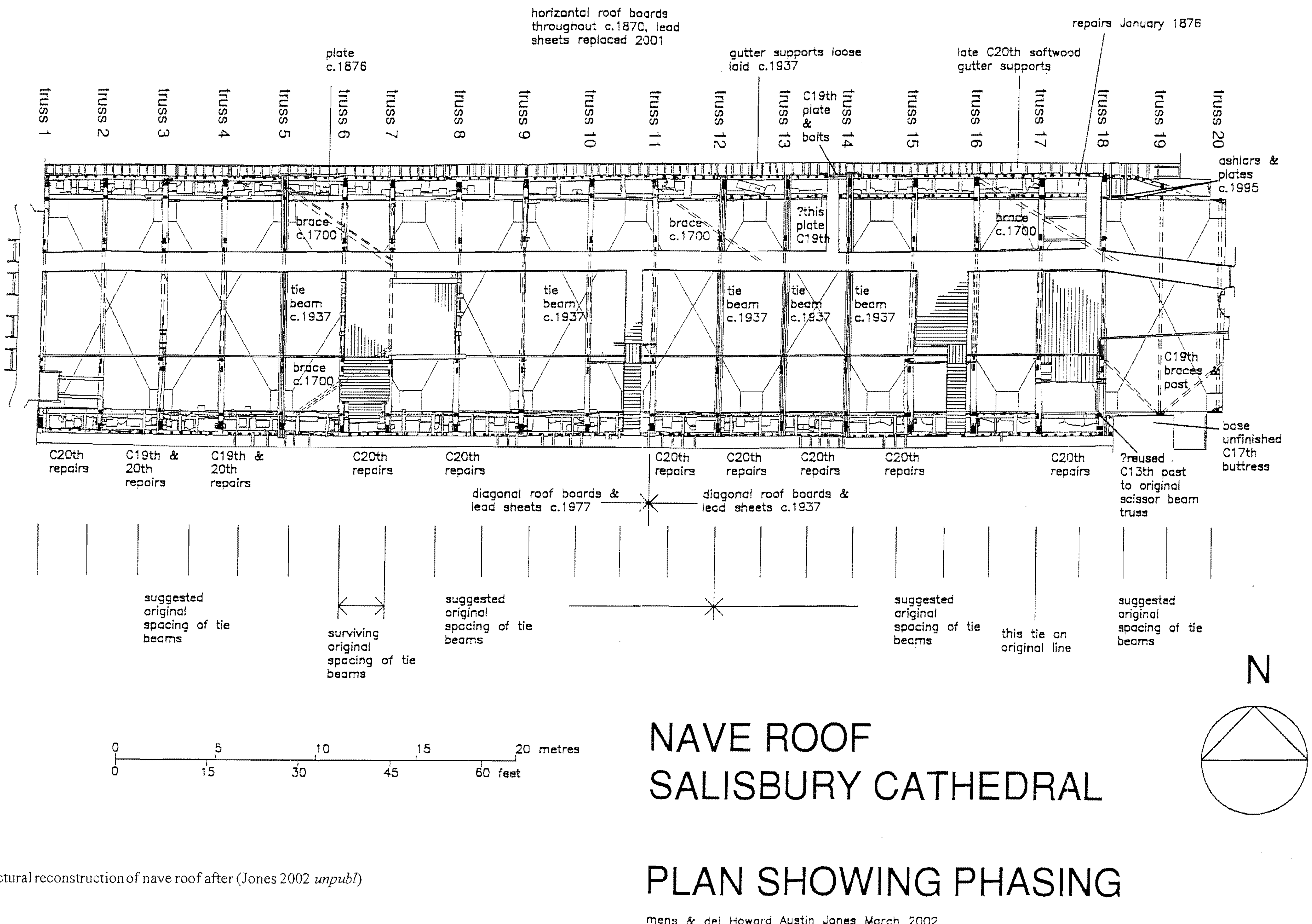
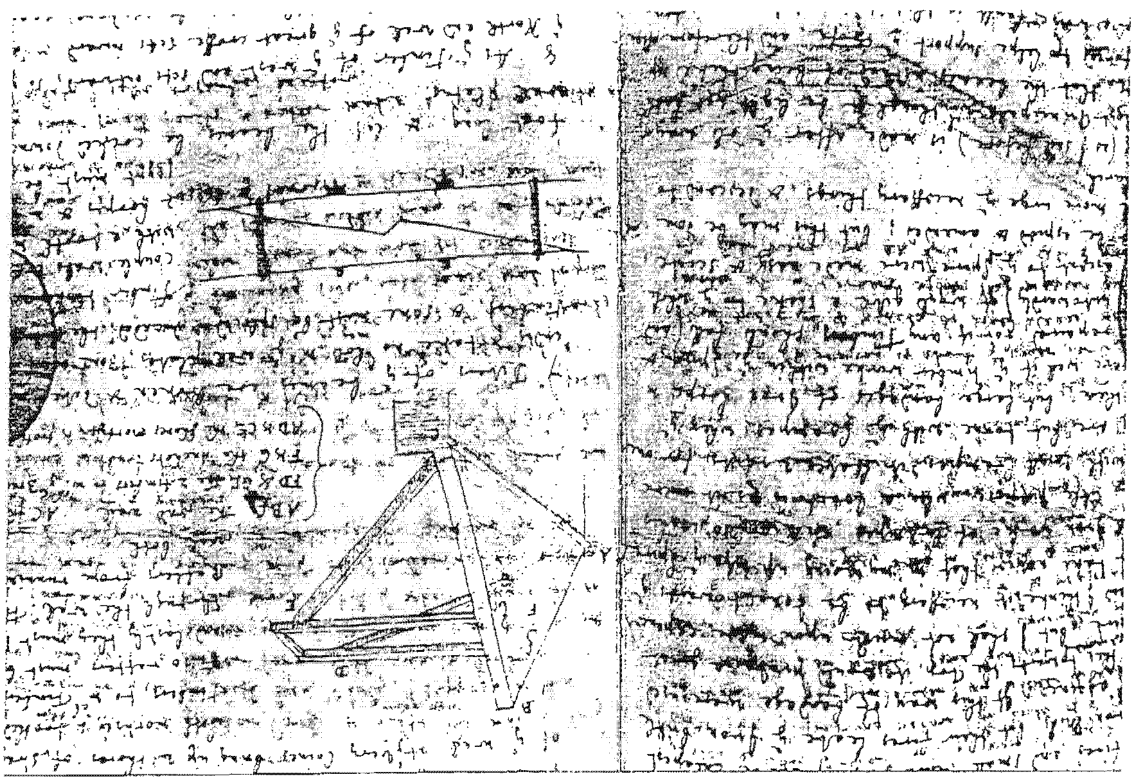
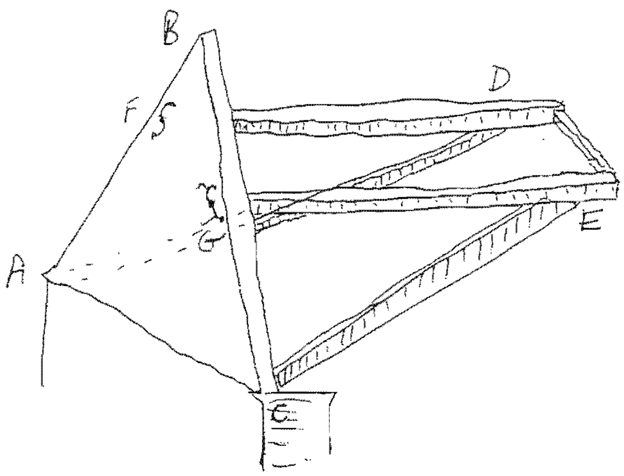


Figure 5: Conjectural reconstruction of nave roof after (Jones 2002 *unpubl*)





(ABC, the end wall. AC the set off at the coins.

(FD & GE the 2 timbers to which ye braces are pinned down.

(F & G the anchors.

(AD & CE the shores mortised and toothed in at D and E.'

Figure 8: Detail of proposed repair to west end of nave roof by Sir Christopher Wren in 1668 (Wren 1668; Tatton-Brown 1995)

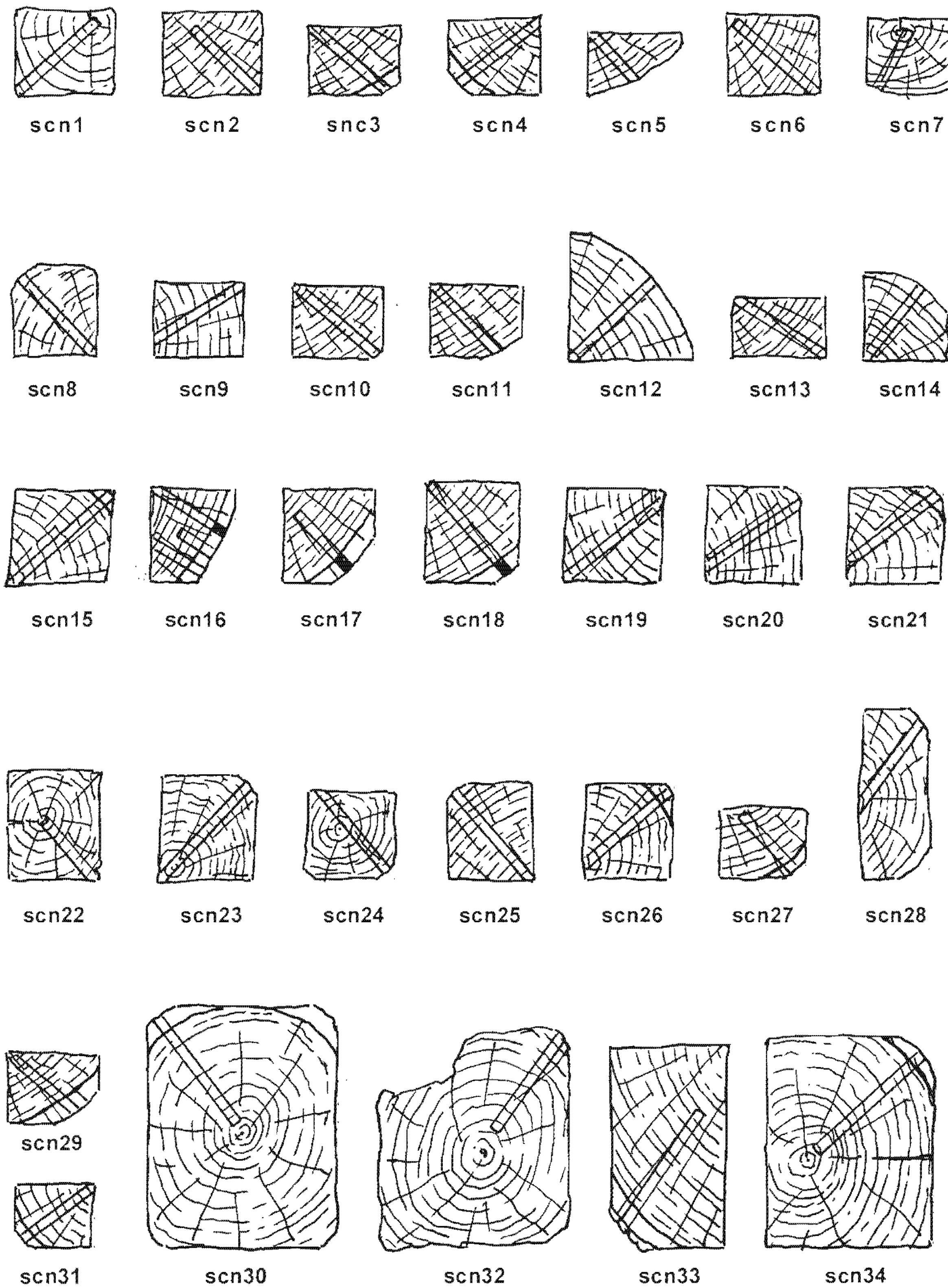


Figure 9: Scale section drawings of timbers sampled (scale 1:10)

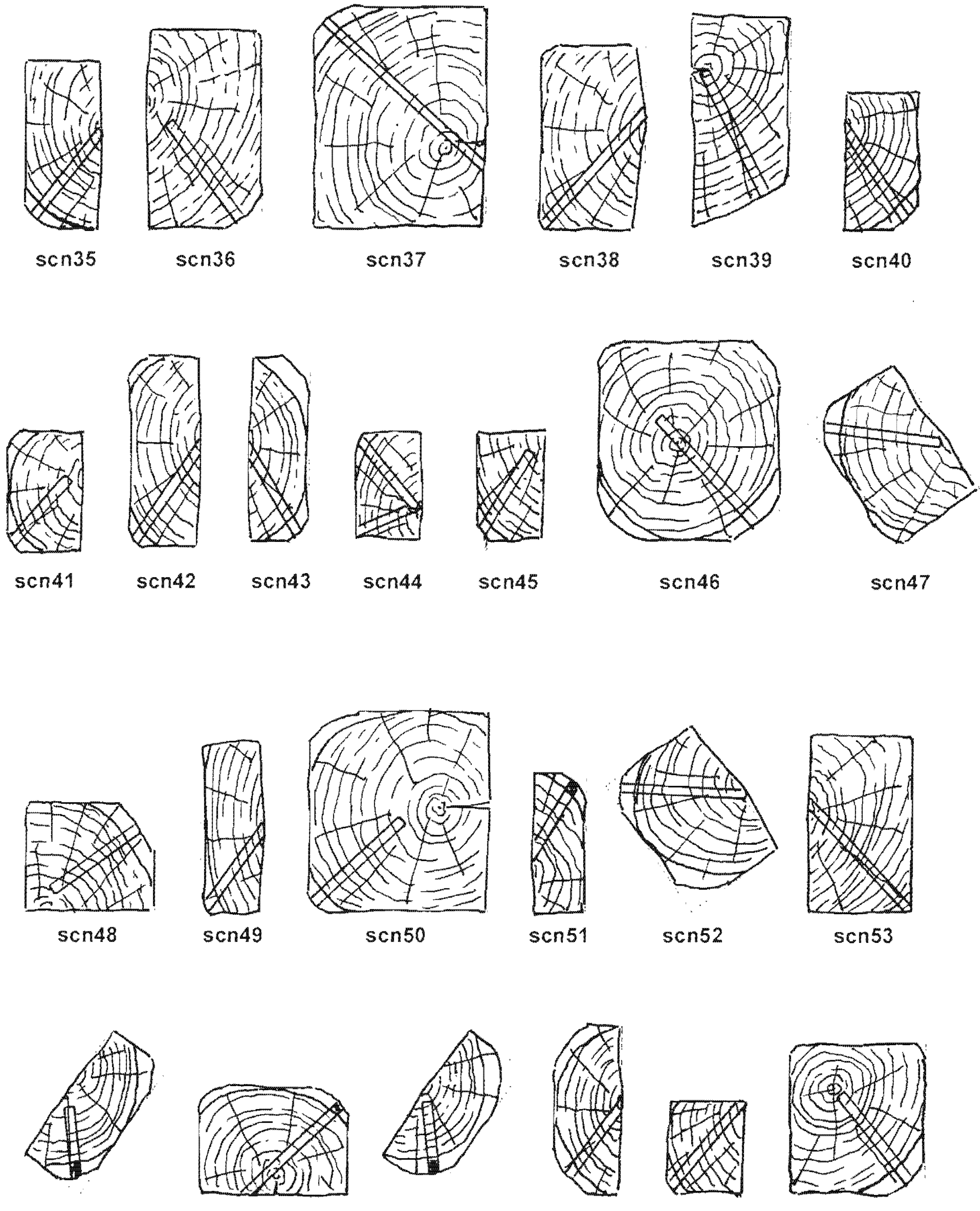


Figure 9 (cont): Scale section drawings of timbers sampled (scale 1:10)

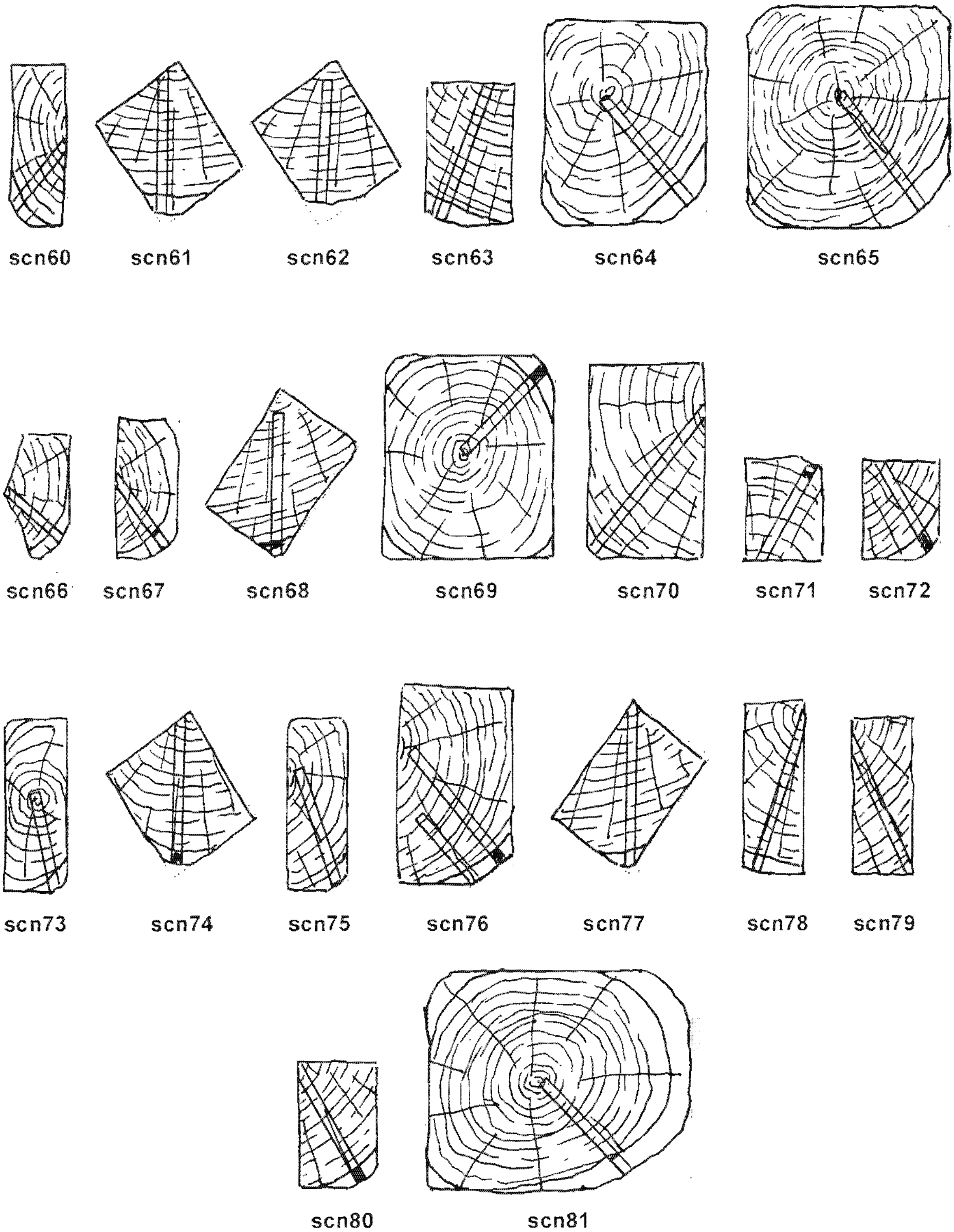
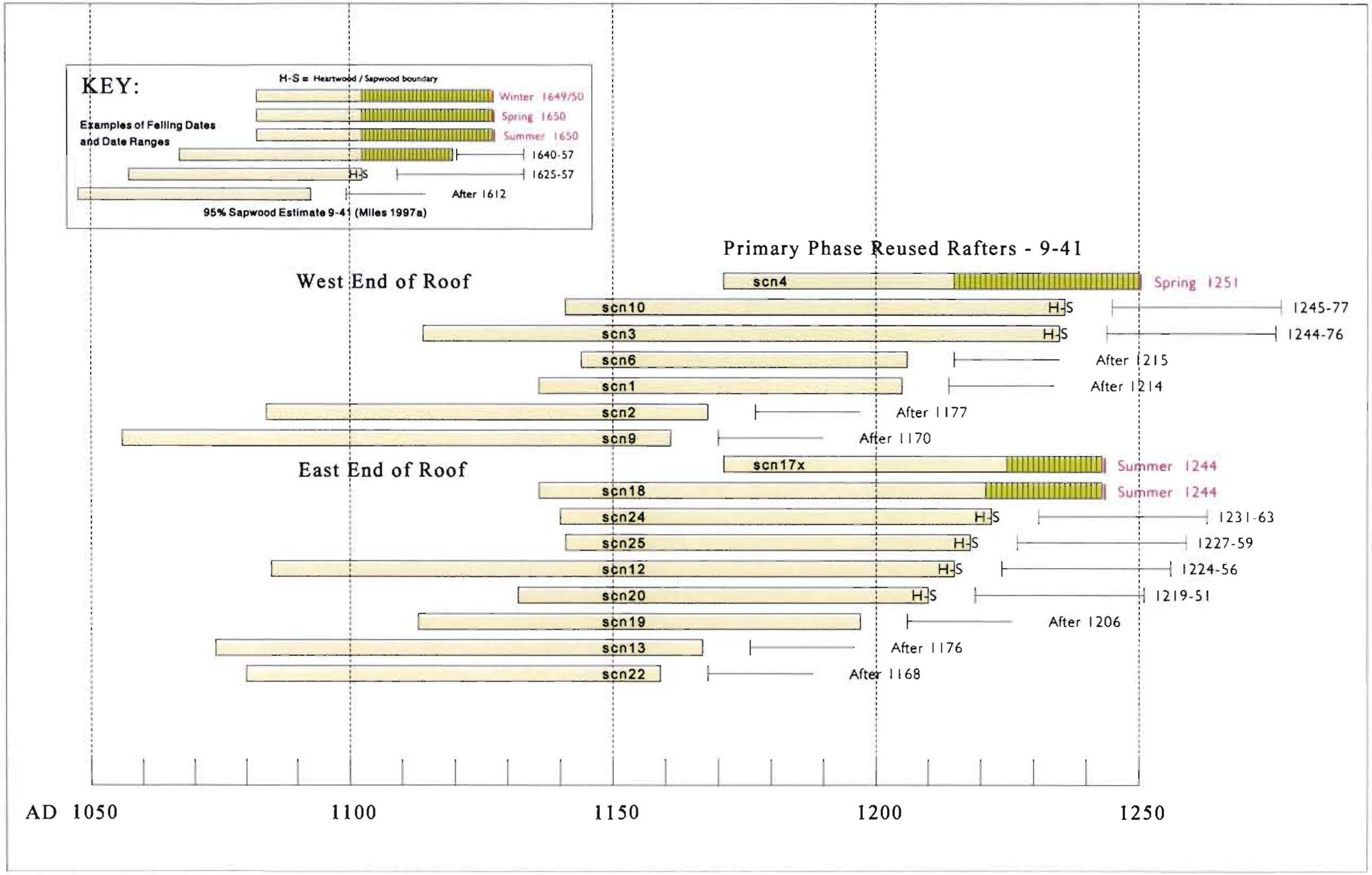


Figure 9 (cont): Scale section drawings of timbers sampled (scale 1:10)

Figure 10: Bar diagram showing dated Phase 1 samples in chronological position



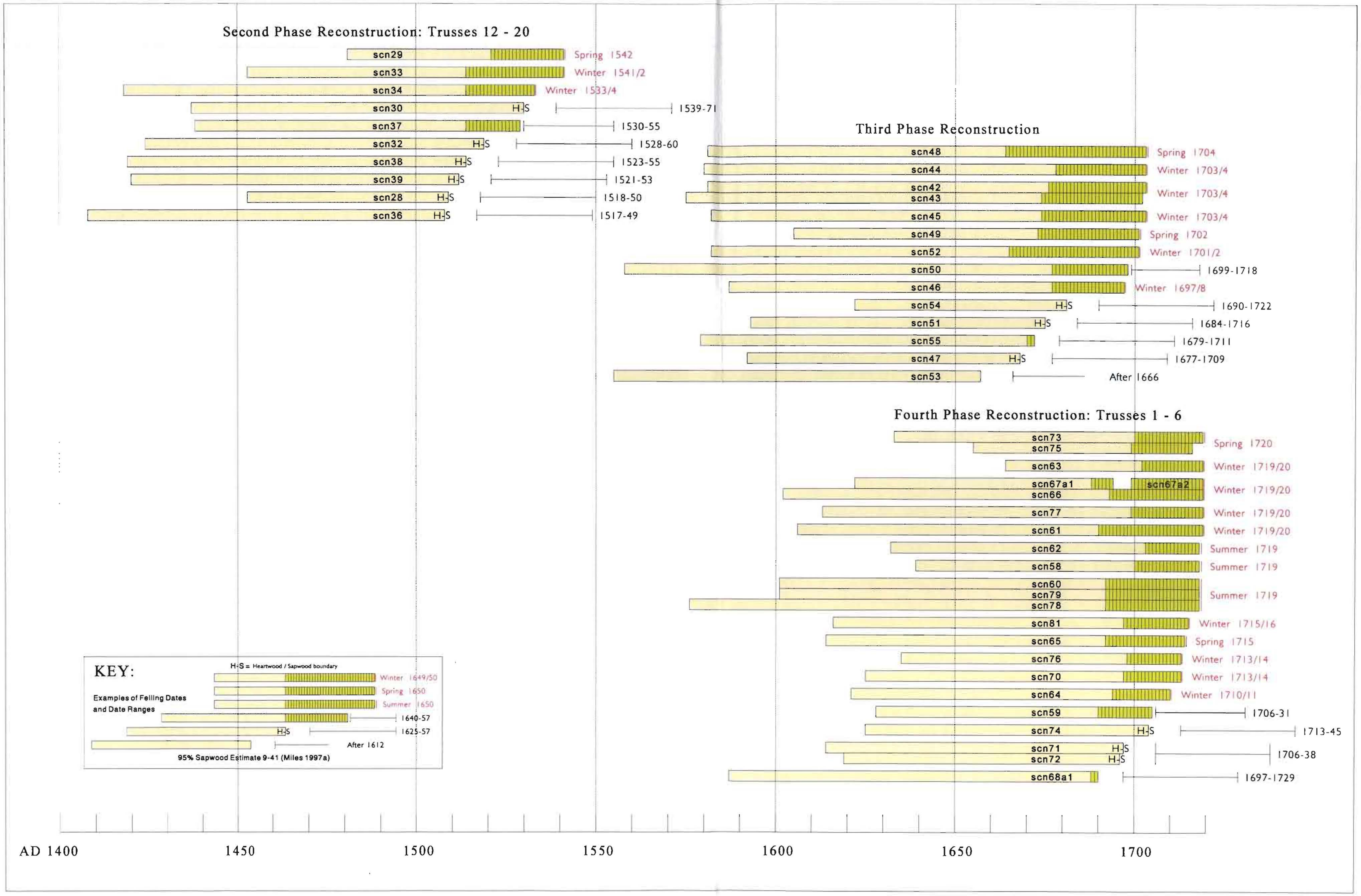
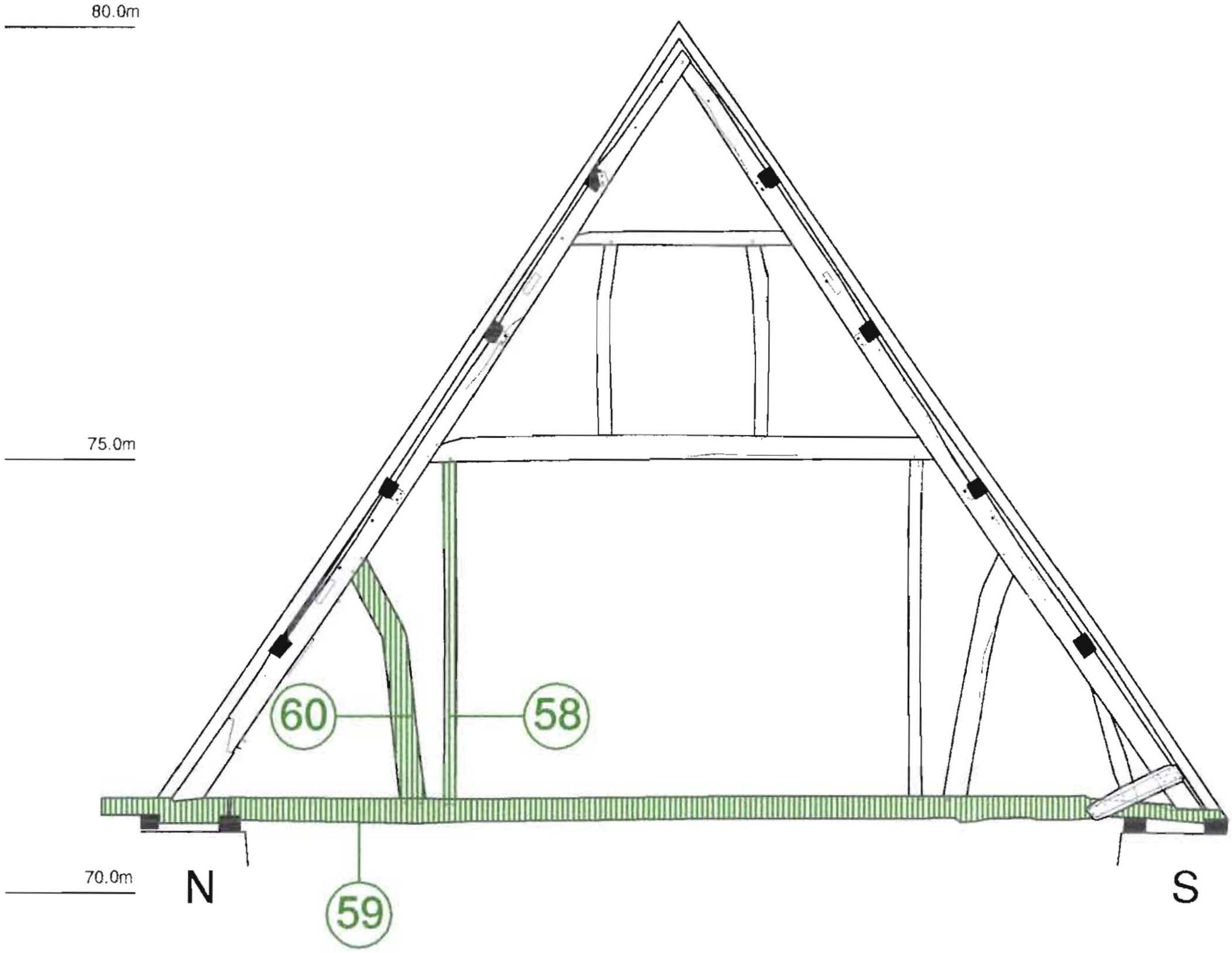


Figure 11: Bar diagram showing dated Phase 2, 3, and 4 samples in chronological position



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

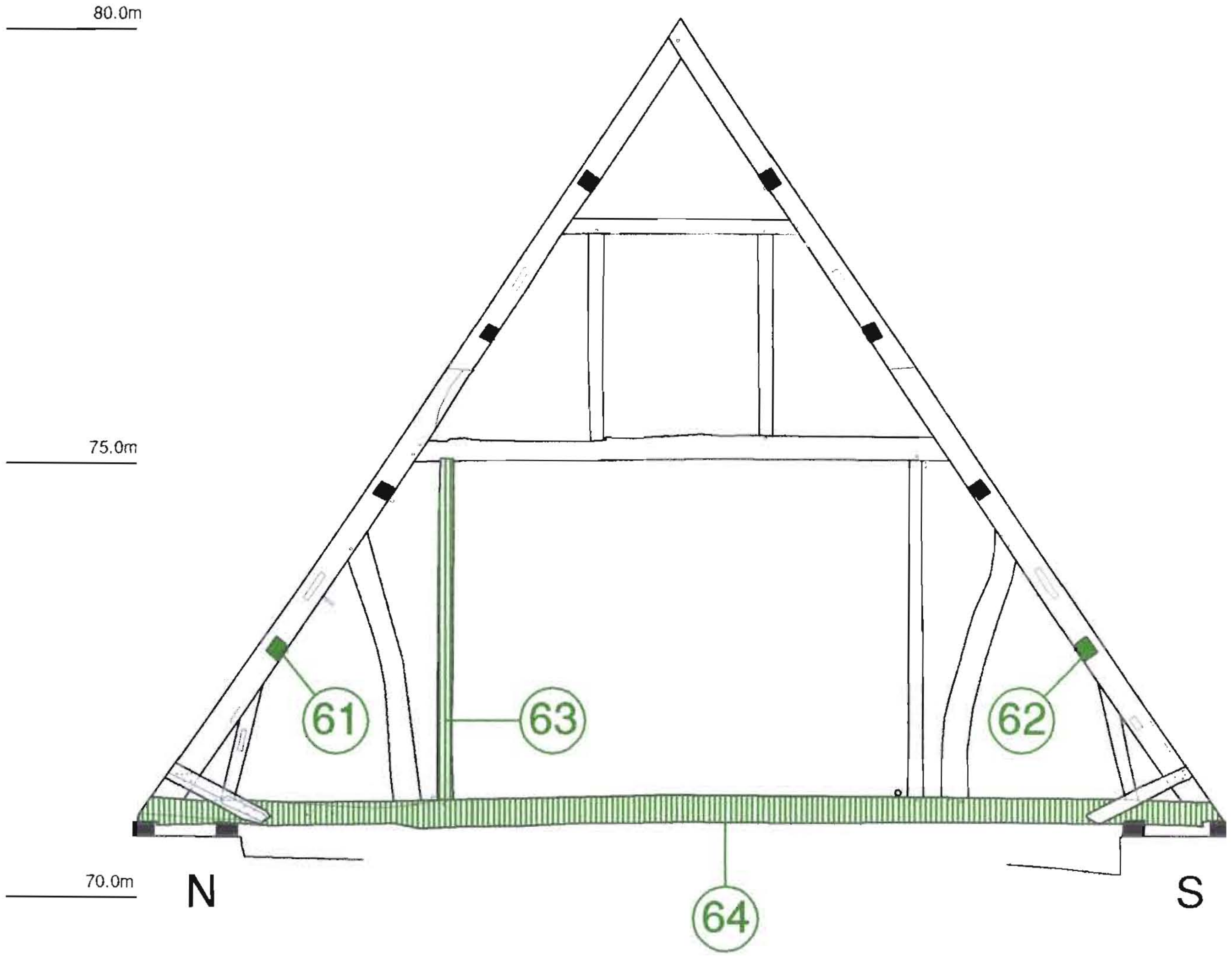
fourth phase reconstruction (AD1720) trusses 1-6

0 1 2 3 4 metres
0 6 12 feet

NOTE
all samples prefixed 'scn'

Salisbury Cathedral
Nave Roof

west face Truss No 1



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

fourth phase reconstruction (AD1720) trusses 1-6

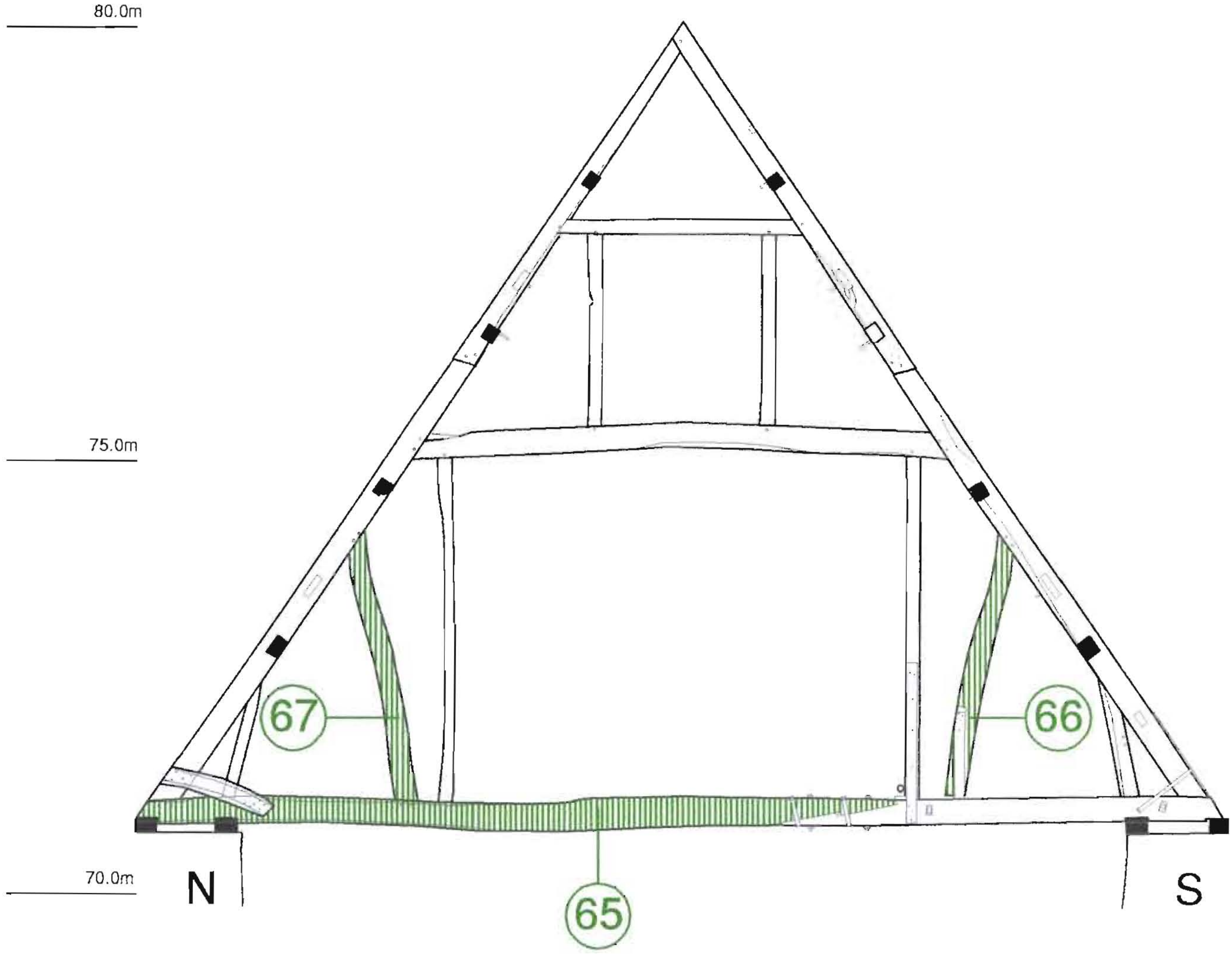
0 1 2 3 4 metres

0 6 12 feet

NOTE
all samples prefixed 'scn'

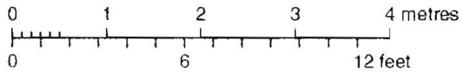
Salisbury Cathedral
Nave Roof

west face Truss No 2



Key

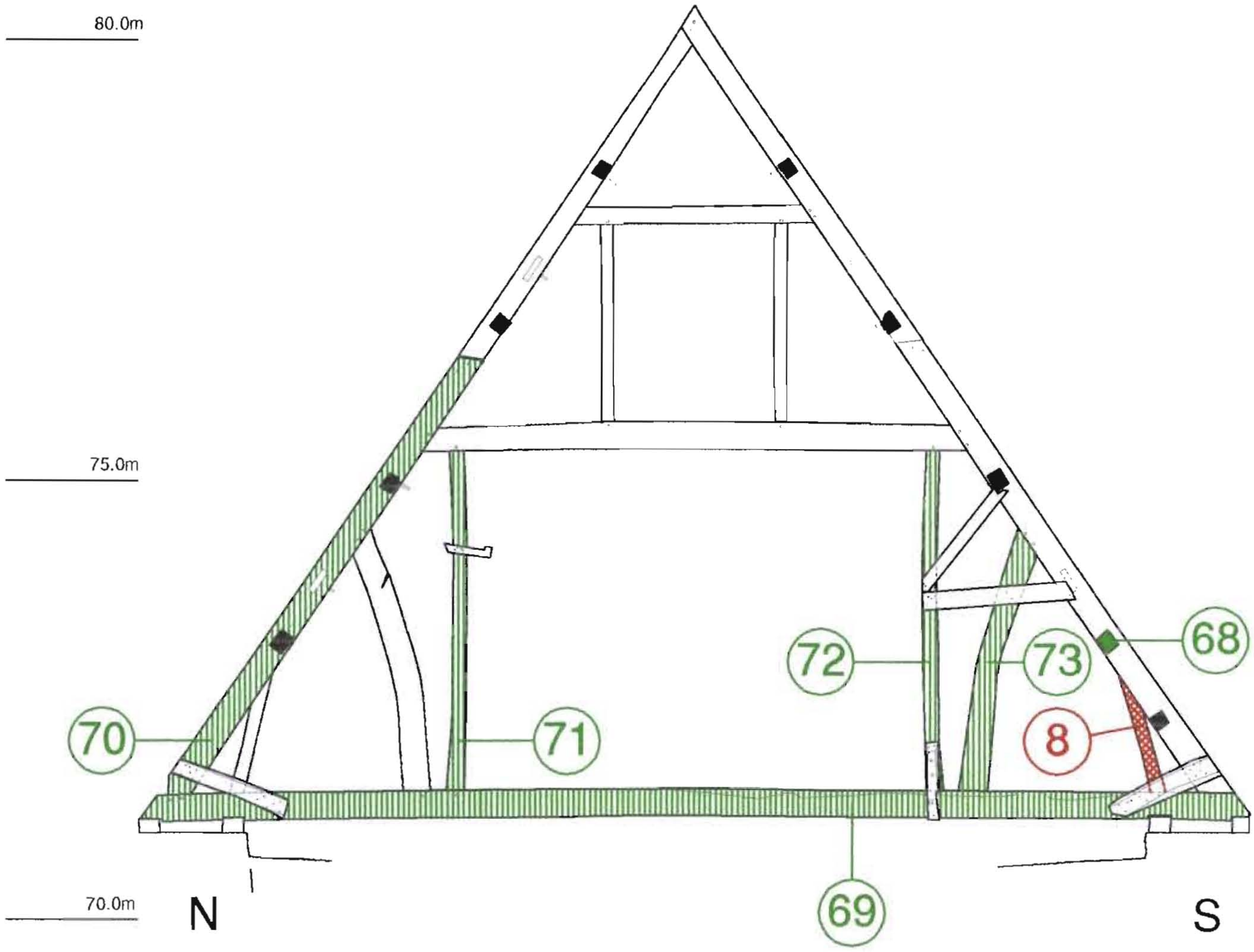
- primary phase (AD1244-1251) timber reused
- second phase reconstruction (AD1542) trusses 12-20
- third phase reconstruction (AD1704) trusses 7-11
- fourth phase reconstruction (AD1720) trusses 1-6



NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 3



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

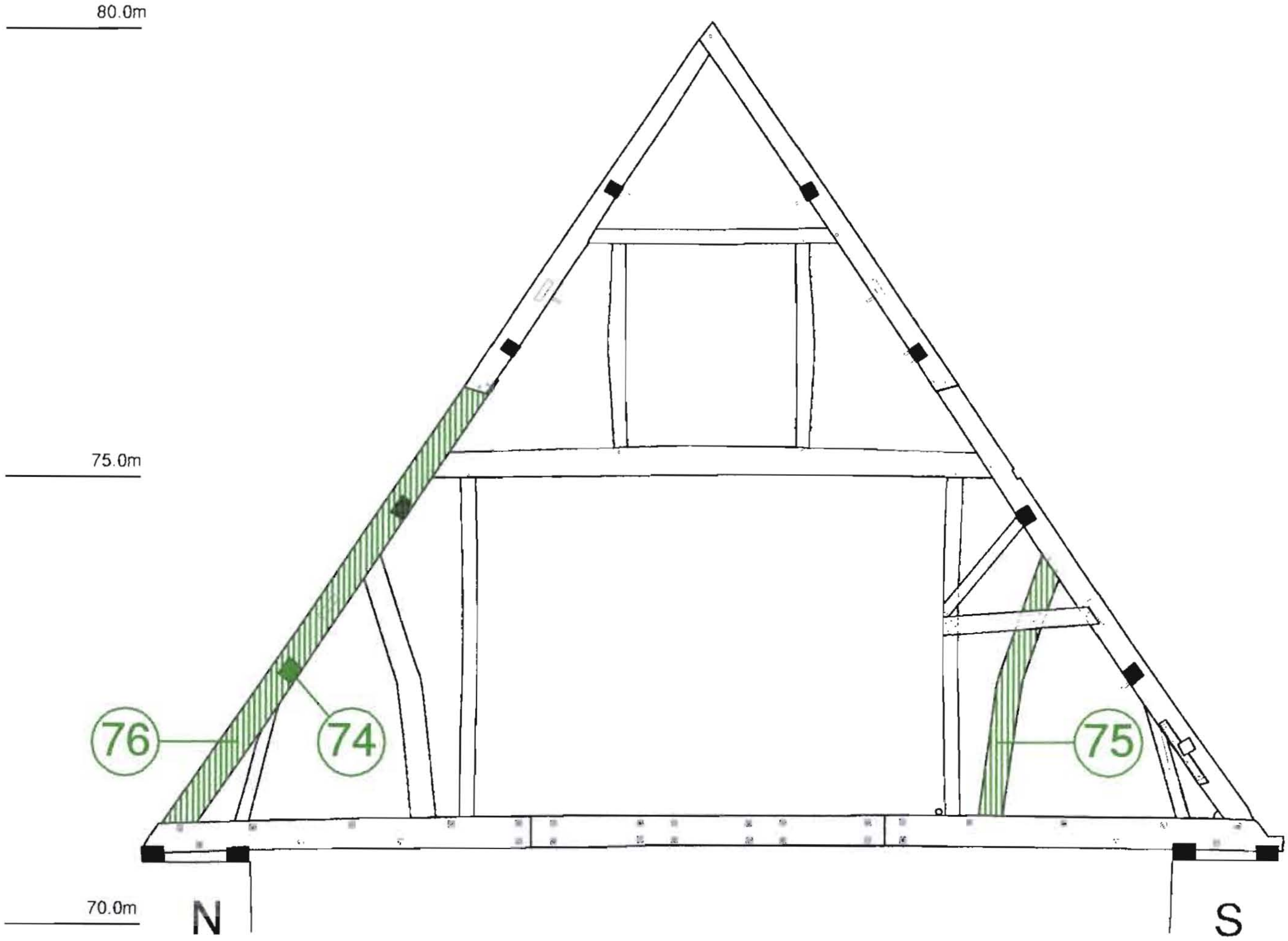
fourth phase reconstruction (AD1720) trusses 1-6

0 1 2 3 4 metres
0 6 12 feet

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 4



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

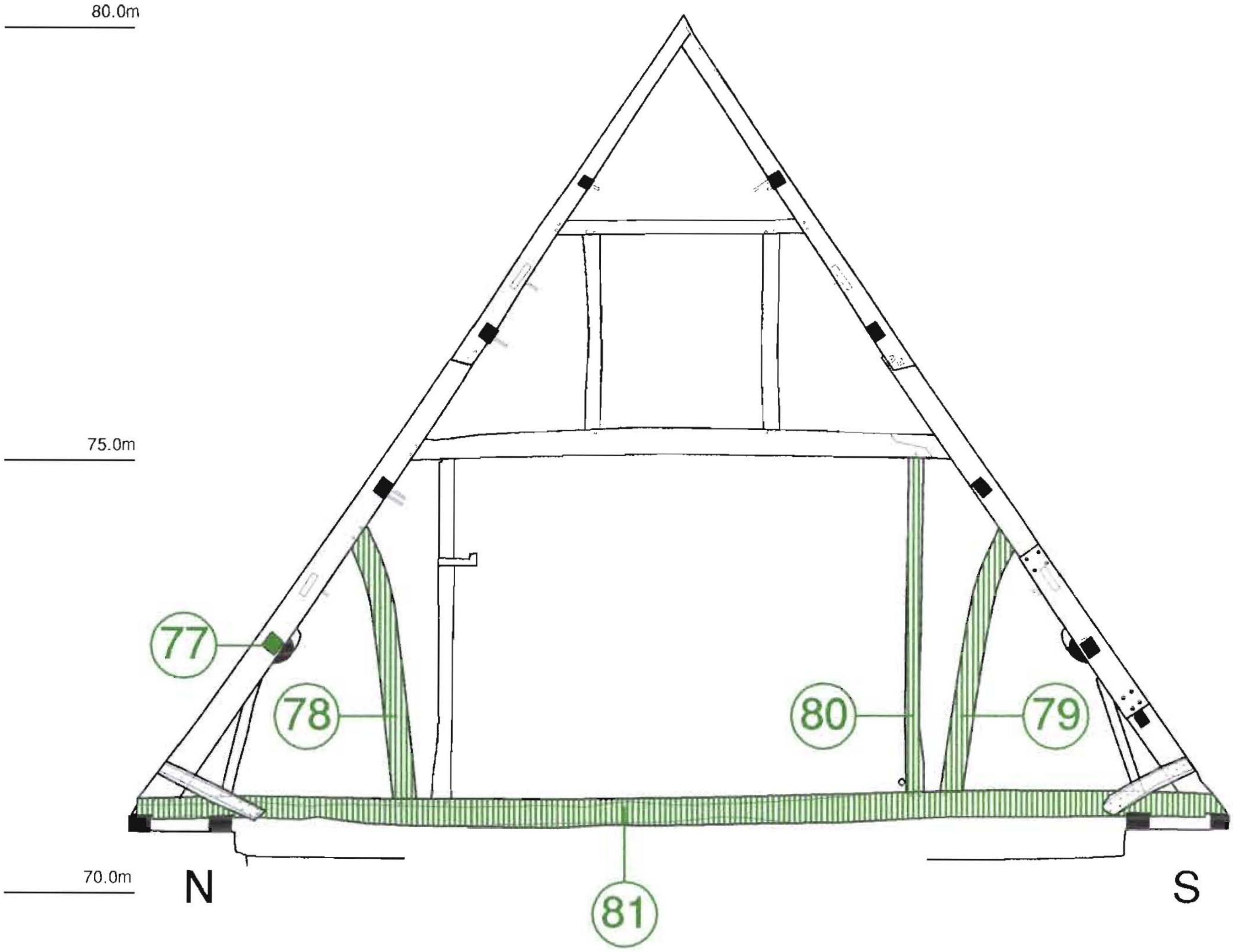
fourth phase reconstruction (AD1720) trusses 1-6

0 1 2 3 4 metres
0 6 12 feet

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 5



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

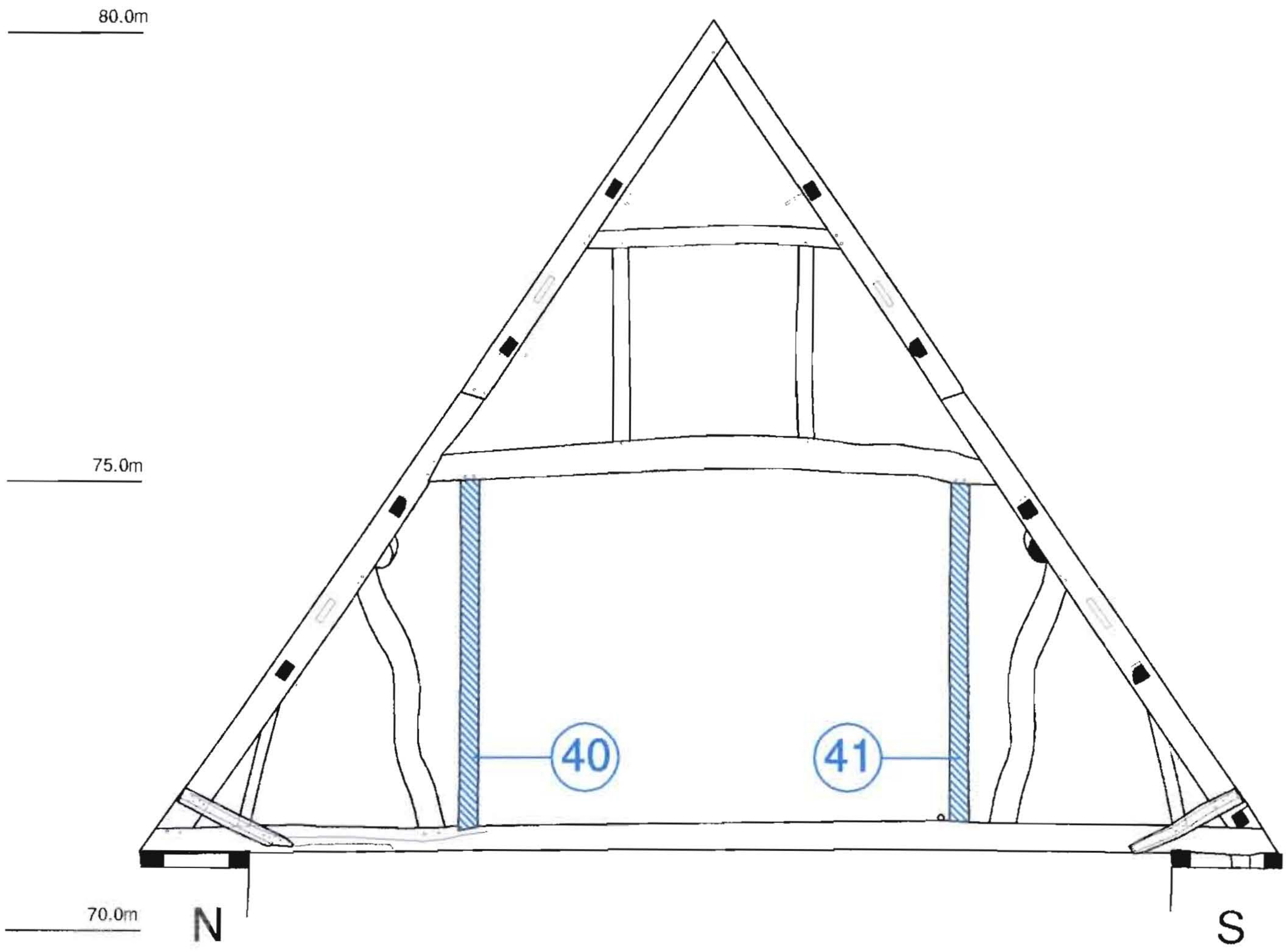
fourth phase reconstruction (AD1720) trusses 1-6

0 1 2 3 4 metres
0 6 12 feet

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 6



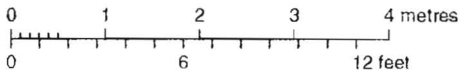
Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

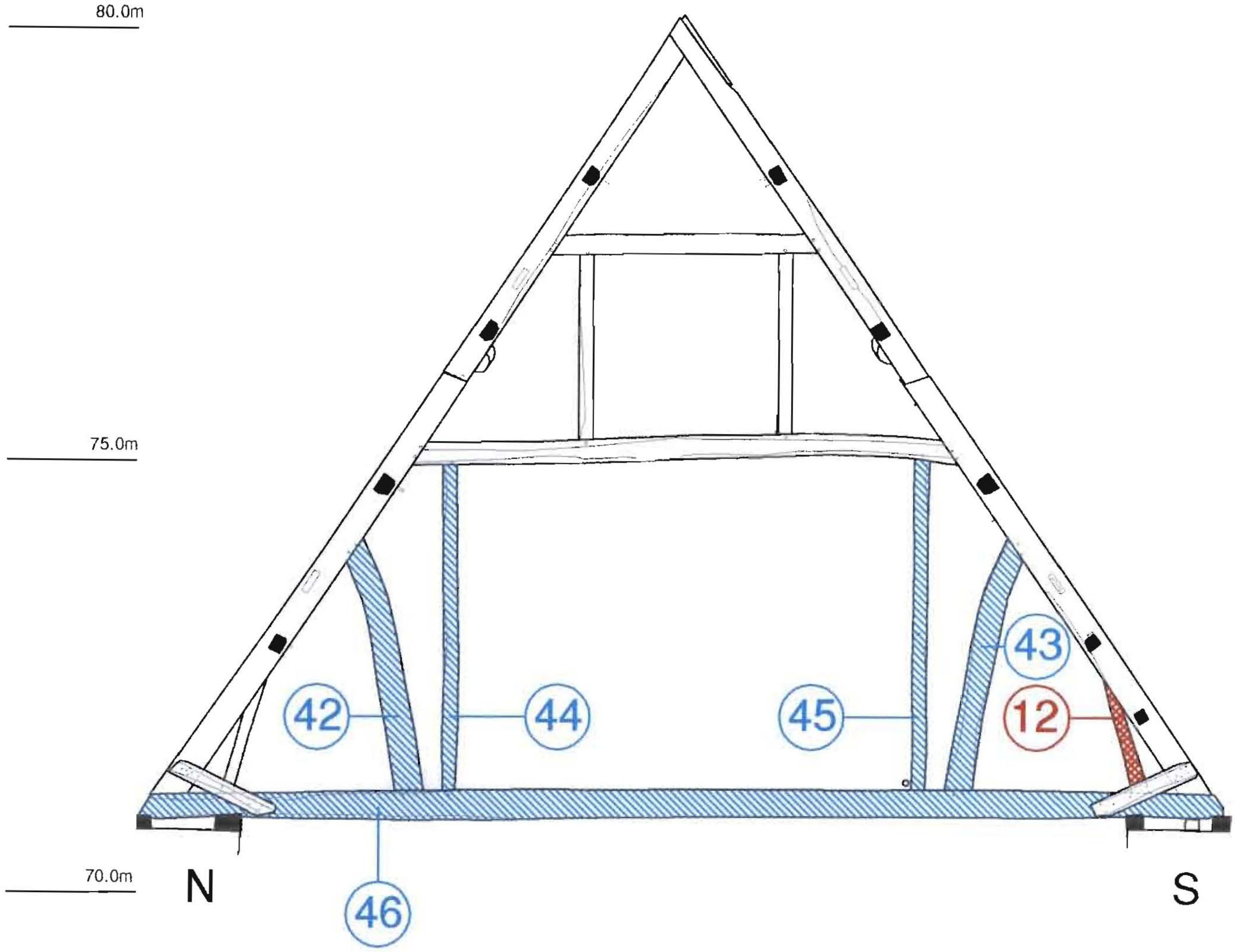
fourth phase reconstruction (AD1720) trusses 1-6



NOTE
all samples prefixed 'scn'

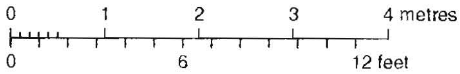
Salisbury Cathedral Nave Roof

west face Truss No 7



Key

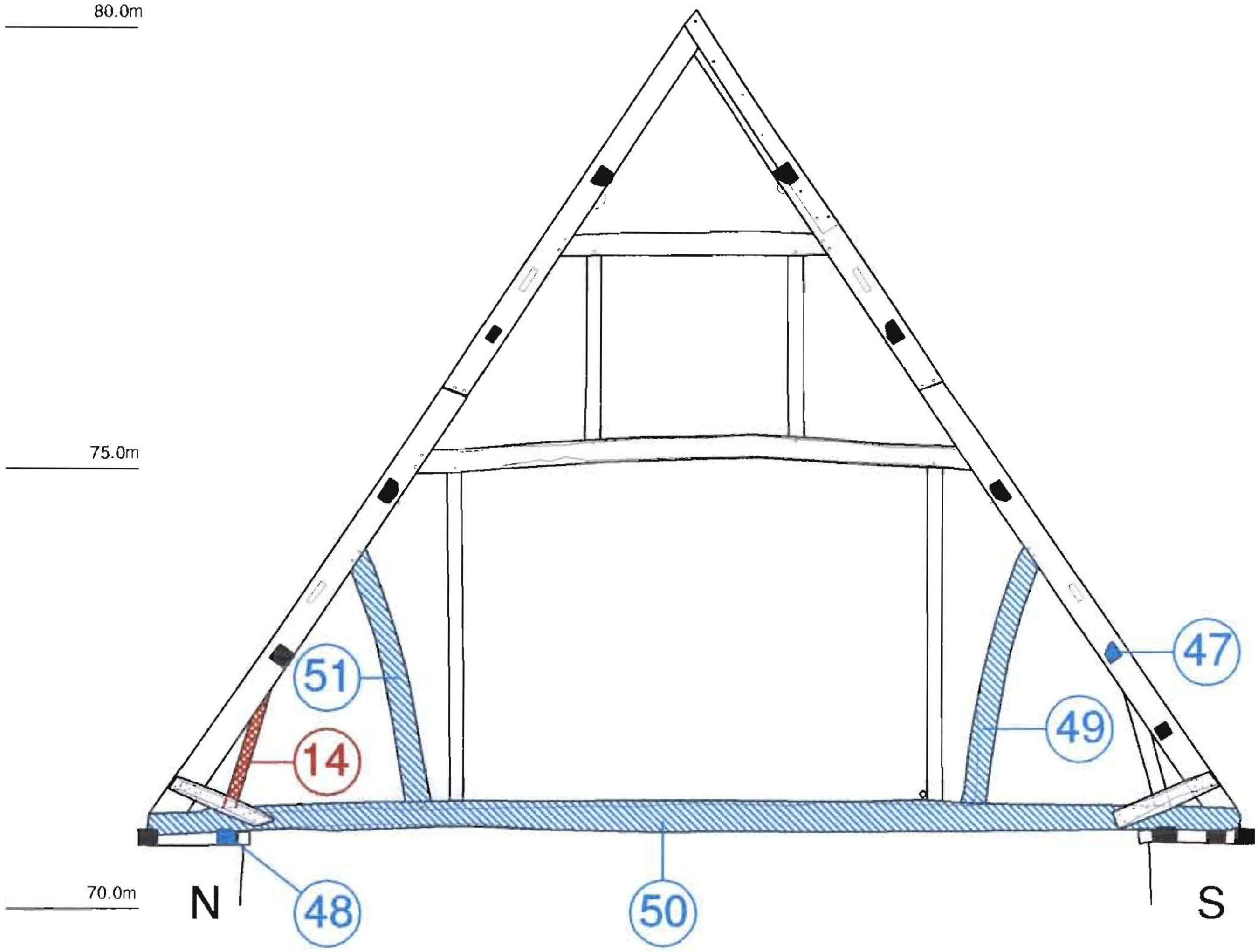
primary phase (AD1244-1251) timber reused	
second phase reconstruction (AD1542) trusses 12-20	
third phase reconstruction (AD1704) trusses 7-11	
fourth phase reconstruction (AD1720) trusses 1-6	



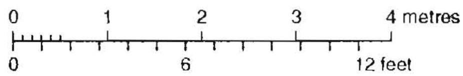
NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 8



Key



primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

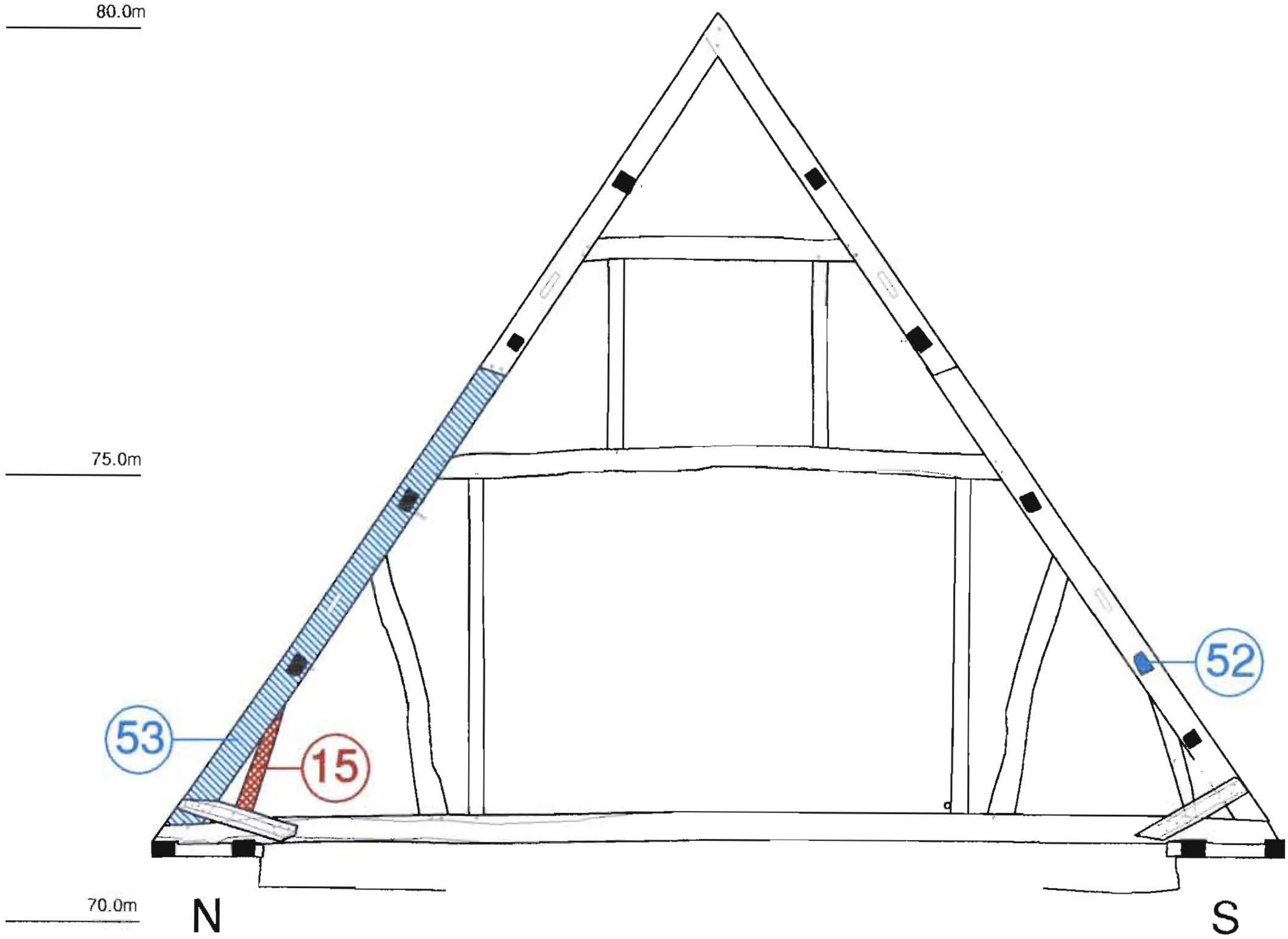
third phase reconstruction (AD1704) trusses 7-11

fourth phase reconstruction (AD1720) trusses 1-6

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 9



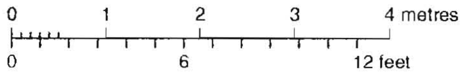
Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

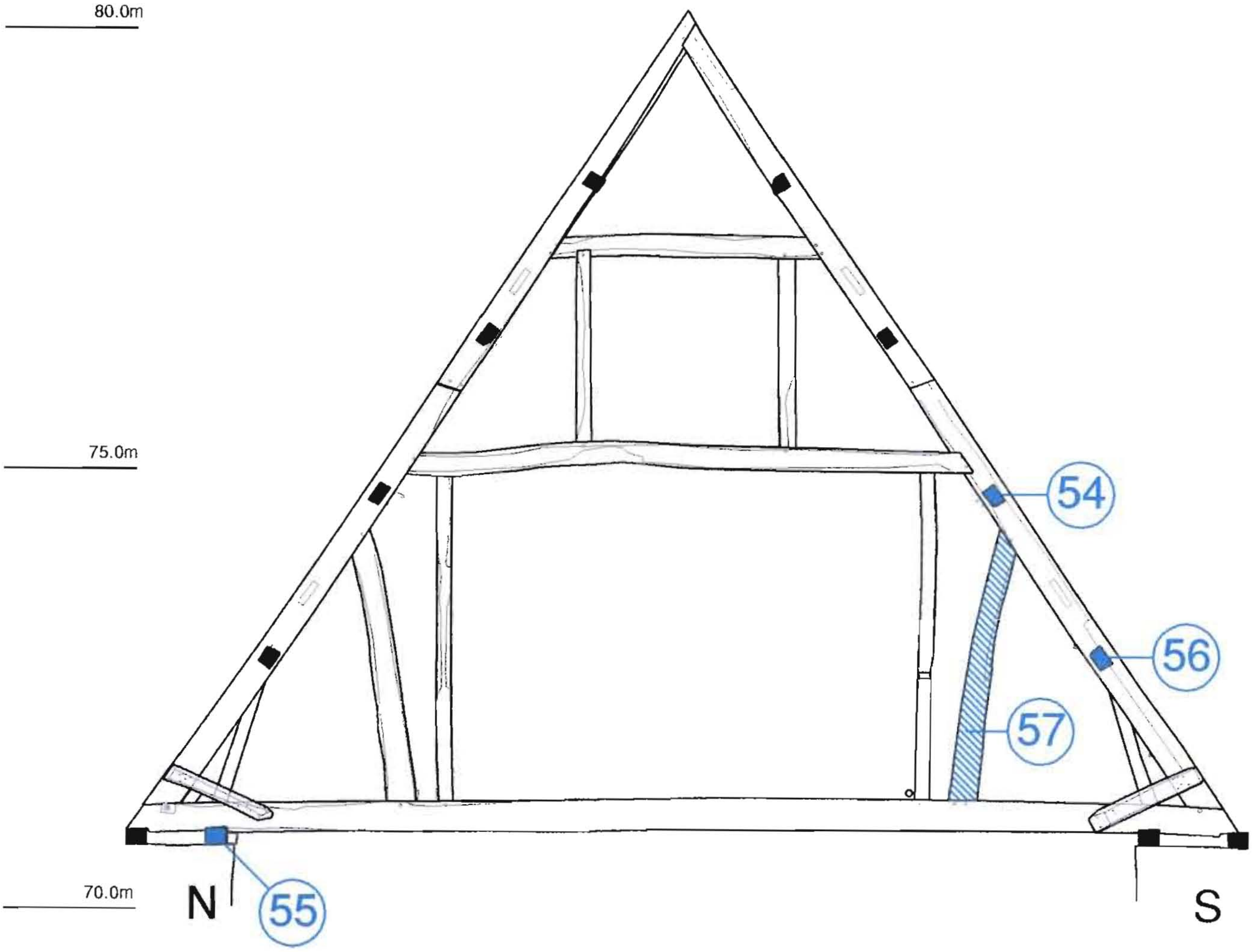
fourth phase reconstruction (AD1720) trusses 1-6



NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 10



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

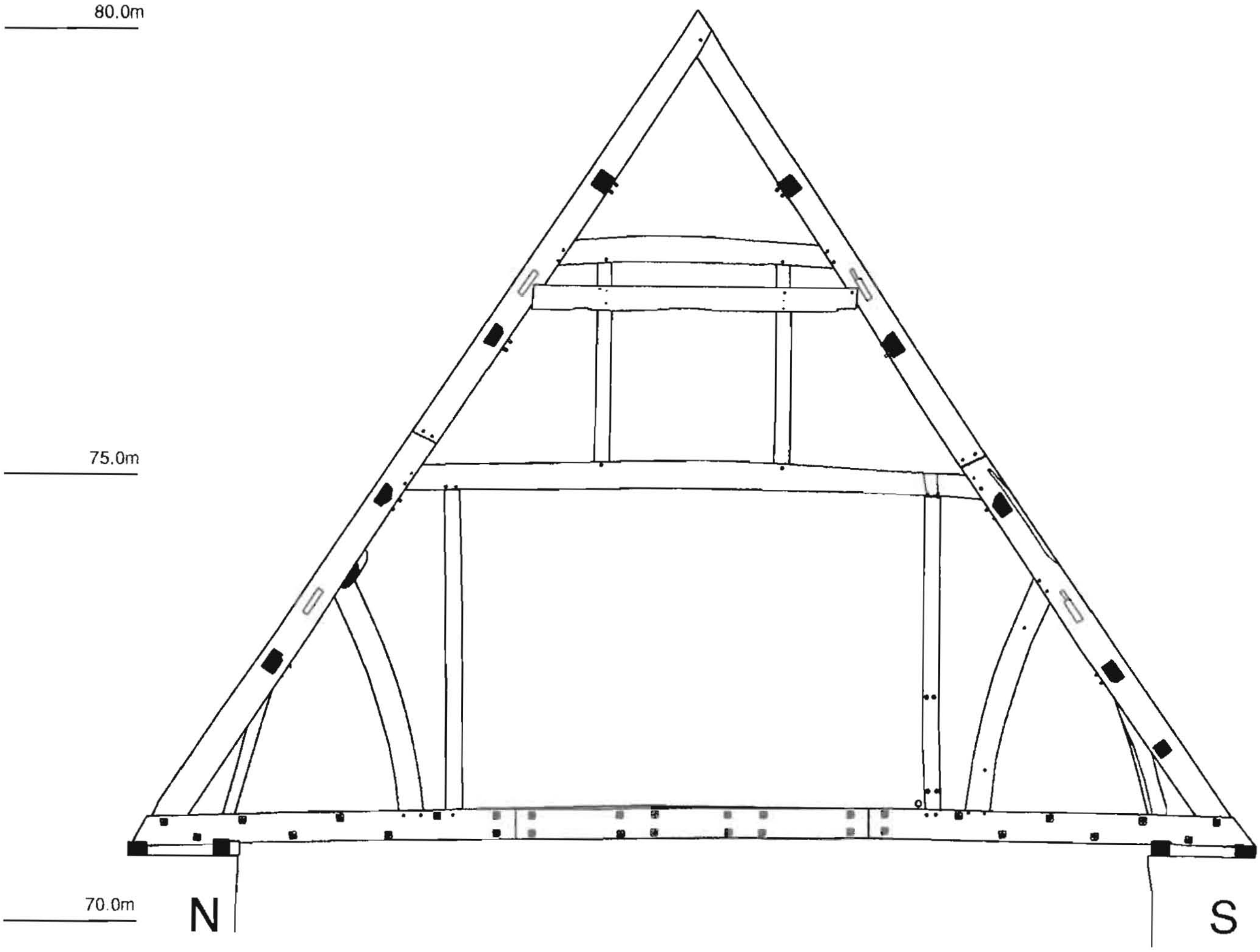
fourth phase reconstruction (AD1720) trusses 1-6

0 1 2 3 4 metres
0 6 12 feet

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 11



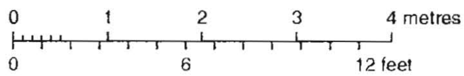
Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

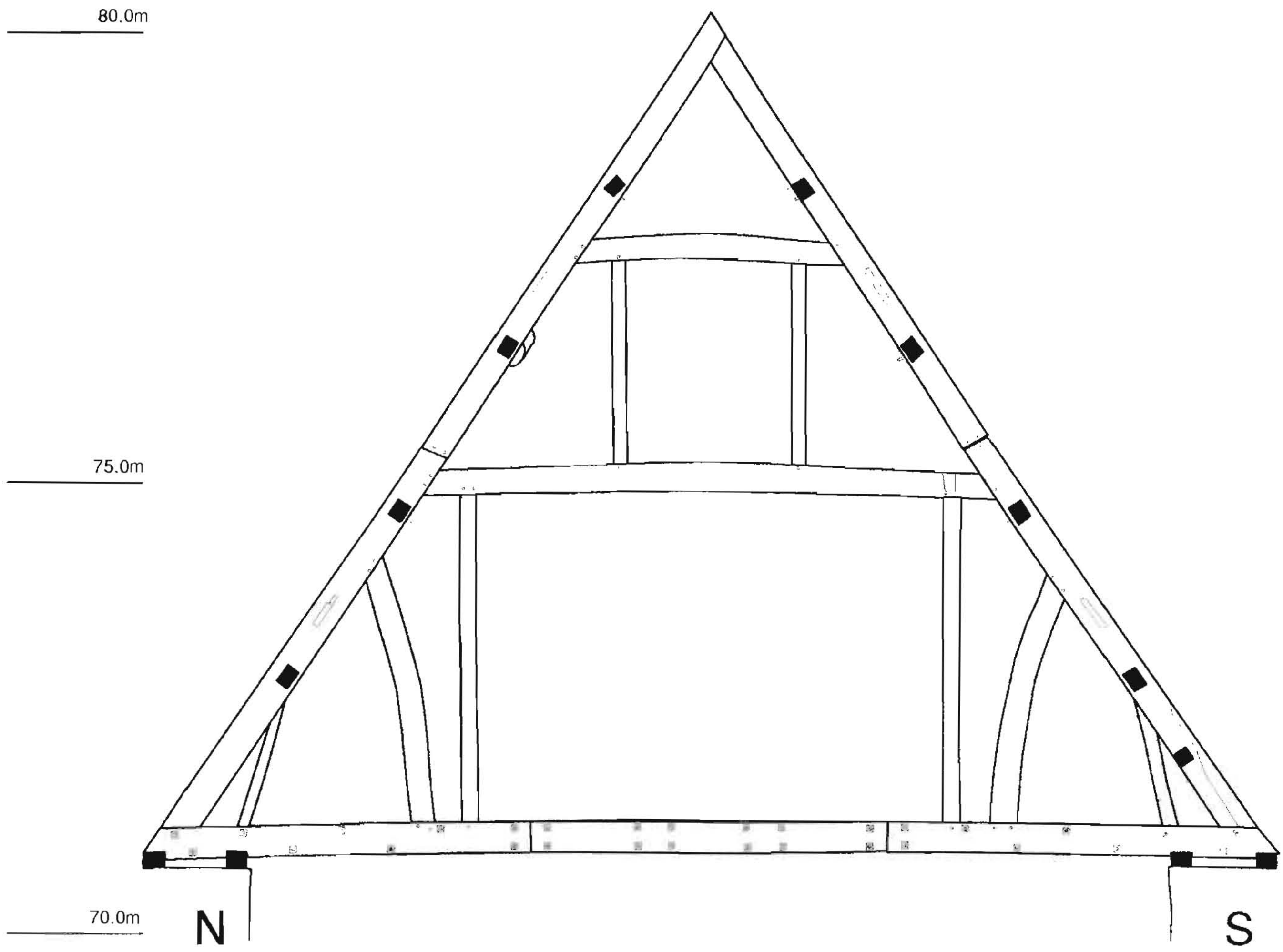
fourth phase reconstruction (AD1720) trusses 1-6



NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 12



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

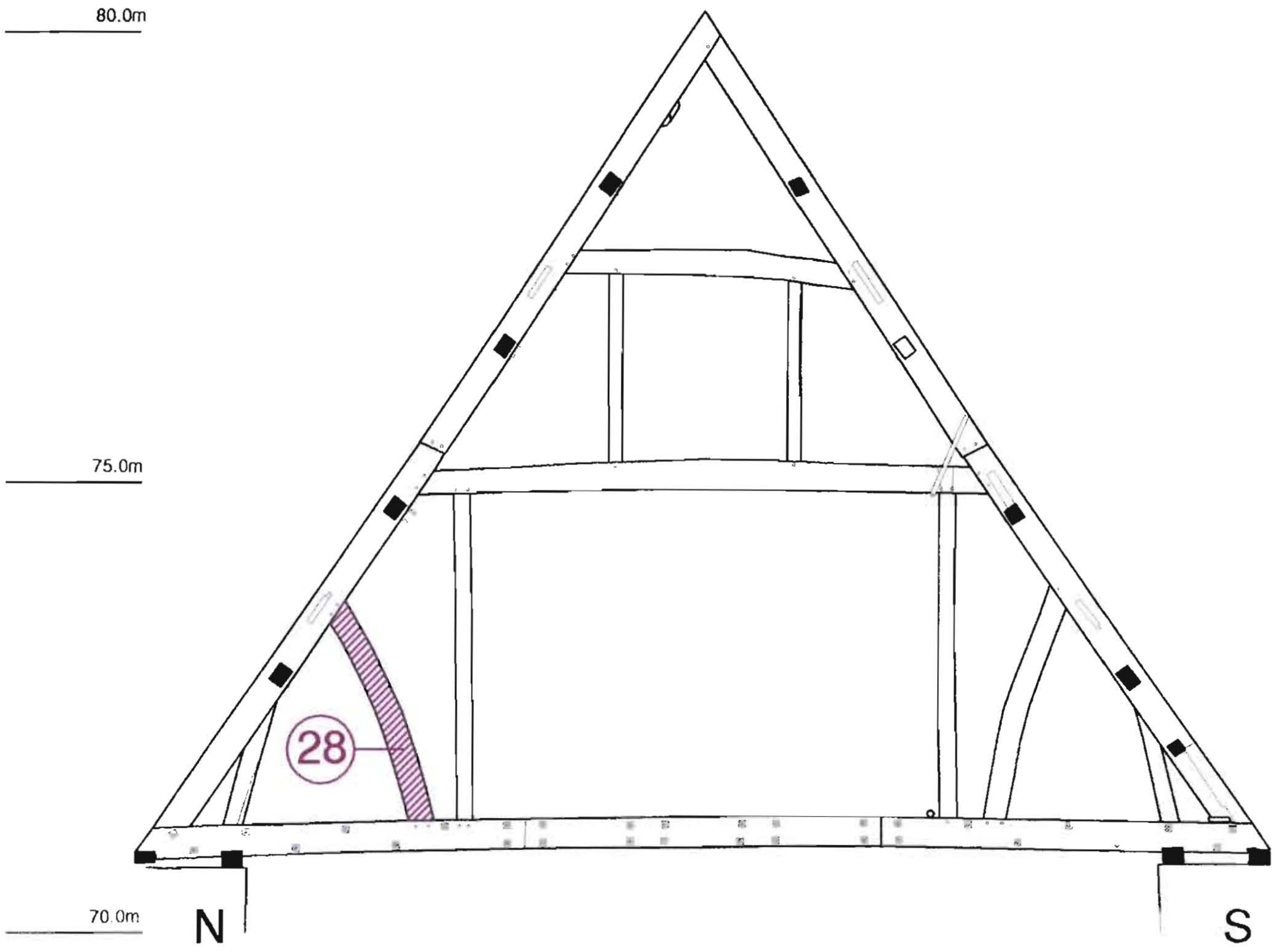
fourth phase reconstruction (AD1720) trusses 1-6

0 1 2 3 4 metres
0 6 12 feet

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 13



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

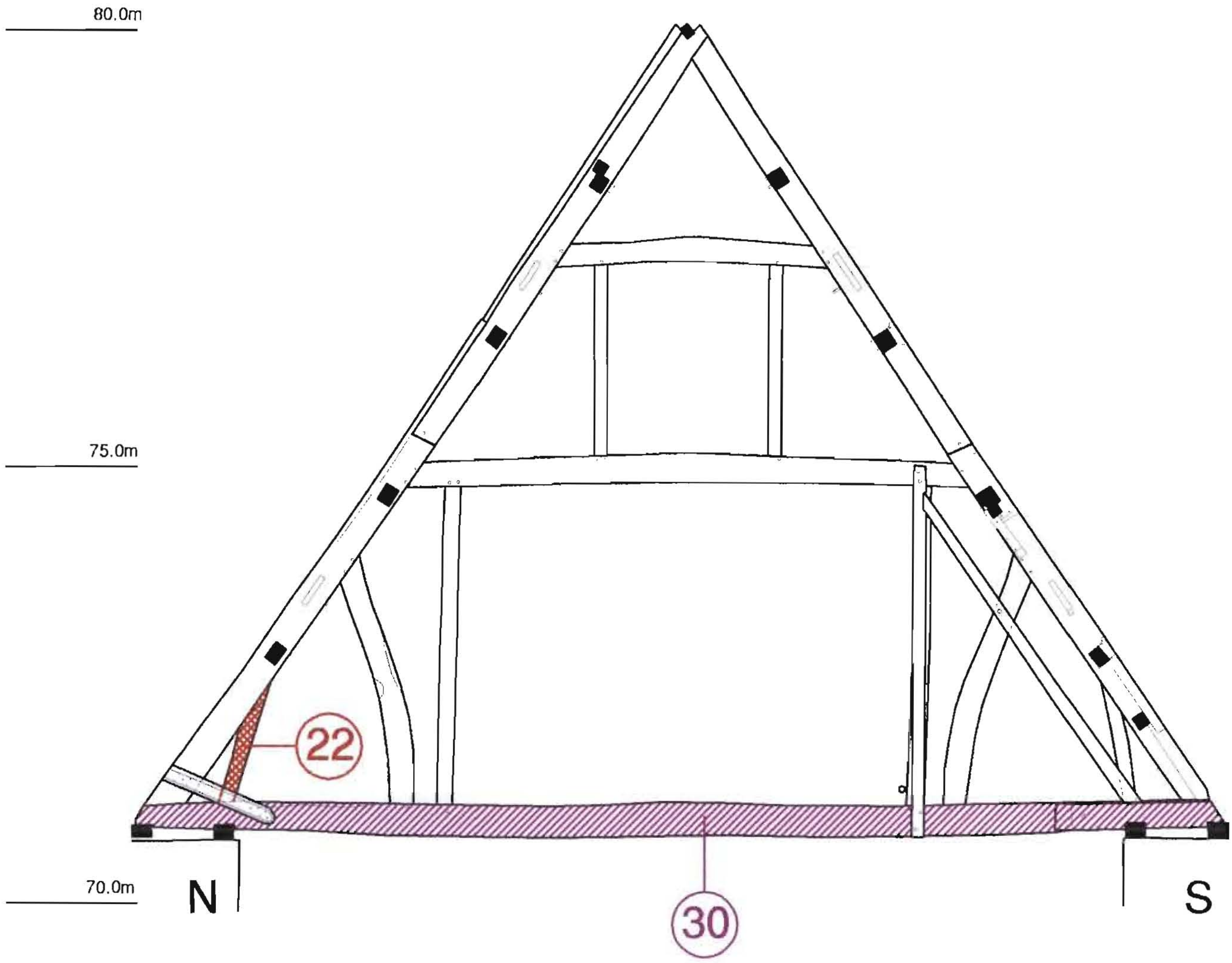
fourth phase reconstruction (AD1720) trusses 1-6

0 1 2 3 4 metres
0 6 12 feet

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 14



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

fourth phase reconstruction (AD1720) trusses 1-6

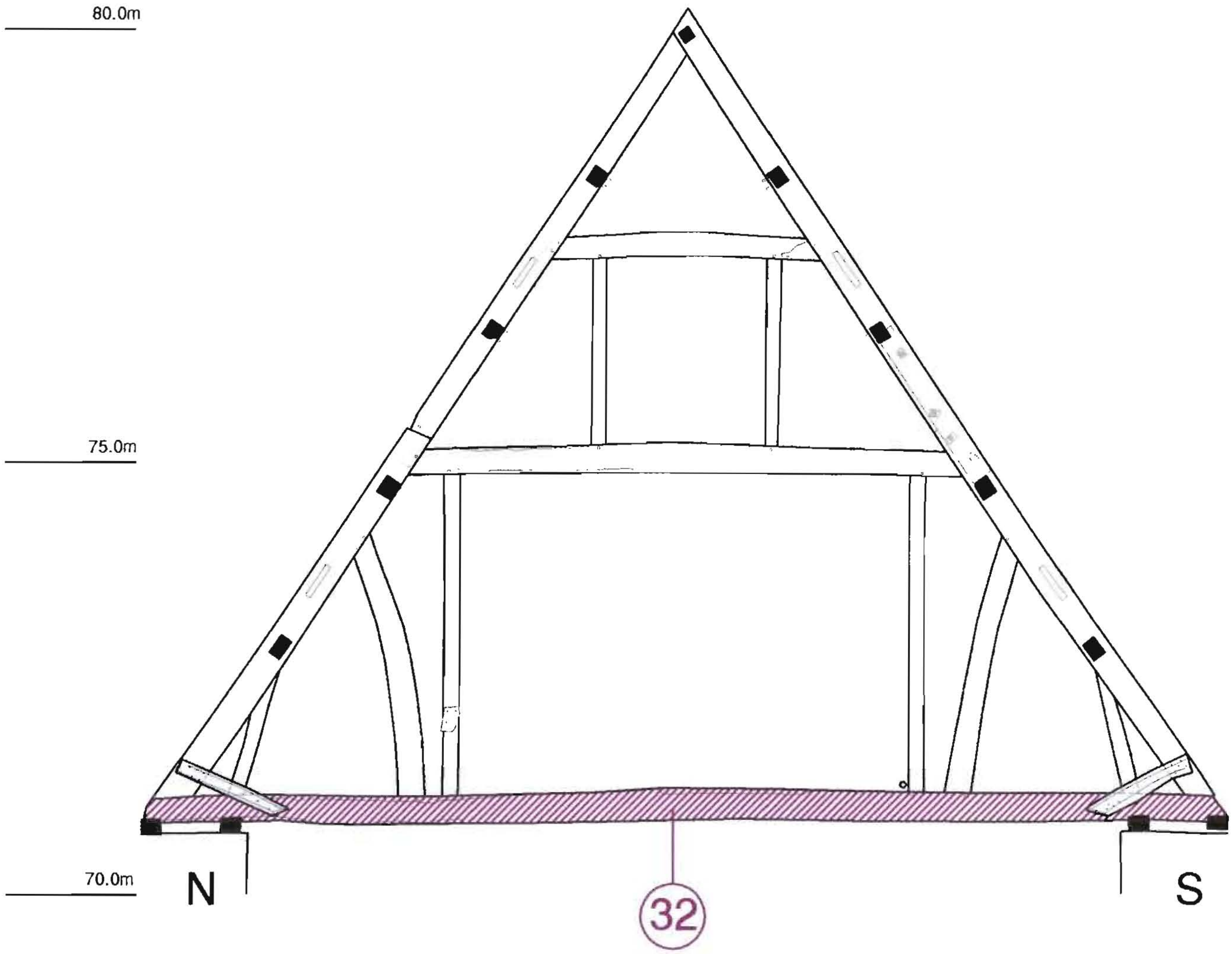
0 1 2 3 4 metres

0 6 12 feet

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 15



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

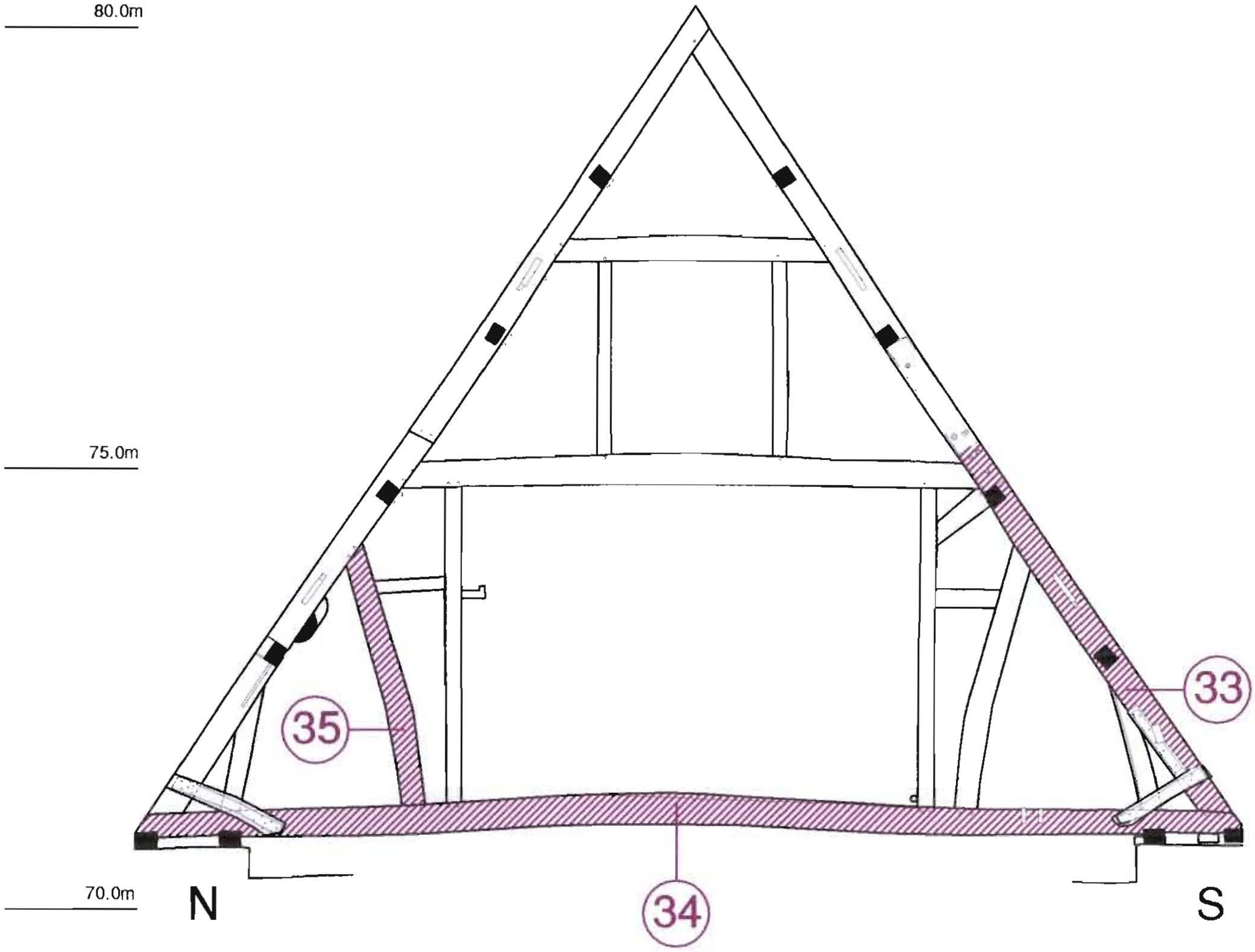
third phase reconstruction (AD1704) trusses 7-11

fourth phase reconstruction (AD1720) trusses 1-6

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 16



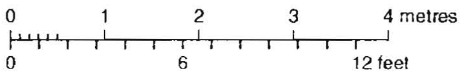
Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

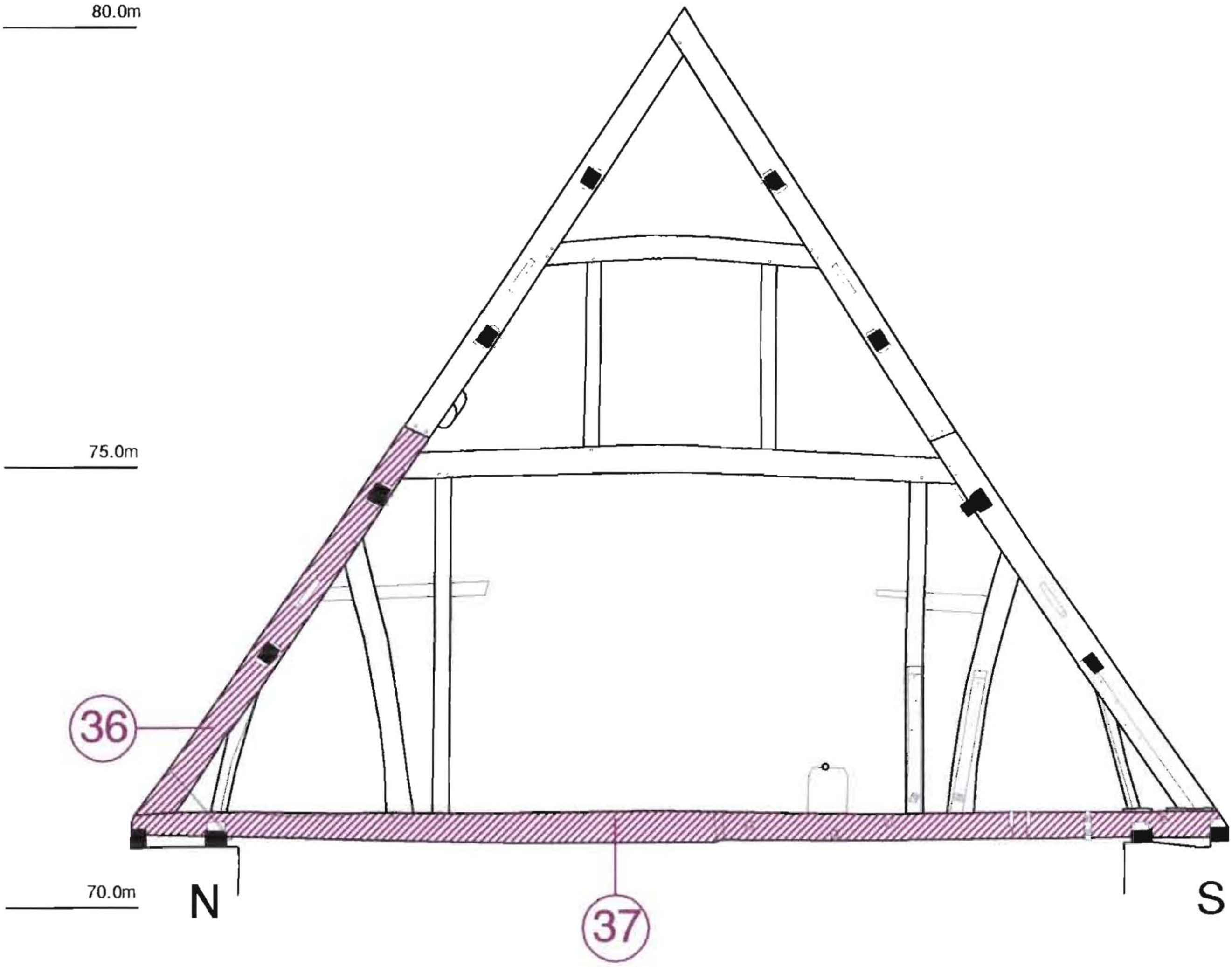
fourth phase reconstruction (AD1720) trusses 1-6



NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 17



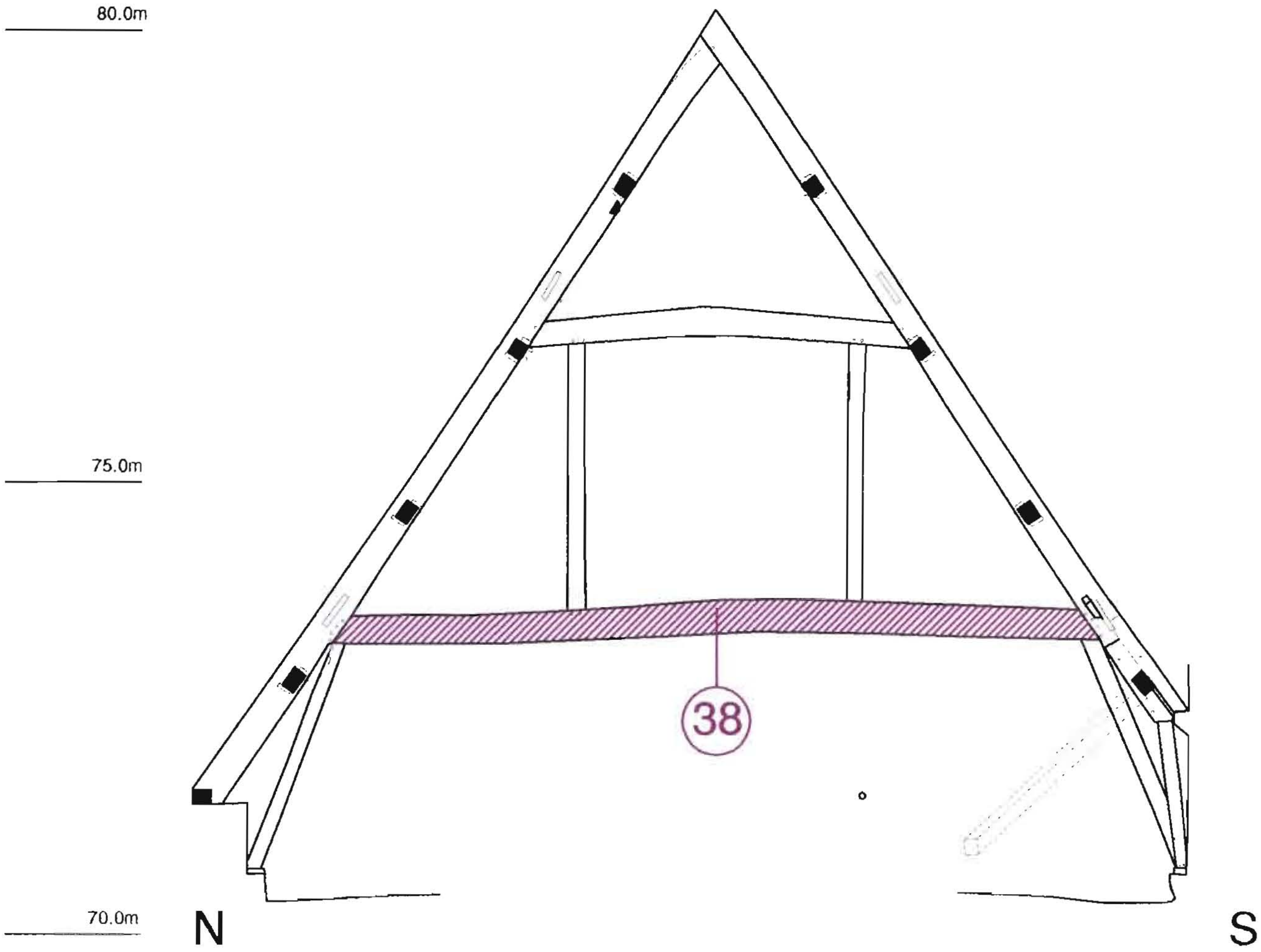
Key

	primary phase (AD1244-1251) timber reused
	second phase reconstruction (AD1542) trusses 12-20
	third phase reconstruction (AD1704) trusses 7-11
	fourth phase reconstruction (AD1720) trusses 1-6

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 18



Key

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

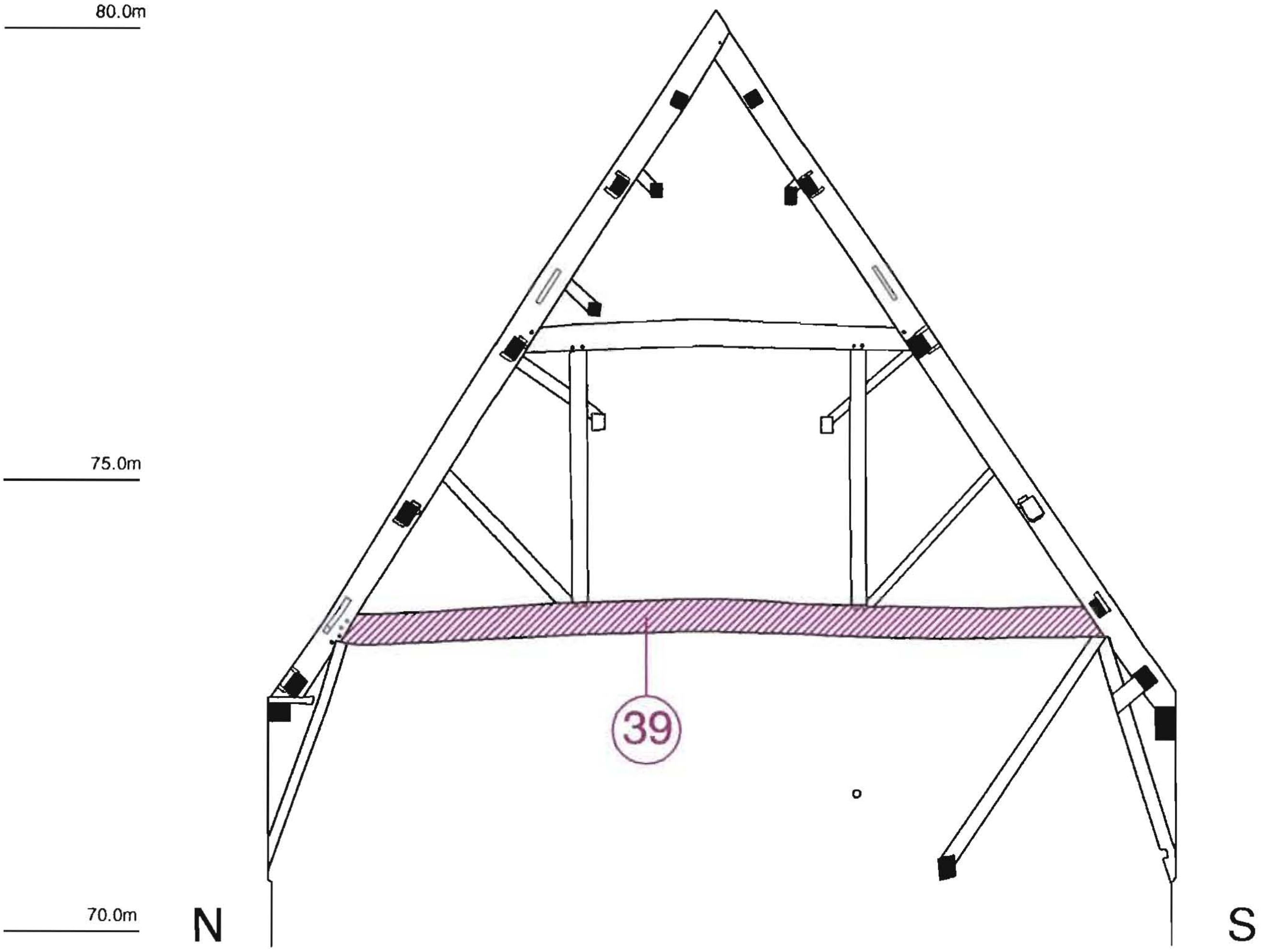
third phase reconstruction (AD1704) trusses 7-11

fourth phase reconstruction (AD1720) trusses 1-6

NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 19



Key

0 1 2 3 4 metres
0 6 12 feet

primary phase (AD1244-1251) timber reused

second phase reconstruction (AD1542) trusses 12-20

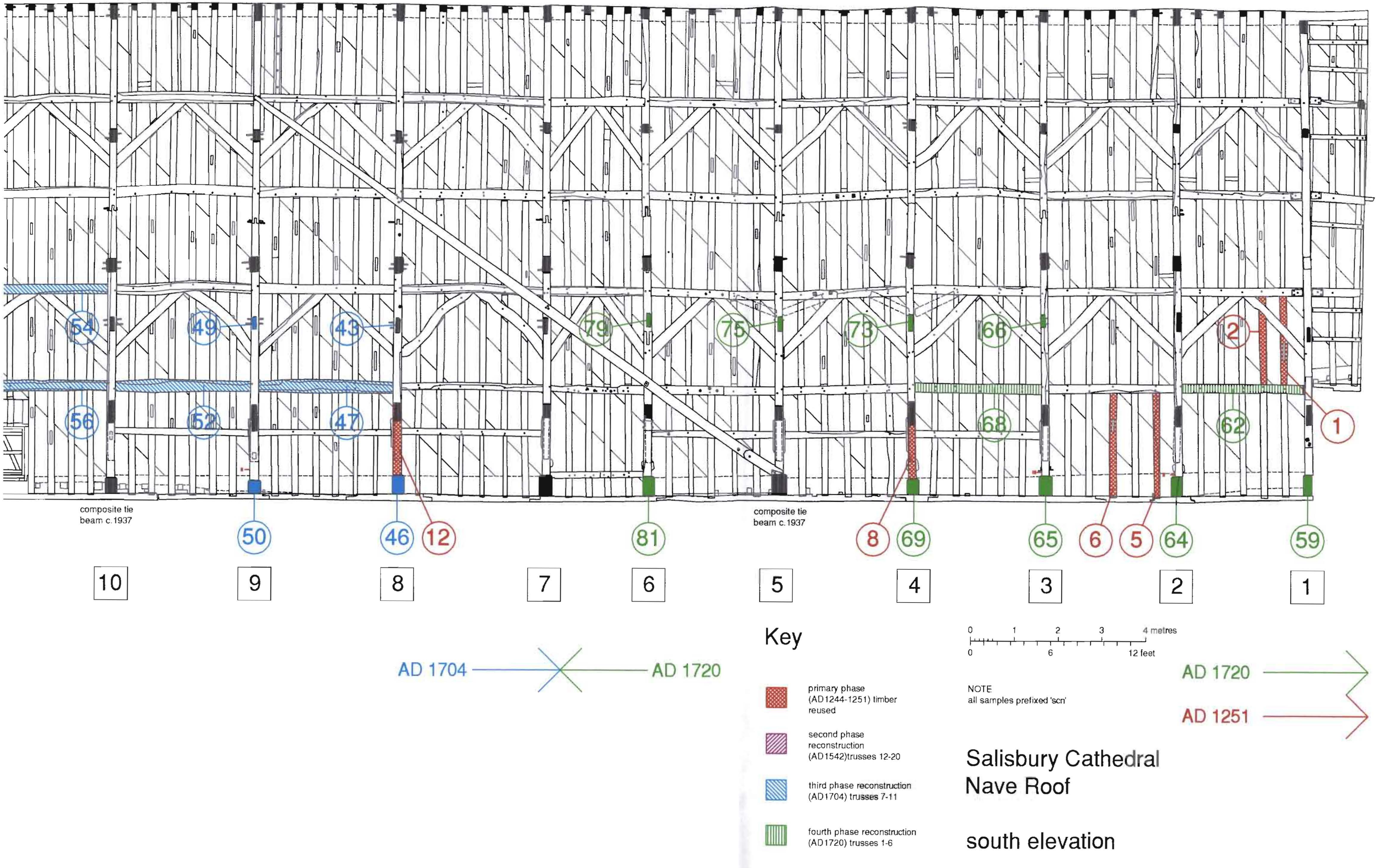
third phase reconstruction (AD1704) trusses 7-11

fourth phase reconstruction (AD1720) trusses 1-6

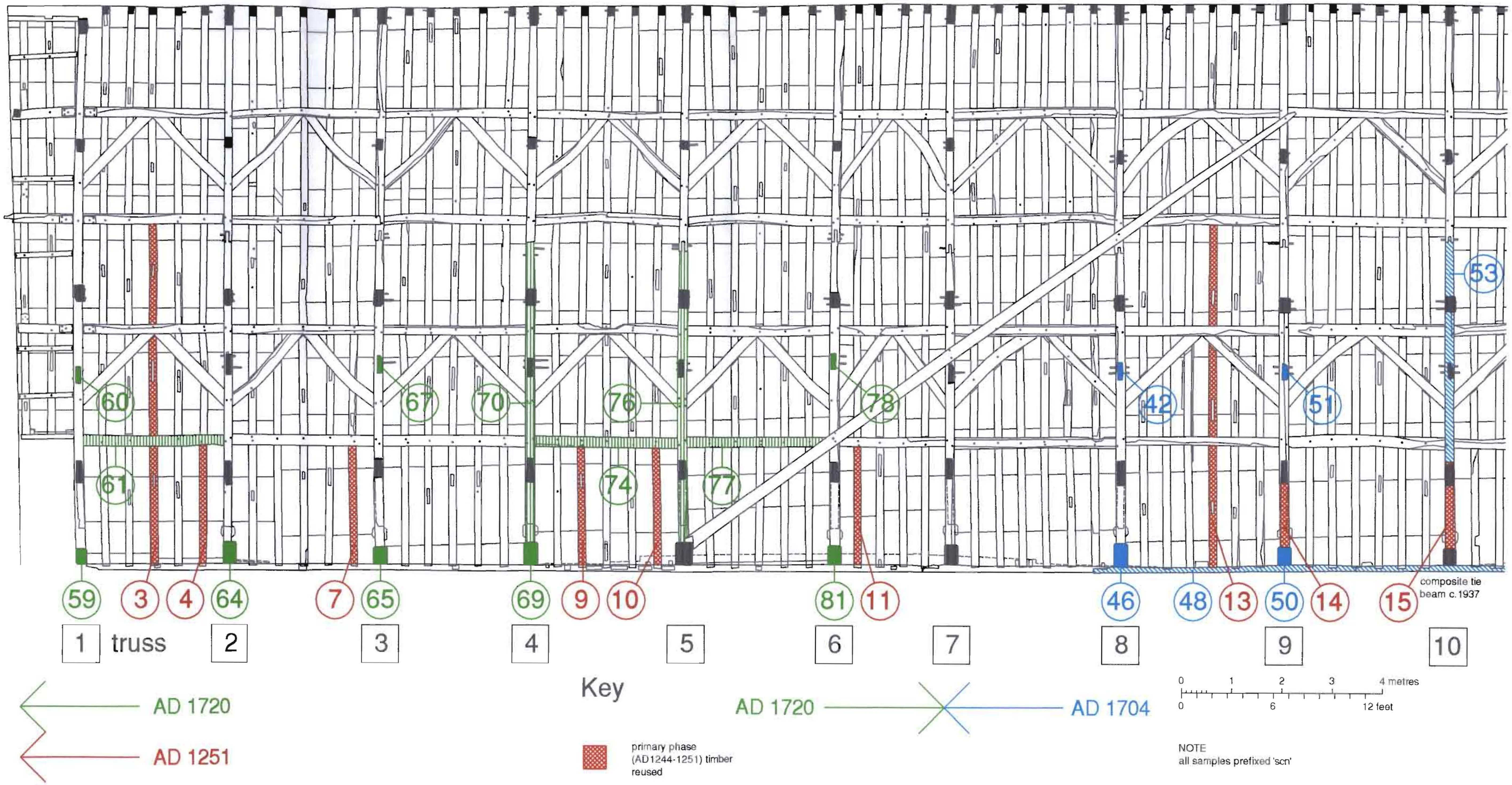
NOTE
all samples prefixed 'scn'

Salisbury Cathedral Nave Roof

west face Truss No 20


54
49
43
79
75
73
66
2
56
52
47
68
62
1
composite tie beam c.1937
50
46
12
81
composite tie beam c.1937
8
69
65
6
5
64
59
10
9
8
7
6
5
4
3
2
1
AD 1704
AD 1720
Key
primary phase (AD1244-1251) timber reused
second phase reconstruction (AD1542)trusses 12-20
third phase reconstruction (AD1704) trusses 7-11
fourth phase reconstruction (AD1720) trusses 1-6
0 1 2 3 4 metres
0 6 12 feet
NOTE
all samples prefixed 'scn'
AD 1720
AD 1251
Salisbury Cathedral
Nave Roof
south elevation


39
38
31
57
braces & struts (dotted) to trusses ?c.1870
rafters truncated to accommodate base unfinished C17th buttress
37
33
34
32
30
composite tie beam c.1937
composite tie beam c.1937
composite tie beam c.1937
20 truss
19
18
17
16
15
14
13
12
11
AD 1542
AD 1243
Key
primary phase (AD1244-1251) timber reused
second phase reconstruction (AD1542)trusses 12-20
third phase reconstruction (AD1704) trusses 7-11
fourth phase reconstruction (AD1720) trusses 1-6
0 1 2 3 4 metres
0 6 12 feet
AD 1542
AD 1704
NOTE
all samples prefixed 'scn'
Salisbury Cathedral
Nave Roof
south elevation



Key

primary phase (AD1244-1251) timber reused

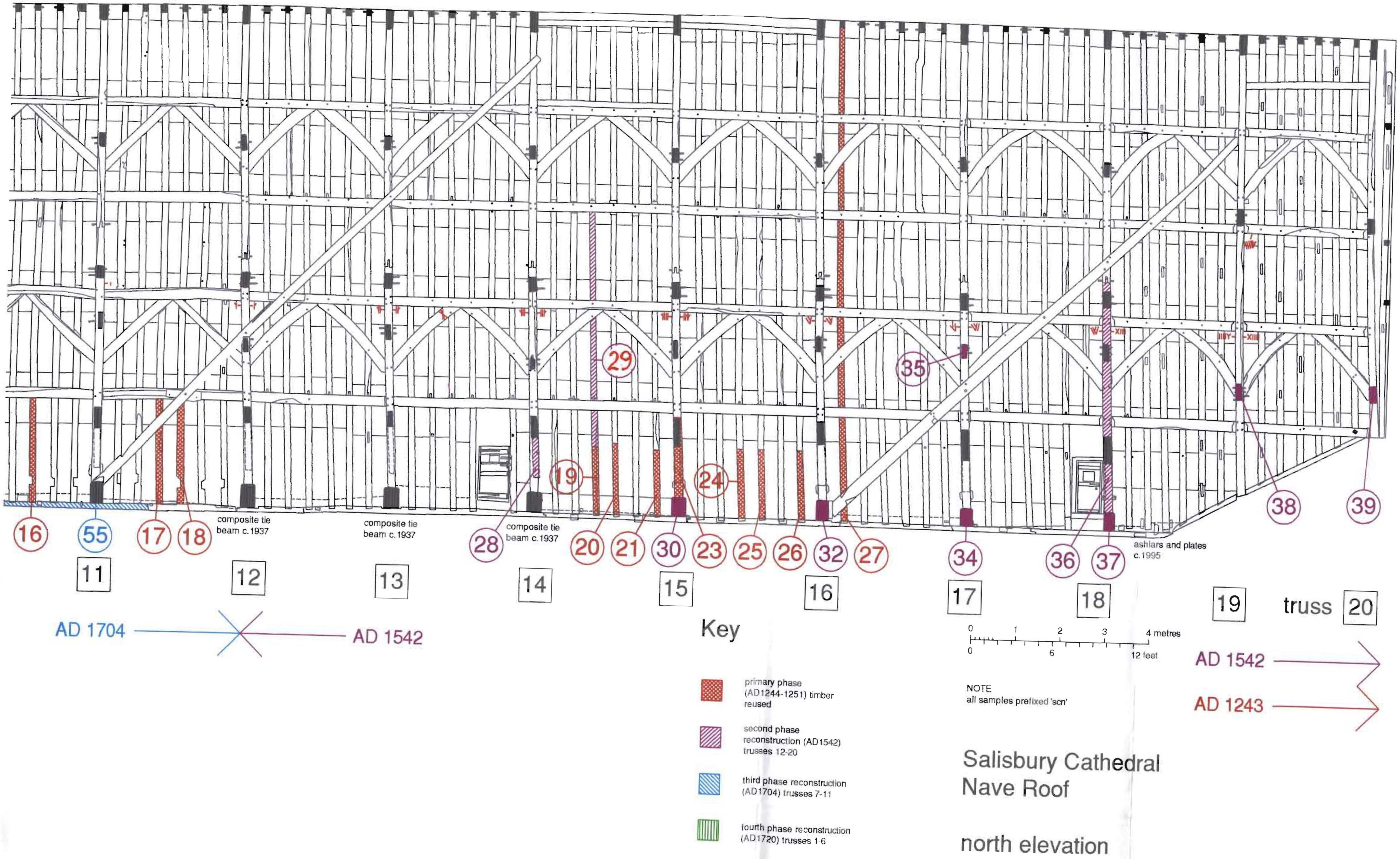
second phase reconstruction (AD1542) trusses 12-20

third phase reconstruction (AD1704) trusses 7-11

fourth phase reconstruction (AD1720) trusses 1-6

Salisbury Cathedral
Nave Roof

north elevation



16
55
17
18
composite tie beam c.1937
composite tie beam c.1937
28
composite tie beam c.1937
29
19
20
21
30
24
23
25
26
32
27
35
34
36
37
ashlars and plates c.1995
38
39
11
12
13
14
15
16
17
18
19
truss 20
AD 1704
AD 1542
Key
primary phase (AD1244-1251) timber reused
second phase reconstruction (AD1542) trusses 12-20
third phase reconstruction (AD1704) trusses 7-11
fourth phase reconstruction (AD1720) trusses 1-6
0 1 2 3 4 metres
0 6 12 feet
NOTE
all samples prefixed 'scn'
AD 1542
AD 1243
Salisbury Cathedral
Nave Roof
north elevation