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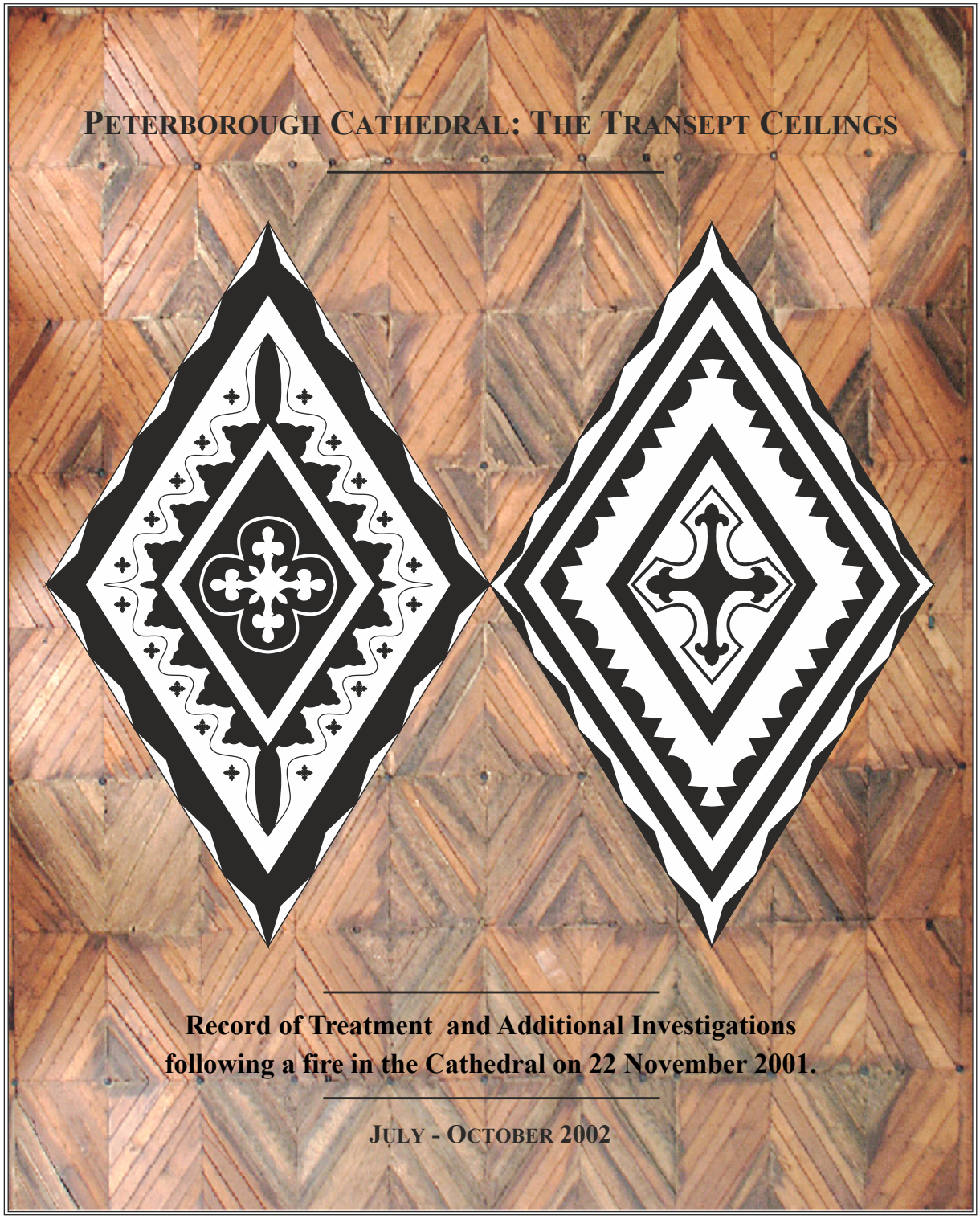

PETERBOROUGH CATHEDRAL: THE TRANSEPT CEILINGS

Record of Treatment and Additional Investigations following a fire in the Cathedral on 22 November 2001.

JULY - OCTOBER 2002

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LIST OF ARCHIVE DRAWINGS

The following composite photographs of J.T. Irvine's 1880s drawings are reproduced in Appendix 2. The photographs of these original drawings are stored in the Cathedral Library.

Arch Draw 1 J.T. Irvine's archaeological record drawing of the side of the South Transept showing the masts which would have supported the First Coffered Ceilings and the closely spaced tie beams of Robert de Lindsey's reconstruction.

Arch Draw 2 J.T. Irvine's plan showing the layout of Robert de Lindsey's closely spaced tie beams. The red lines indicate, "those in old times removed" as Irvine states it. In probability these were removed during Blore's reconstruction of 1826.

Arch Draw 3 J.T. Irvine's archaeological record of Robert de Lindsey's tie beams in cross section showing the end of a ceiling joist mortised into the tie beam and the slot between.

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Arch Draw 7 South Transept – J.T. Irvine's drawing showing Pearson's replacement ceiling beam shown pink and it's new supporting structure shown yellow worked in along side the 1761 roof.

Arch Draw 8 North Transept - J.T. Irvine's drawing showing Blore's roof structure shown yellow with the Robert de Lindsey ceiling beams suspended from a softwood longitudinal beam shown yellow hung from the post tie beams. Note Irvine's curious inclusion of what appears to be an upper layer of ceiling boarding above the noggins. This is probably a mistake in interpretation.

Arch Draw 9 South Transept - J.T. Irvine's second drawing showing Pearson's replacement ceiling structure.

ABSTRACT

This report is a record of investigations and treatment carried out from July-October 2002 to the North and South Transept Ceilings. Included in this report is a detailed written, graphic and photographic condition survey and treatment record of both the Ceiling structures and surviving painted decoration; references to previous recorded treatment and investigations; a record of tests conducted as a preliminary to this treatment phase; and observations and findings made during the condition survey and treatment.

ACKNOWLEDGEMENTS

The Perry Lithgow Partnership and Hugh Harrison wish to thank the Dean and Chapter of Peterborough Cathedral for their enthusiasm and commitment to the conservation of the Transept Ceilings.

We are grateful to Julian Limentani, Cathedral Architect to the Dean and Chapter, and Gillian Lewis, Consultant Conservator to the Cathedral, who gave invaluable guidance and practical support throughout. The extensive archival research carried out by Donald Mackreth, Cathedral Archaeologist, has contributed significantly to our understanding of the Ceiling structure and the painted scheme.

The dendrochronological investigations carried out by Ian Tyres of the Sheffield Dendrochronology Laboratory, University of Sheffield has been central to the project. We would like to thank Ian Tyres of the Sheffield Dendrochronology Laboratory, University of Sheffield for his thorough work and collaboration. Also we particularly like to thank English Heritage for funding the dendrochronological investigations.

Preliminary analysis of coatings and residues was carried out by Catherine Hassall. Jane Davies, of Jane Davies Conservation was responsible for the subsequent paint sample analysis. We are grateful to both of them.

The graphic documentation for the technical survey is based on photogrammetric drawings of the underside of the ceilings plotted by Downland, Lychgate House, Ramsbury, Wiltshire, SN8 2PB

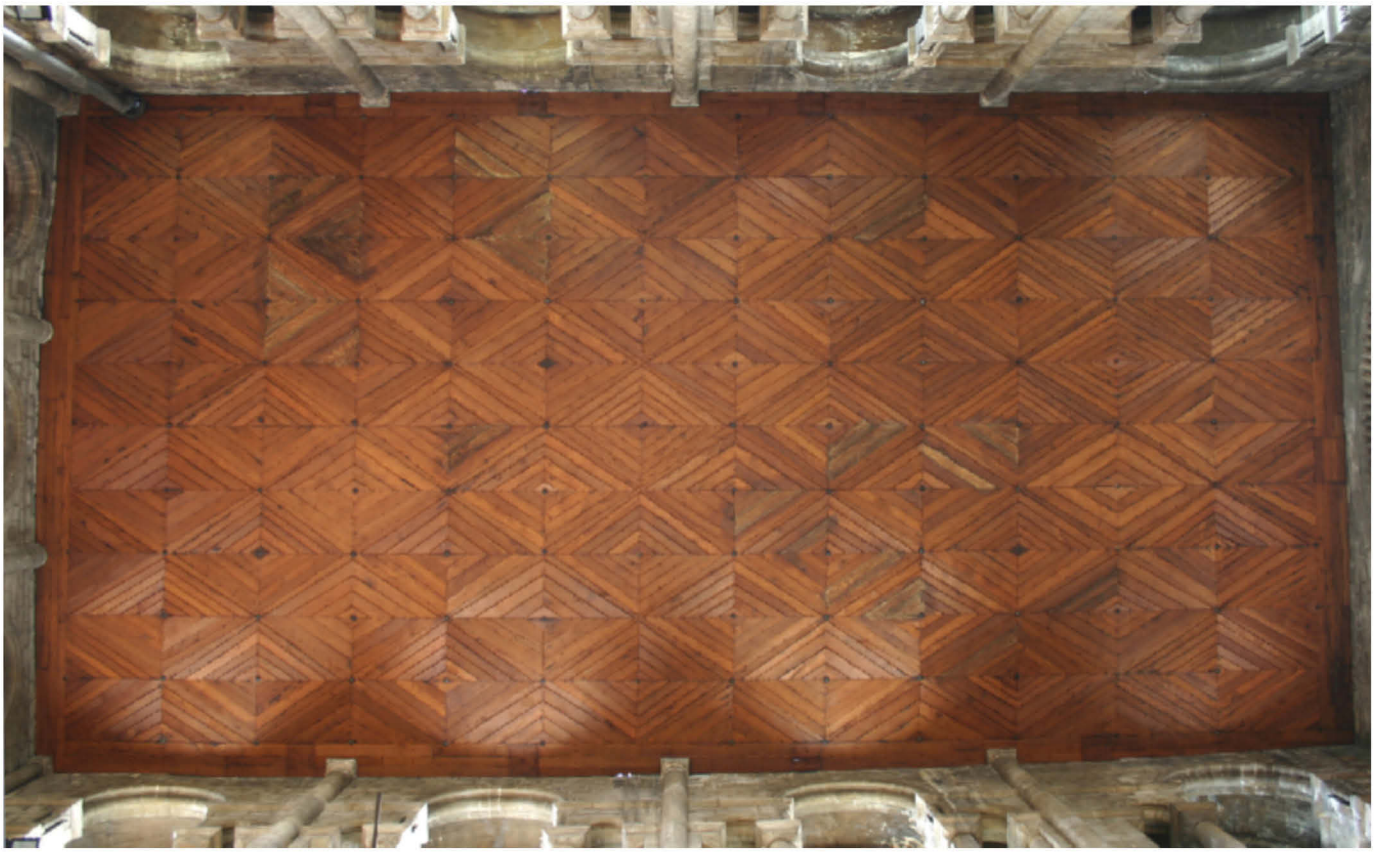
North Transept

South Transept

Figure 1. *Overall images taken from the Crossing of the North and South Transept Ceilings following conservation.*

North Transept

NORTH



SOUTH

South Transept

NORTH

SOUTH

Figure 2. *Overall images taken from below of the North and South Transept Ceilings following conservation.*

PART 1: INTRODUCTION

1.1. GENERAL

The fire in Peterborough Cathedral on 22 November 2001 was confined to the east end of the North Aisle which was used as a storage area for stacks of polypropylene chairs. A verger fortuitously spotted the blaze, some 15 minutes before smoke detectors activated, allowing a speedy response by the Fire Brigade. The fabric and objects within Bay 1 of the North Aisle sustained considerable physical damage. Everything else in the Cathedral was coated with a veil of soot. This report is a record of the soot removal and of the additional investigations and treatment to the wooden boarded North and South Transept Ceilings. These works were carried out from July to October 2002.

1.2. OBJECTIVES

The specified aims of this project were:

- To investigate how much paint is left on the boards and to ascertain their condition.
- To investigate the boards and ascertain their age.
- To investigate the boards present condition.
- To record any previous work and intervention.
- To carry out analysis of the paint.
- To remove the grime and soot on both sides of the boards.
- To make sure the timbers are secure and sound and that there are no loose nails.
- To document the conditions and work carried out on the ceiling.

1.3. CONSERVATORS

Treatment of the Ceiling boards and Ceiling structure was carried out by Hugh Harrison - Ringcombe Farm, West Anstey, South Molton, Devon EX36 3NZ - and his team Peter Ferguson, Bob Chappell and Cameron Stewart.

Richard Lithgow and Mark Perry of the Perry Lithgow Partnership, 1 Langston Lane, Station Road, Kingham, Oxon OX7 6UW carried out treatment of the painted decoration. Assistant conservators - Louise Bradshaw, Cristina Beretta, Greg Howarth, Alexandra Kosinova, Sarah Livermore, Rachel Witt, Fernando Caceres.

The fire occurred two weeks after completion of the fourth phase of condition recording and treatment works to the cathedral's Nave Ceiling. The Perry Lithgow Partnership and Hugh Harrison had been collaborating on that project since 1997. Although of slightly different date the Transepts and Nave ceilings have many similar characteristics both in original technique, materials and conservation history. The conservator's detailed knowledge of all aspects of the Nave ceiling was particularly helpful during the investigation and recording of the Transepts.

1.4. DOCUMENTATION

Richard Lithgow and Hugh Harrison have collaborated in compiling this document. All sections relating to the Ceiling structure have been written by Hugh Harrison and Peter Ferguson; sections relating to the painted decoration by Richard Lithgow.

The principle objective has been to gather and record as much information as possible about the Ceiling structures and painted decoration. The emphasis has been on the collection rather than the display of information. A considerable amount of data is now available in written and graphic formats, not all of which is presented in this report. All additional data is archived as source material and that which can be displayed electronically has been copied onto the CD-ROM presented to the documentation co-ordinator for this project.

Four sets of the photographic record have been presented to the Cathedral, the Perry Lithgow Partnership and Hugh Harrison each retain a set.

1.4.1. Graphic Record

Photogrammetric drawings produced by Downland Ltd provide a base for the graphic illustration of the technical survey and treatment record. As has been the case throughout the Nave Ceiling conservation project categories of damage, deterioration, surface accretions and previous interventions have plotted onto the graphics. This hand-plotted information has been scanned into the computer and redrawn as multi-layered vector graphics using Corel Draw software. In this form, categories of information are superimposed onto the photogrammetry and may be printed out in any combination, scale or format. For the condition survey of both the structure and the painted decoration categories of damage and deterioration have been plotted onto photogrammetric plans of individual panels at 15:1 scale. For the treatment record all interventions made during this phase have been similarly plotted and identified. All this information has been transferred onto overall plans of the Ceilings and has been reproduced at 55:1 scale in Part 10 of this report.

The graphic record has been digitised so that any combination of categories may be generated in any format on overall plans of the Transept Ceilings or on plans of the individual panels. All of this report – including the graphics have been copied to the CD-ROM. A copy of that disk, along with all source material associated with this project, will be submitted to the documentation co-ordinator for this project.

To supplement the digitized graphic record created by the Perry Lithgow Partnership, Peter Ferguson of Hugh Harrison Conservation has produced 11 hand-drawn diagrams and sections illustrating aspects of the ceiling structure. These are included as **Appendix 1** of this report.

Composite photographs of J.T. Irvine's 1880s drawings illustrating the Pearson intervention are reproduced under the heading 'Archive Drawings' as **Appendix 2** of this report. The photographs of these original drawings are stored in the Cathedral Library were taken by Don Mackreth, the Cathedral archaeologist.

1.4.2 Written Record

In addition to the text of this report, and to compliment the graphic record, a tabulated written record has been compiled describing the condition of all original and intermediate boards remaining on the North and South Transept Ceilings. Similar condition records were made of the 1880s boards in the North Transept. These records, in electronic format, have been copied onto the CD-ROM. The original, hand-written tabulated sheets form part of the source material submitted to the documentation co-ordinator for this project.

1.4.3 Photographic Record

The photographic record consists of colour prints and forms **Appendix 8** of this report. Each ceiling panel (130 per ceiling) has been photographed following treatment using moderately angled flashlight. In addition, examples of deterioration and phenomena categorised in the graphic and written records have been photographed before, during and after treatment. **Appendix 6**, List of Plates, contains a description of each photograph. **Appendix 7**, Plate Reference Sheets, which are based on the photogrammetric drawings, locate the ceiling area covered by each photograph.

PART 2: HISTORY OF THE TRANSEPT CEILINGS

2.1 THE ORIGINAL CEILINGS

The Norman transepts were commenced by Abbot Martin de Bec early in the 12thC and completed by his successor William de Waterville between 1155-1175 to which period the first roof and ceiling belong.[1]

From surviving evidence and the almost identical layout and dimensions of the two transepts, it is suggested that both ceilings were originally coffered, each being divided into twelve principal panels. The survival of capped masts within the masonry of the exterior walls and the empty pockets 325mm above the present ceiling level at the gable wall of the North Transept (see **Drawing 3**) point to this assumption being the most likely.

2.2 THE SECOND CEILINGS

The vaulting of the nave was commenced by Abbot Benedict 1177-1193 and completed by Robert de Lindsey between 1214-1222.[2] The dendrochronology of the surviving original ceiling boards in the two transepts show that he also did major works in the transept roofs which resulted in a completely reconstructed ceiling with closely spaced tie beams substituted for the original coffered lay out. The boards have been dated to the early C13th and are of English origin confirming that they pre-date the boards in the nave. Thus we can see that the lozenge patterned boarding arrangement complete with its characteristic grooving was developed for the transept ceilings then copied in the nave when the stone vault was dismantled and taken out c. 1235 by Robert de Lindsey's successor.

Thanks to measurements and drawings prepared by J.L. Pearson's Clerk of Works J.T. Irvine in 1892, the transept ceilings have been well documented and site evidence seems to confirm the accuracy of his records.[3] Irvine shows the Robert de Lindsey ceilings as being constructed of closely spaced tie beams 340x210x11415mm in length at approximately 750mm centres. This was confirmed on site by measuring the filled pockets still discernable in the masonry of the east and west walls of the South Transepts and those visible to a more limited extent in the North Transept.

The 1892 Irvine drawings and photographs taken during Leslie Moore's reconstruction in 1925, show these tie beams to have been mortised to receive ceiling joists 135mm wide and to have been provided with a slot between the mortises 300mm wide and 35mm deep and placed 60mm above the underside of the tie beams. Its exact use has not been established, but may well have been associated with noggins, which would in all probability have been positioned between tie beams to give support to the board ends.

Some of these noggins appear to have survived, incorporated within the present structure to support the perimeter boarding and traps. These short pieces of timber conform in length to the original setting out of the tie beams and some still have their original birds beak joints on at least one end. Dendrochronology has established that these timbers belong to the period of the Robert de Lindsey ceiling and double rows of nail holes have been recorded on their underside suggesting that they originally supported the boarding.

No original paint has been found on the boards surviving from this second ceilings. Nevertheless it is evident from designs visible in shallow relief on some of these early boards and from the positioning of the parallel grooves on board edges - as on the Nave Ceiling - that the Transept Ceilings were decorated with a paint scheme in the thirteenth-century. The painted design followed the arrangement of the

[1] D. MacKreath 15.11.02 letter to J. Limentani
[2] ibid
[3] NRO Irvine papers

Ceiling boards to form interlocking rows of diamond-shaped compartments, with alternate rows ending with half compartments. The inner boards of each compartment were decorated with a cross. Embellished, linear versions of both the Cross Fleurie and the Cross Treflée are visible in shallow relief. Also each compartment had an inner and outer band of four parallel lines painted in grooves. One board on the North Transept Ceiling appears to have in shallow relief traces of a border design: what for the Nave Ceiling we have described as a bun pattern. This would suggest the early scheme included a series of linear border patterns as well as the parallel lines within each diamond compartment (see **Fig. 3**).

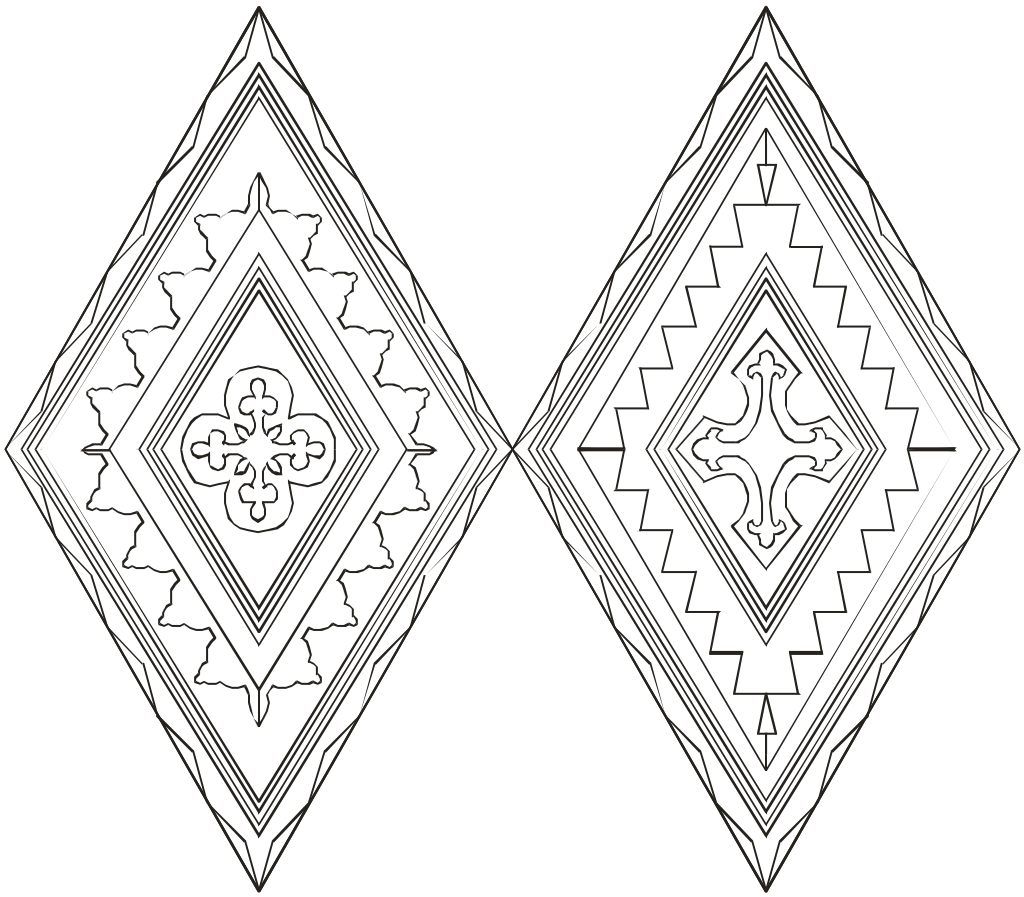


Figure 3. *Speculative reconstruction of two C13th linear painted lozenges on the Transept Ceilings. There is firm evidence only for the crosses and inner and outer band of four parallel lines. No original paint has been found to indicate the original colour scheme.*

2.2.1 Interventions up to Pearson's Restoration

In the absence of records to the contrary, it seems that the Robert de Lindsey ceiling remained substantially unaltered until after the Restoration in 1660. Cathedral records infer that during the Civil War and Commonwealth period, the Cathedral suffered serious neglect requiring substantial repair after the monarchy had been restored. The presence of a tie beam on brackets dated 1668 at the south end of the South Transept together with substantial numbers of C17th replacement boards (intermediate boards) found only in the South Transept as confirmed by dendrochronology, suggests the extent of this.

In 1761 extensive repairs were carried out to the South Transept roof, which contemporary Cathedral records describe as "taking down, rebuilding and carving of new roof of the south end of the cross aisle."[4] No evidence has been found to suggest that this involved the ceiling structure. However the

[4] NRO Peterborough Cathedral Dean and Chapter Vouchers, Box X5157

repairs must have contributed to the status quo in 1826 when Dean and Chapter "resolved that the North Transept be new roofed according to plan by Mr Blore, Architect". Presumably the South Transept was still in a satisfactory state of repair even if as suggested by Don MacKreath, the present Cathedral archaeologist, the 1761 roof was largely composed of re-used earlier timber. It does appear however that in 1802 the Cathedral architect Edward James Wilson reported on and suggested additions to the "old beams of the South Transept"[5] and that in 1825 work was undertaken by Daniel Ruddle "forming trusses for the South Transept roof", which was superintended by Wilson.[6] Repairs, including Layton's repainting of the ceiling continued for a further two years. The ceiling was again repaired in 1847 and this continued intermittently until 1862 and again in1877[7] suggesting that Wilson's decision not to re-roof might have been short sighted.

Edward Blore's roof over the North Transept, massively timbered in softwood, still remains substantially as built. The old oak ceiling beams beneath, as recorded on Irvine's drawing (see ***Arch. Draw. 8***), were attached by Blore to a 350x325mm softwood longitudinal beam hung from the roof tie beams on wrought iron bolts. These old oak ceiling beams must refer to those belonging to the Robert de Lindsey ceiling, every alternate one of which was, according to Irvine, "in old times removed" (see ***Arch. Draw. 2***). From Irvine's 1892 perspective, this must mean by Blore or earlier but evidence for a date has not been found. The same decision was however taken for both ceilings whereas repairs from the Restoration onward for the most part only involved each transept in accordance with its own particular needs.

From the board surveys carried out in 2002, very few nail holes were found in remaining original boards at the position of the alternate tie beams "in old times removed", certainly not enough to confirm that the boards were ever attached to them. This is curious, but might suggest why it was easy to remove the tie beams without disturbance or damage to the original boards. It should be noted that in the nave, nailing to noggins at the mid board length was also to say the least erratic, many areas of original boarding showing no evidence of nailing whereas in others it was substantial.

There is no evidence to suggest the ceiling paint was restored at the time of the 1660s intervention; however it does appear there was repainting in the mid-eighteenth century. Some of the paint traces surviving on early boards and on seventeenth-century metal washers appear very similar in cross section to that used for repainting the Nave ceiling in the 1740s (see item 6.4.1). It may be the Transept ceilings repaint coincided with the 1761 structural repairs (see above); although it is unlikely the paint and technique would be so similar unless the same restorers were involved. The essentially linear early painted design on the Nave Ceiling was transformed into the much bolder present scheme by the 1740s restoration. From the limited evidence available it would appear the same thing happened on the Transept Ceilings.

There is documentary evidence of a further repaint in the 1820s. The work was carried out by Charles Layton (who was also involved in the 1830s repaint of the Nave ceiling).[8] If the Nave Ceiling is anything to go by, the 1820s restorers made no significant alterations to the 1740s scheme but simply repainted many elements. This is discussed more fully in item 6.4.2.

[5] NRO Irvine papers 5.50 404
[6] NRO Peterborough Cathedral Dean and Chapter Vouchers, 5052/3/1825/3
[7] NRO Peterborough Cathedral Dean and Chapter Vouchers, Boxes X5054 and X5055
[8] D. Mackreth, letter to J Limentani, 30 June 2002.

Figure 4. *Pre-1880s photograph showing a section of the North Transept Ceiling as well as significant structural cracks in the north crossing arch wall.*[9] *Evidence suggests the ceiling painted decoration is significantly different from the thirteenth-century linear design. It is probable the alterations were made in the 1740s and that scheme was simply repainted in the 1830s.*

[9] Reproduced from The Friends of Peterborough Cathedral Journal 1981. The photograph illustrated an article entitled 'The Central Tower Saga' by R.S Wingfield Digby of a lecture given to the Burgh Society on 17th March 1980. Photo credit 'L. Shipsides'

2.3. THE THIRD CEILINGS

2.3.1 Pearson's Restoration, late 1880s

J. L. Pearson's restoration of the ceilings date from his rebuilding of the central tower. Pearson initially took down the first two ceiling bays in each transept adjacent to the tower to facilitate the rebuilding of the latter after 1886. He subsequently took down all the boarding and replaced most of it with new oak together with all the noggins to both ceilings. He also replaced four tie beams in the North Transept presumably because they were no longer structurally sound, and seven tie beams in the South Transept (see **Drawings 1** & **2**). In the case of the North Transept these replacements were hung off Blore's longitudinal beams as described above, but for the South Transept, Pearson devised an upper and lower tie beam system connected by posts and braces which was worked in alongside the 1761 roof. This is shown on J.T. Irvine's drawings (see ***Arch. Draws. 7 & 9***) and on our **Drawings 5** & **6** as modified by Leslie Moore 40 years later.

Pearson's Clerk of Works J.T. Irvine was known to have been sympathetic to retaining as much of the mediaeval fabric as possible and it is probably due to him that many of the mediaeval and C17th replacement boards were re-used. Since the old ceiling was painted, a decision had to be taken as to whether the new ceiling would also be decorated. Although estimates were sought as recorded in the Cathedral archives (see item 6.4.3), it was obviously decided to leave the transepts in the natural oak finish and remove the existing paint from the retained old boarding.

Irvine's conservation retained as many of the mediaeval ceiling beams as possible and according to Moore who later took them out, seven in the South Transept had been turned over owing to deflection (Architects Journal Feb 11th 1925). This statement however is questionable. Only six original beams remained after Pearson's restoration in addition to the C17th beam 1. From examination of a photograph showing an original beam taken during Moore's restoration and reproduced in the Architects Journal article, it can be seen that the slots to take the board noggins are in their correct position suggesting that the beam had not in fact been turned over. Pearson's new tie beams alternated with the retained originals suggesting that his reason for replacing them was not the specific condition of each individual beam but the need to provide an overall new support system to a generally weakened structure without removing all of it. It is hardly feasible that natural decay should have been confined rigidly to every alternate beam and judging from the photographs showing deathwatch beetle damage to one of the beams retained by Pearson (Moore AJ. Feb 11th 1925) it might be inferred that all the beams were in a parlous state when Pearson examined them.

2.3.2 Moore's Restoration 1920s

Irvine's approach of conservative intervention was also a key factor in Moore's view for the acceleration of insect and fungal damage, which lead to his major reconstruction work in the Cathedral roofs completed in stages between 1924 and 1927. He initially recommended that the retained old beams should be treated with preservative but in point of fact they were eventually all removed and replaced with his laminate construction which could be built up in situ on site without major disturbance to the surrounding structure and in particular the taking down of the ceiling boards and noggins.

Moore's work in the North Transept was completed in 1924 three years ahead of the South Transept which followed the presbytery and the nave in 1925 and 1926 respectively. It is interesting to compare Moore's design for the North Transept with his later solution for the South Transept where we see a more self assured and minimalist approach to a similar problem and the clever incorporation of Pearson's earlier work. (See **Drawings 5** and **6**). To Leslie Moore belongs the introduction of hessian backing to the ceiling boards as carried out throughout the Cathedral. No further work of major structural significance has been carried out on the transept ceilings since Moore's reconstruction except for the fitting of steel channel supports to the ends of Moore's cambered composite beams in the North Transept, thought to have been inserted in the 1950s.

PART 3: TECHNICAL SURVEY OF THE STRUCTURE

3.1 SECOND CEILINGS

3.1.1 Structure

No timber survives from the first ceilings for either transept. There is however surviving timber in both transepts from the second ceilings in the form of short lengths of oak varying in length from 570-700mm and of average girth 100 x 60mm. This timber was re-used by Pearson in both transepts for the construction of perimeter ceiling traps and for supporting perimeter boarding. See **Plates 4** to **9** and **Drawing 8.** Dendrochronological dating has established this timber as belonging to the period of the second ceiling.

Some of these mediaeval timbers are almost certainly re-used original noggins, which would have supported the ends of the diagonal boarding. Original birds beak joints now disused occur on the ends of many of these and original board nail holes are visible where the re-used timbers have been laid upside down or on their sides. See **Plate 7** and **Drawing 8**.

Measurements taken off re-used timbers where original joints survive on both ends (**Plate 5**) show that these timbers would have fitted into the slots known to have been present in the second ceiling tie beams from photographs taken by Moore when he removed them and as recorded by J.T. Irvine (**Arch Draw 4**). They are also of the correct length to have fitted between the old beams as recorded by Irvine (**Arch Draw 1**) and as confirmed by the filled beam pockets (**Plate 3**).

3.1.2 Boarding

No boarding survives from the first ceiling for either transept. However 68 boards from the second ceiling remain in the North Transept and 368 in the South Transept. These are referred to in the text as original boards. In addition to these original boards, a further 55 intermediate boards belonging to the C17th remain in the South Transept only. These boards were retained by J.T. Irvine as part of Pearson's third ceiling. The original boards have been dendrochronologically dated to the period of the second ceiling. (See item 3.3 Dendrochronology below)

Sufficient original and intermediate boards survive in the South Transept to provide a number of complete or near complete panels, enough to determine the general pattern of the original board layout and this is confirmed by the surviving paint shadow. This is indicated on **Drawing 6**, but it should be appreciated that there is none the less considerable detail variation.

Panels 5 and 6 in Bay M, South Transept, were measured and drawn (**Drawing 6**) and may be said to be fairly typical. Each panel consists of a baseboard on the longest diagonal with an average of 2-3 boards either side which are ship lapped over the base board and each other being nailed at approximately 125-150mm spacings each end and randomly clench nailed at approximately 300mm centres along the leading edge. Many of the principal boards either side of the baseboard are of considerable width, up to 500mm, with the outermost boards formed out of the end off cuts from these middle boards resulting in their being laid across the grain in a number of instances (**Drawing 9**).

The original boards are nearly all radial and appear to be very straight grained and generally flat, between 6-9mm thick. A few of the very widest boards are tapered from 12mm to 4mm and one 430mm wide board noted was feather edged. (See **Drawing 9**). The boards are generally thinner and wider than those of the Nave and were obtained from very large trees of considerable age. It was not possible to determine absolutely how the original boards were manufactured. Only a small number of boards had hessian removed from the back and these did not produce enough usable evidence.

Overlaps, where examined, indicated considerable variation of width in each panel from 25mm to 85mm (**Plate 12**). Unlike the Nave boarding there was no evidence found to suggest that the board edges had been carefully worked to produce a tight fit.

Three original boards in each panel bear the four characteristic parallel grooves along the board edge, which are found in the Nave, (**Plates 10**, **11**, and **13**). The grooves are uniformly 9mm wide and are spaced 9mm apart. The depth is nominal, possibly 1-2mm. Their relationship to the paint scheme suggests that their function was to provide a lining-out guide for the painters. Where boards forming the inner lozenges are laid cross-grained, the grooves have been cut across the grain (**Plates 10**, **11** and **15**).

3.1.3 Fixings

There is no evidence of nailing in the joints of the surviving noggins. The evidence recorded by Pearson and Moore showing slots in the original tie beams suggests that the noggins would have been carefully made fractionally oversize to fit between each beam and offered into the slots at an angle then tapped into position at 90° to the joists at positions to suit the board ends. This method would have ensured a tight fit without the requirement to nail or pin.

Where surviving noggins have been re-used upside down or on their side, the exposed original underside was consistently found to have two rows of nail holes. The nails are set 25mm from the edge of the timber at 125-150mm spacings. The nails appear to have been finely tapered and flat shanked and almost certainly supported the original boarding (**Plate 7**).

It would appear that Pearson de-nailed the original boards and re-nailed mostly into the original holes, very little damage occurring to the woodwork in the process. Spacing is approximately 125-150mm at the ends and about 250-300mm along the board edges (**Plates 61-62**). There was no evidence found to suggest that Pearson took down and re-used original boards in pairs (or more) without releasing original nails, though a few original nail heads remain embedded in the boards and these are indicated on the graphics.

Twelve re-used washers have been identified on the underside of the ceiling in the South Transept and twenty-seven in the North Transept. All are associated with Pearson beams above. Twelve re-used washers have been identified on the underside of the ceiling in the South Transept and twenty-seven in the North Transept. All are associated with Pearson beams above. Samples of paint surviving on their surface have been analysed and were found to be very similar to the paint used on the Nave Ceiling in the 1740s (see item 6.4.1). The washers (**Plate 16**), which appear to belong to the C17th, have a function more decorative than structural and are all placed at the central point of each lozenge. They bear a close physical resemblance to the C17th washers used for the scarf bolts on Tie Beam 14 (**Plate 28**, **Drawing 7**) and are of equal dimensions at 75mm diameter and 2-3mm in thickness. Examination of the original board ends where these washers are missing or misplaced shows no evidence of the washers imprint in the paint shadow which suggests that they are a later addition. This does not however explain the preponderance of washers in the North Transept where there are no surviving intermediate boards. The only common link being that all the washers occur under Pearson's replacement beams.

3.1.4 Intermediate Repairs to the Second Ceilings

Major structural repair was carried out to the South Transept ceiling in the late C17th when Tie Beam 14 at the south end was replaced together with substantial amounts of boarding. From the pattern of surviving original and intermediate boarding, it would appear that all the boarding to the ten panels in Bay 9 was replaced at this time together with localised areas of boarding to most of the other bays, (see Graphics).

Beam 14 has been fully measured, described and drawn (**Drawing 7**) and is characteristic of C17th work. The quality of timber and finish is not as good as the mediaeval work. It is suggested that the beam may have been made in two pieces due to the unavailability of larger timbers possibly because of the massive naval reconstruction programme taking place at that time which demanded huge quantities

of prime timber. This would also have affected the quality of timber available. The decision to scarf the beam at the centre would have lead to the decision to insert support brackets at each side, which interestingly have been given decorative moulded ends and are dated and initialled presumably by the Master Carpenter but his name has not been traced. Considering that the brackets are visible from the underside, it seems odd that they are not placed equidistant from the centre line of the ceiling or the scarf joint. No explanation for this can be suggested.

Drawing 7 also details an identical assembly of empty mortises and a dovetail joint at each end of the beam. These have not been analysed but it is possible that they remain from an earlier roof assembly, although whether this was the mediaeval roof, the contemporary C17th repairs or repairs carried out by Daniel Ruddle in 1825 is not known.

The intermediate oak boards are exceptionally wobbly grained, full of knots and fairly fast grown. They tend to have pit sawing marks on the backs and they show more evidence of splitting and fragmenting than the earlier boards. (Ian Tyers' comments). Boards measured were generally 9mm thick and of variable width up to about 300mm. Two boards that were measured each featured one edge chamfered at about 45°, though the precise reason for this is not clear. Their widths were almost identical at about 265mm. The boards have been dated by dendrochronology to the late C17th.

3.1.5 Miscellaneous Interventions to Second Ceilings

Some small circular traps filled from behind survive in the South Transept in the original boards in panels G4, K1, K3 and L5. These were not examined in detail so their purpose has not been identified. They are not however knot holes as in the case of a similar hole in one of Pearson's replacement boards in panel M2 and a number of similar holes in Pearson's boards in the North Transept. A number of small piecings in were also noted in both original and later boards and marked as timber inserts on Graphic 1.

3.2 THIRD CEILINGS

3.2.1 Pearson's Interventions

Pearson's structural interventions are discussed in context under 1.3.1 above and are recorded on **Drawings 1-6** and **8**. They may be summarised as follows:

North Transept

a. Replacement of tie beams 1, 3, 8 and 14 in oak and hung off Blore's 1826 roof support structure. (See Graphic 3)

b Replacement of all board noggins in oak but re-using some earlier timbers to support perimeter boarding and traps.

c Replacement of boarding in oak but re-using 3.2 % of original material.

d Insertion of perimeter traps.

South Transept

a Replacement of tie beams 1,3,5,7,9,11 and 13 in oak together with new supporting structure worked into 1761 roof. (See Graphic 3)

b Replacement of all board noggins in oak but re-using some earlier timbers to support perimeter boarding and traps.

c Replacement of boarding in oak but re-using 25.8 % of original and intermediate material.

d Insertion of perimeter traps.

3.2.2 Structure

Pearson's replacement tie beams are substantially of the same dimensions as those they displaced. The oak used for both transepts appears to be Baltic, all from the same source. The timber has been mechanically cut and shows characteristic band saw marks on each surface (**Plates 34 and 36**). Some show distinctive scored lines on their sides, which would appear to be caused by a fault in the saw milling process (**Plate 35**).

Some of the main tie beams carry brand marks on their ends together with cargo marks and hauling hook marks. The brand marks have all been hammered into the grain and are about 25mm in height. The most common one occurring is H2P; others noted were ME and A1V. A few beams had contemporary ferrous 'S' shaped reinforcement cramps driven in across radial splitting occurring from the heart wood. All the above have been recorded and appear on **Drawing 10**.

Tie beam 14 at the north end of the North Transept has mortises cut on both sides at the top, which have not been used (**Drawing 4**). These are 980mm apart and are centred over the principal noggins below. There is no satisfactory explanation for this variation which is most likely to have been a setting out mistake; though why it was necessary to cut a complete new set of mortises on the other end instead of adapting one side to fit the perimeter noggins is not possible to explain.

3.2.3 Boarding

Dendrochronological analysis suggests that Pearson's boards were all obtained from one source and there is no appreciable difference in quality or finish on either ceiling. Most of his boards are planed but there are examples of unplaned boards being used (**Plate 39**). There is however some considerable variation in both board width and thickness with boards ranging from about 120-450mm in width and from 13-17mm in thickness, all without taper. There are very few extreme boards, the majority falling within the 150-250mm width band. The overall board layout, while confirming to the original shiplap fixing sequence throughout (**Drawing 6**), shows considerable variation in terms of the number of boards used in each panel due to the apparent random selection and perhaps supply of board sizes. Thus we find in the North Transept combinations of 9, 10, 11, 12 and 13 boards used. This compares with from 4 up to 8 boards per panel where original boards have survived complete.

There is an important difference that separates Pearson's board arrangements for the North Transept from those of the South Transept apart from the number of original boards re-used which are considerable less in the North Transept. In the North Transept the baseboard is centred over the diagonal line of the panel with the rest of the boards overlapped each side of centre to produce a tapered face to the baseboard approximately 200mm wide diminishing to 100mm, which alternates with each panel. This consciously picks up the same setting out detail used on the Nave ceiling.

In the South Transept, where there are many more original boards re-used, the new boarding with only one or two exceptions, is not set out to produce this tapered face to the baseboard. It does not appear to have been a feature of the original board layout and Pearson has not introduced it here even where panels have been completely re-boarded, furthermore in most instances the baseboards are not centred on the diagonal line of the panel and neither are the original panels. The above observations are made clear if one refers to the plan layouts of the two ceilings reproduced on the graphics.

Pearson's arrangement of the centre boarding to the lozenges differs in the main from the original layout, which used either small or large boards but always in fours. Pearson uses four in the South Transept in association with the re-used original boards, but where he completely re-boards the two bays adjacent to the tower he uses, with one exception, two boards only. This practice of two boards is extended over the greater part of the North Transept, the centre lozenge varying considerably in size. There are however exceptions which occur randomly, where a very small single board is sometimes used and in other cases four small boards, which all adds up to the careful use of the board off cuts presumably to save time and materials.

3.2.4 Fixings

Pearson nailed his new boarding in much the same way as the original second ceilings had been fixed using broad dome headed nails with a long flat shank.

Evidence suggests that he did not pre-drill the board edges. Where nails in board edges appear side by side in both directions, the cleated over ends of the reverse nails were visible on the underside and there was evidence of splitting at the point of surface breakthrough (**Plate 45**). This was not able to be examined from above as the hessian covering the boards was not removed except from the first few original boards being released for dendrochronological analysis.

Nailing conformed approximately to two per board end (**Plate 39**), three in the case of the widest boards, with edge nailing at approximately 300mm centres and about 19-25mm from the edge.

Where Pearson used bolts or staplestraps to support the structural timber above, boarding was cut round these obstructions and additionally nailed as necessary (**Plates 37** and **40**). The cutting around was noticeably crudely carried out in many instances.

Pearson used a system of wrought iron bolts and straps in lieu of wooden pins in association with his timber jointing to support his structural interventions and these are shown on **Drawings 5** and **6**. **Drawing 5** shows straps used by Pearson for supporting Queen Posts, which were later modified by Moore. **Drawing 6** shows a slot wedged iron strap used for securing the upper tie beam to the Queen Post on ceiling truss no.1, South Transept and the vertical bolt arrangement for securing the same post to the lower tie beam.

Pearson's re-use of older washers at the centre of the board lozenges has been described in 2.1.3 above. These are used in association with new nails up to 20mm in diameter across the domed head. Curiously this mainly decorative use of ironwork is not carried through at every board lozenge and there is no evidence to suggest that where missing, they have been subsequently removed. As there are no new washers used, it would seem as if this is another example of Irvine's conservation practice where he simply kept what remained of these earlier washers rather than discard them. Moore later replaced the remaining original tie beams with his laminate beams and as part of his structural system used matching bolts and washers which are shown as type 1 on **Drawing 11**. (See also Graphic 3)

3.2.5 Moore's Interventions

Moore's structural interventions are discussed in context under 2.3.2 above and are recorded on **Drawings 1-5** and **8**. They may be summarised as follows:

North Transept

a Removal of 10 remaining original tie beams and their replacement with independent composite trussed rafters. (See also Graphic 3)

b Modification of Pearson's replacement tie beam no's. 3 and 8 into independent braced rafters.

c Strengthening of Pearson's replacement noggins with longitudinal beams hung off the ceiling trusses.

d Applying hessian backing to the ceiling boards.

South Transept

a Replacement of the complete 1761 roof but retaining and modifying Pearson's double tie beams as an independent trussed ceiling rafter system.

b Removal of 6 remaining original tie beams and their replacement with laminated tie beams longitudinally braced to the alternate trussed rafters. (See Graphic 3)

c Applying hessian backing to the ceiling boards

3.2.6 Structure

Moore completely re-roofed the South Transept but retained and skilfully adapted Pearson's double tie beam arrangement into a new support structure for the ceiling detaching it from the old roof where it had been notched and strapped to the Queen Posts (see **Plate 31** and **Drawing 5**). Where he removed the remaining mediaeval ceiling tie beams, these were replaced with 12mm laminates "A" built up and screwed together in situ to provide a composite beam replacement, a system which he perfected and used throughout the Cathedral as we have already seen in the nave. Longitudinal softwood braces "B" from Pearson's upper tie beams back to the composite beams "A" were introduced and connected to longitudinal softwood bearers "C" introduced over Pearson's replacement principal noggins and coach screwed to them (see **Drawing 5**).

Moore retained the Blore softwood roof of 1826 but detached the ceiling from it by removing the longitudinal bearer and wrought iron bolts and supporting it on twelve independent cambered trussed girders built in situ between Blore's roof trusses and bearing directly into the east and west walls in steel shoes. Two of these trusses suitably modified, numbers 3 and 8, (see **Drawing 3**) were built around Pearson's replacement ceiling tie beams. The other two Pearson beams adjacent to the tower and north gable walls being left unaltered. In place of the ten tie beams removed, 12mm laminates screwed together in staggered lengths were built up to support the board ends and principal noggins "D". These laminated beams were attached to longitudinal bearers "E" coach screwed on top of Pearson's principal noggins and bolted to the cambered lower section of the trussed girder with galvanised steel bolts. These lower sections are of composite construction made up of three 285x100mm sections in staggered lengths through bolted together "F". **Drawings 3** and **4** show details of the design and construction assembly.

Moore's laminated tie beams differed in section between the two transepts. In the South Transept he used nine 225 x 12mm boards individually screwed together with pockets cut out of the three middle layers to form mortises for Pearson's oak noggins (**Drawing 5**). In the North Transept where the laminated beams are suspended from Moore's cambered composite beams above they are reduced to six 12mm layers built up from 150 and 75mm wide boards arranged in a stepped profile on which the half joint on the end of the noggins rests (**Plate 51**, **Drawing 4**).

A curious anomaly was discovered under beam 12 South Transept (**Plate 54**, **48-49** and **Drawing 8**) where diagonally laid out boarding was inserted, presumably as levelling packers. They were likely to have been placed there originally by Pearson but were retained by Moore between a double layer of hessian. The fact that they are of oak and have been laid diagonally may well be because they were made from Pearson's board off cuts, the angle being the same as that of the principal board lozenges.

Moore used softwood throughout as he did elsewhere in the Cathedral. His timber was all treated with a strong creosote type preservative which leaves a dark residual surface stain.

There is some evidence to suggest that Moore pre-prepared and assembled all his structural timbers on the ground before re-assembling them in the roof. The presence of sets of Carpenter's marks on the ends of components forming the cantilevered ceiling trusses for example, point to this (**Plate 52**).

3.2.7 Boarding

Moore did not need to renew any boarding. His main intervention was to apply hessian to the back of the boards as he did throughout the rest of the Cathedral roofs. This operation was carried out after he had removed the remaining original tie beams but before he fitted their replacements built in situ from 12mm laminates. The hessian therefore forms a continuous membrane over the boarding and under the beams except where Pearson's tie beams were retained.

3.2.8 Fixings

Moore uses galvanised mild steel for his coach bolts, coach screws, washers, straps, staple hangers and board screws with very little use of unprotected steel.

One curious departure from his standard method of fixing is seen in the North Transept ceiling trusses 3 and 8, where the Queen Post braces are attached to Pearson's tie beam using a mortise and tenon joint secured by two 12mm wood pins (**Drawing 3**). Whether this was a case of re-using an earlier joint has not been established.

When Moore re-roofed the South Transept it seems odd that he did not leave in place the old 1761 outer Queen Posts and simply cut them off just above the seating for Pearson's inserted upper ceiling tie beams. Instead he removed them completely leaving the ends of the upper tie beams cantilevered out 3 meters. Pearson's wrought iron staple strap was left in situ and adapted as shown on **Plate 31** and **Drawing 5**. He introduced a connector rod taken through the end of the upper tie beam and attached to Pearson's staple strap which could then be tensioned up from the top by screwing down the nut. This action applied at both ends would have produced a limited upward thrust at the centre span of the upper tie beam, which would help to counter any long-term deflection of Pearson's lower tie beams supporting the ceiling. It is possible that the connector rod might be made of wrought iron as it has been coated with red oxide paint. If so this is another departure from Moore's standard specification. This crude post tensioning system is the only answer one can give for the omission of the other Queen Posts mentioned above unless the later were in poor structural condition. In the 76 years since Moore carried out this work, the ends of the heavy oak upper tie beams have deflected by approximately 19-32mm, leaving the nut displaced from the beam's upper face (**Plate 31**). Pearson's lower tie beams do not appear to have sagged.

The adaptation of Pearson's staple strap referred to above caused it to shift out of the vertical, its original position can be seen imprinted on the sides of the tie beam (**Plate 50**). In so doing it caused splitting to some of the Pearson boarding on the underside as seen in **Plate 37**.

The reason for the later introduction of mild steel support channels to Moore's cambered composite beams in the North Transept has not been established. It was obviously considered necessary to further support the beams at the point where they entered the wall masonry. From their appearance it is thought that the work is not earlier than the 1950s. Nor can it be explained why the length of the channel protruding from the face of the wall varies in such an apparently haphazard way from as short as 830mm to as long as 1550mm along the east wall of the North Transept for example.

As in the case of the nave, Moore built up his composite beams in single layers each being screwed down to the layer beneath. A large number of the screws used for the first laminate of each composite beam protrude on the underside of the boarding as is indicated on Graphic 2. Moore evidently carried out a number of repairs to boards in situ by screw re-enforcing the board edges wherever necessary including the later Pearson boards.

It also appears that in a number of cases Moore used small single laminate patches to strengthen damaged boards although these were not examined being concealed under the hessian. The positions of these are suggested by the Graphics recording the protruding screw ends. Moore also strengthened the perimeter boarding in the same way, noticeably around the heating flue pipe where it passes through the ceiling in the South Transept (but not in the North).

There are noticeably less protruding screws in the North Transept (394 compared to 594 in the South) either beneath Moore's composite beams or in board edges and random patching. This appears to relate directly to the lesser number of original boards present in the North Transept and the tendency for the Pearson boards to be thicker than the original boards which would reduce the frequency of the screw ends breaking through.

There were no screws recorded as being driven from the underside of the ceiling upwards for the South Transept but in the North Transept, single screws were placed in a number of perimeter traps and these are shown on Graphic 2.

3.3. DENDROCHRONOLOGY

3.3.1 Structure

Dendrochronological sampling was carried out in the transepts by Ian Tyers of Sheffield University but subsequent analysis has not been able to date or find a suitable chronology for the C17th tie beam and brackets in the South Transept. Neither could a date be established for the battens round the edge of the North Transept. In the South Transept the battens were dated and fell into two groups, early C13th with sapwood and some 11thC and 12thC with no sapwood. It was not able to be proved whether or not the timbers originated from the same trees.

Sampling was mainly carried out by taking sacrificial cores but for the smaller sectioned perimeter timbers, thin slices were carefully sawn from selected ends (**Plate 75**). These were later re-attached using P.V.A. glue and stainless steel pins.

The later 1880s ceiling support structure and the tie beams inserted by Pearson in the South Transept and the lesser number of identical replacement tie beams he inserted in the North Transept, have been successfully dated and sourced and this marks a "dendrochronological first" for the UK. The oak was dated 1716-1882, the latest tree ring present being 1867. the sequence matches modern data from Poland and places the timber source in the area of the Bialowieza forest in eastern Poland, an area formerly Lithuanian but at the time the timber was exported, under Russian control.

3.3.2 Boards

Dendrochronological analysis of the original, intermediate and modern (Pearson) boards was carried out in the transepts by Ian Tyers of Sheffield University by direct measurement of the ends.

Measurement of the modern (Pearson) boards was carried out in situ as board ends were accessible in the perimeter traps and in a number of diagonal panel boards which had drooped. Analysis showed that the Pearson boards used for both transepts came from the same trees, two trees being identified producing sequences of 193 and 167 years in length. These have not so far been dated.

In the case of the original and intermediate boards, the board end mitred joints were found to be so tight and the boards so thin that in situ measuring was not possible. It was therefore decided to release specific boards and directly measure the ends. Releasing and re-instatement of the boards was carried out by Hugh Harrison Conservation, the selection of the boards being made by Ian Tyers in conjunction with Hugh Harrison. A total of 39 boards were analysed, a further 4 boards in the North Transept and 7 boards in the South Transept were also released in order to access other selected boards. Some were not measured after release because they had unsuitable ring sequences or were too fragile and one board was not measured because it had an unusual paint survival.

An excellent set of results was obtained from both original and intermediate boards. In the case of the original boards, both transepts produced similar felling dates from the late 12thC to early C13th. The boards are English and probably fairly local in origin. The intermediate boards gave felling dates of late C16th to the mid to third quarter of the C17th corresponding nicely to the recorded date of 1668 on the tie beam support bracket. These boards are also English and probably sourced locally.

Extreme care was exercised in the removal of the boards. The nails, which are all C19th were removed and saved for future metallurgical analysis should it be required.

At the start of the operation it was decided that the boards would be very carefully freed from the hessian leaving the latter in position and intact (**Plates 66-67**, **69-72**). This technique was subsequently abandoned when it was realised that an unacceptable proportion of the fragile wood surface was detaching and remaining fixed to the hessian. The hessian thereafter was cut to release the boards and left on the back.

After the boards had been analysed, they were replaced using stainless steel wood screws and washers, the heads being painted in acrylic colour to match the wood (see Graphic 6). In the majority of cases this operation was relatively straight forward, but there were a number of places where the overlap between board edges was very minimal and the board edges themselves very thin. In these instances an oak strengthening batten was introduced over the hessian above the board edges which were then screwed to it. (See **Plates 73-74 and Drawing 2**).

Where the hessian had been cut, this was sealed from above using strips of sail cloth heat applied using Beva 371 wax adhesive (**Plates 73-74**).

PART 4: CONDITION SURVEY OF THE STRUCTURE

4.1 STRUCTURE

The Ceiling support structure to both transept ceilings including all earlier periods remaining is in very good order. No evidence was found of active fungal decay and insect infestation, splitting or loose joints.

There has been some minor deflection of Pearson's upper tie beams in the South Transept due to Moore's later intervention and this is described in 3.2.8 above (**Plate 31**).

Preliminary tests were made on a few randomly picked support structure fixing bolts dating from Moore's interventions. The bolts, when withdrawn, showed some minor corrosion, sufficient to warrant extracting all bolts in this category for examination and treatment in both transepts. The number of bolts scheduled for removal in the North Transept totalled 104 and in the South Transept, 54. The number of bolts scheduled for removal in the South Transept was considerably lower on account of the greater number of Pearson tie beams present where the use of bolts was minimal compared to Moore's structural system which relied heavily on their use.

The bolts removed, which were all about 500mm in length were those from which Moore's laminated beams are suspended from the softwood bearers in the South Transept and the cambered composite beams in the North Transept. Those in the South Transept were sheradized and painted in red oxide whilst galvanising protects those in the North Transept.

4.2 ORIGINAL AND INTERMEDIATE BOARDING

A board by board survey of all the re-used original and intermediate boards was carried out on both transepts and form a detailed electronic attachment to this report (on disk). The board by board survey (electronic version) refers to the panels as located on the Graphics accompanying this report, using the same panel references and board numbers. All of the original and intermediate boards for both transepts were recorded for their condition and type in accordance with the Specification. It was considered that the information of the record of the extent of infestation present at this time would be extremely useful to compare with levels of infestation that might be found in the future. Where there was no sign of infestation present on Pearson's replacement boards, the board has been generally omitted from the record. The letter "P" prefixing the observation column refers to Pearson.

In general all of the original and intermediate boards retained by Pearson are sound with little evidence of previous repair and most could be described as being in good condition. There were no loose boards that required fixing but a number of small loose fragments were secured by the painting conservators.

A number of boards exhibited signs of earlier wet rot along edges. In a few instances this extended to the complete length of the board. Some minor timber loss associated with this wet rot was noted on a number of boards.

Earlier common furniture beetle and death watch beetle attack (no longer active) was noted intermittently over many of the boards, in a number of cases extending along the board edges. Only in one or two cases of common furniture beetle attack did the flight holes and tunnelling extend over the whole board surface.

A small number of original boards exhibited heavy weathering on the face. Damage to the face of intermediate boards was confined to tearing due to planing against the grain and this occurs frequently.

Splitting of the boards both original and intermediate is a common occurrence. In a number of cases these splits extend over a considerable length of the board and in a few instances split the board in two. Most splitting is confined to board ends and is usually caused by nailing. A few boards have split due to shrinkage.

A number of board samples display surface damage by gunshot. The angle of entry shows that most shots seem to have been fired from almost directly below.

4.3 PEARSON BOARDING

A board by board survey of the C19th boarding was carried out in the North Transept but not in the South Transept and forms a detailed electronic attachment to this report (on disk). All the C19th boarding fitted by Pearson is still in very good condition and securely fixed with one or two minor exceptions referred to in Part 4 of this report.

Splitting, due to shrinkage and nailing (boards not pre-drilled) is commonplace with a number of the longer splits extending to the full length of the board.

Sporadic deathwatch beetle attack (not active), was noted over a small number of boards which was heavy in one or two places. A very few boards had some dormant common furniture beetle infestation which was not extensive and a few boards had a small amount of decay due to former wet rot particularly on edges.

A number of boards were damaged on the surface by gunshot. Angle of entry shows once again that most shots were fired from almost directly below.

4.4 FIXINGS

All boarding new and re-used was fitted or re-fixed by Pearson using new nails. These are still in excellent condition and tight and therefore do not give cause for concern.

Table of Nail Categories Marked on the Accompanying Graphics

CATEGORY	NORTH	SOUTH
Nail ends original No explanation for any of these, in particular four grouped together in Board e, M4, South Transept	4	7
Nail ends other These are mostly 1890s nails in boards edges that have either been cleated over so that the end has re-appeared below the adjacent board, or are two nails driven in opposite directions.	97	8
1890's nail heads Shows the more extensive nailing by Pearson compared with the original pattern of nailing	6,654	7,334
Wire nail heads Additional edge nailing by Moore	13	139

CATEGORY	NORTH	SOUTH
Other nail heads (other boards) Those on the South Transept are mostly associated with intermediate boards and presumably are the original fixings for those boards which were not removed by Pearson. Those on the North Transept are non-standard Pearson edge nailing.	44	66
Other nail heads (original boards) Possibly old repairs.	19	31
Original nail heads (other boards) Reused by Pearson.	0	11
Original nail heads (original boards) Nails not removed when Pearson dismantled the ceiling (see also Other nail heads, Other boards above)	0	39
Nail holes other (other boards) Mostly on other board ends occurring under beams replaced by Moore.	2,432	1,325
Nail holes original (original boards) Relates directly to the number of original boards left in each ceiling after de-nailing by Pearson.	8	347
Nail holes other (original boards) Mostly other nails removed from original board ends under original beams replaced by Moore.	108	645

PART 5: TREATMENT OF THE STRUCTURE

5.1 CEILING STRUCTURE ABOVE

No treatment was required to any of the structural timber in the roof space except for reinstatement of noggin ends removed for dendrochronological analysis (see 3.3.1. above). An initial vacuum cleaning of all exposed surfaces in the roof space (**Plate 59**) was undertaken.

As a precaution against possible movement damage, an Acro prop was temporarily inserted adjacent to each bolt to be taken out (**Plate 65**) before removal, cleaning where necessary, greasing with Castrol high temperature grease and replacing with the insertion of an inert washer made from Plastazote between the iron washers and the timber. In the North Transept, 76 bolts were removed and checked from a total of 104 identified. The remaining 28 being obstructed from above by other structural components could not be withdrawn. However all nuts were loosened and lowered sufficiently to enable Plasterzote washers to be fitted. The same operation and specification was carried out in the South Transept where all 54 bolts that had been identified were taken out and serviced, none being obstructed from above due to the structural support system being of a different design to that of the North Transept.

5.1 CEILING STRUCTURE BELOW

No treatment was required to boards of any period in either transept with the exception of some minor isolated repairs and the re-instatement of boards selected for dendrochronological analysis (see 3.3.2. above).

Small loose fragments of boarding were re-attached by the painting conservators and are discussed in item 7.4 of this report. Two larger fragments were identified in the North Transept and re-attached by Hugh Harrison Conservation using Plextol B500. and stainless steel screws and washers (**Plate 64** and **Drawing 1**, board ‘d’. panel E1 North Transept, board ‘a’ panel E0 North Transept).

Some of the boards in panel C8 in the North Transept (**Drawing 1**) were found to be loose having apparently been pushed down from above possibly by the impact of being trodden on at some point in the past. These were re-fixed using stainless steel screws and washers.

All nail heads on the underside of the boards were treated by the painting conservators using two coats of Paraloid B72 (see item 7.6). .

PART 6: TECHNICAL SURVEY: THE PAINTED DECORATION

6.1 GENERAL

The first opportunity for a detailed close inspection of the South Transept Ceiling was in June 2002 when the access scaffolding was completed. Prior to that it had been assumed that many of the smooth-faced oak ceiling boards were easily boards partially re-faced or sanded down in the 1880s, when it was thought the painted decoration on the ceiling was removed. The reason for this misinterpretation was the patchy surface discolouration on many of the newer looking boards, when viewed from a distance, simulated the weathered finish of early boards. It soon became evident that the surface discolouration was a coating arbitrarily smeared onto the machine-cut 1880s boards that were adjacent to early boards. Initially, it was thought that the tinted coating had been applied in the 1880s to feather in the transition from old to new boards. Only later did it become obvious that the coating was simply smeared residue from when dissolved paint was wiped from the early boards.

Very little paint survives on the exposed surface of thirteenth-century and seventeenth-century (intermediate) boards. On some thirteenth-century boards dark shadowing indicates a border pattern (**Plate 92**) or an inner cusped frame for a Cross (**Plate 87**). However a few tiny fragments of full-thickness paint did escape the 1880s stripping (**Plates 90, 93**). When a number of early boards were removed from the ceiling for dendrochronological dating some paint was found on the overlapped edges (**Plates 78-83**). This provided an opportunity for paint sampling; it also confirmed the boards retained in the 1880s were marginally realigned at that time; and that the decision to remove the paint scheme was made after the ceiling structure was reinstated.

The 1880s restorers did not bother to remove residual decorative paint from the retained seventeenth-century metal washers. Instead these were overpainted in black. Samples of decorative paint were obtained from one of these washers and from an area of protected ceiling board that had been protected by a washer which had subsequently dropped slightly.

6.2 SAMPLE ANALYSIS

6.2.1 Preliminary Sample Analysis

To inform the preliminary investigations and development of a treatment strategy samples of the dark residual coating and a sample of what may have been residual original ground were obtained from the South Transept Ceiling and sent to Catherine Hassall, an independent paint analysis. The letter, photographs and captions sent with the three samples are reproduced as **Appendix 3** of this document. Catherine Hassall's analysis findings are reproduced as **Appendix 4.**[10]

Treatment tests had indicated the dark residual coating[11] and the associated semi-opaque whitish layer[12] could both be removed by swabbing with industrial methylated spirits (IMS). It was necessary to investigate the nature of these materials to determine whether they were intended coatings or residue from the 1880s paint removal. Hassall found a resin content in both samples; the dark coating contained

[10] *Peterborough Cathedral, South Transept Ceiling* Report No. X442, Catherine Hassall, July 2002.
[11] Hassall, 2002: Sample 1
[12] Hassall, 2002: Sample 2

no pigment; the whitish material was on top of the dark coating and consisted of lead white, calcium carbonate and iron oxide. The materials and nature of the whitish layer suggest a residual 'mush' of paint and ground. The fact that it is over the dark coating indicates both are residues not properly cleared during paint removal.

Sample 3 was obtained from a weathered original board that appeared to have possible residue from a preparatory layer within the grain. As that initial stage no other indications of paint had been found. The sample was of lead white paint tinted with a few particles of charcoal black and iron oxide. Very similar paint is present in samples analysed subsequently and considered to be from a 1740s repaint.

6.2.2 Paint Analysis

Surviving traces of paint became evident as soot and surface dirt were removed from the Ceilings and particularly when significant areas of paint was found on the overlapped edges of boards removed from the ceiling for dendrochronological dating. Representative paint samples were obtained as treatment progressed and on completion of the work these were sent to Jane Davies for analysis. Jane Davies had carried out the paint sample analysis for Phases 3 and 4 of the Peterborough Cathedral Nave Ceiling conservation project so was able to compare samples taken from the three ceilings. This being a particularly important aspect of the analysis and its interpretation given their closely linked physical histories. The letter, photographs and captions sent with the ten paint samples to Davies are reproduced as **Appendix 5** of this document. Her report is available as a separate document.[13] The analysis results are discussed below.

6.3 THE ORIGINAL SCHEME

As explained already in item 2.2 and illustrated in **Fig.3.** in this report, no original paint has been found on the boards surviving from early thirteenth-century ceilings. Nevertheless it is evident from designs visible in shallow relief on some of these early boards and from the positioning of the parallel grooves on board edges - as on the Nave Ceiling - that the Transept Ceilings were originally decorated with a paint scheme that followed the arrangement of the Ceiling boards to form interlocking rows of diamond-shaped compartments, with alternate rows ending with half compartments. The inner boards of each compartment were decorated with a cross. Embellished, linear versions of both the Cross Fleurie and the Cross Treflée are visible in shallow relief (**Plate 14** and photographs reproduced in **Appendices 3 and 5**).

Investigations of the shallow relief phenomenon, carried out for the Nave Ceiling project, indicate it is due to the masking effect of the painted designs whereby the paint protected the underlying timber from a degrading factor such as weathering, while the surrounding, less protected timber has receded. Dr Al Brewer[14] suggests in his paper written following his site visit and inspection of the Nave Ceiling: '*I would attribute the relief of the trefoil designs to a masking effect of a painted surface. That is, the trefoils were painted, thus protecting them from a degrading factor such as weathering, while the surrounding was less protected; though not necessarily unpainted. The trefoils may simply have been painted with a more protective medium such as oil, as your research indicates, while the surrounding may have been a water-based medium, such as a distemper. The latter may have entirely disappeared.*' Apart from the linear Crosses only one other probable instance of shallow relief was found. One board on the North Transept Ceiling appears to have in shallow relief traces of a border design: what for the Nave Ceiling has been described as a bun pattern (**Plates 81, 90, 91**). This would suggest the early scheme included a series of linear border patterns within diamond-shaped compartments. In addition each compartment had an inner and outer band of four parallel lines painted in grooves (**Plates 10, 11, 87, 94, 97**). Original paint found in similar grooves on Nave Ceiling boards suggests that their function was to provide a lining-out guide for the painters. That Ceiling has an inner and outer band of three

[13] *Peterborough Cathedral, Transept Ceiling: Investigation of Painting Materials and Technique* Jane Davies Conservation, May 2003.

[14] *Observations on Wood Effects for the Nave Ceiling of Peterborough Cathedral* Dr J. A. Brewer, B.Sc., M.A.C. Ph.D, November 2000.

parallel grooves; the inner grooves painted white, red, white; the outer grooves red, white, red. The Transept Ceilings have four parallel grooves in each band but no evidence survives to indicate the paint colours involved.

6.4 SUBSEQUENT INTERVENTIONS

The technical survey of the Ceilings structure found evidence of structural interventions in the 1660s, 1820s, 1880 and 1920s. The detailed study of the ceiling boards to identify all traces of remaining paint and the findings of paint sample analysis both indicate the Ceilings were repainted twice: in the 1740s and the 1820s. The earlier date is assumed because some of the paint traces surviving on the early boards and on the metal washers appear very similar in cross section to that used for repainting the Nave ceiling at that time. The latter because there is a reference to an 1820s repaint of the Transept Ceilings in Cathedral archives (see item 6.4.2 below).

Jane Davies summarises her analysis findings as follows:

> *'Noticeable on the Transept paint samples is the apparent presence of the same coarse composite brown black paint that has been seen in previous research on the Nave ceiling paintings and attributed to the 1740s. The brown black contains characteristic carbon black particles ranging from medium to very large, with a rather angular geometry. Of course it could be the case that distinctive local carbon black supplies were used at different dates, but given the ease of preparation and ready availability of carbon black, on balance it seems more likely that the Transept ceilings were repainted at the time the Nave was treated. The range of pigments identified includes lead white, iron oxides, red lead and carbon black. With the exception of the characteristic brown black, the paint layers appear as conventional variations of off-white, beige, blacks and thin browns, with little to distinguish them. The limited evidence of the surviving paint fragments and the use of materials that were commonly available from the thirteenth to the nineteenth century, has hindered specific dating of individual paint layers. Therefore, it has been difficult as yet to confirm the presence of paint dating to the 1660 intervention. It is very tentatively suggested that the beige ground and brown paint present on samples 2 and 6 maybe indicative of an early scheme. However, there is also evidence within those samples sufficient to refute this. Enough evidence is present to suggest that it is very likely the Transept ceilings were repainted in the 1740s and that the 'composite brown black' paint is the same as that found on the Nave ceiling. As some of the Transept boards were replaced in the 1660s it is considered likely the ceilings were painted then as well. Documentary evidence suggests they were also repainted in the 1830s.*

6.4.1 Mid-Eighteenth Century (1740s?) Repaint

As Davies relates, some of the paint traces surviving on early boards and seventeenth-century metal washers appear very similar in cross section to that used for repainting the Nave ceiling in the 1740s. It may be the Transept ceilings repaint coincided with the 1761 structural repairs; although it is unlikely the paint and technique would be so similar unless the same restorers were involved. The essentially linear early painted design on the Nave Ceiling was transformed into the much bolder present scheme by the 1740s restoration. From the limited evidence available it would appear the same thing happened on the Transept Ceilings.

The Cross Fleurie or Cross Treflée design at the centre of each lozenge was inpainted. The grooving in the boards was ignored and the four-parallel-line inner and outer borders replaced by a number of different border patterns. The evidence of paint shadows, the paint found on overlapped edges of boards removed for dendrochronological dating, and the pre-1880s photograph (reproduced as **Fig. 4**) all indicate the border patterns were variations based on dogtooth and bun patterns and that the light/dark sequencing varied within different lozenges. This is illustrated in **Fig. 5** below.

Figure 5. R*econstruction showing some of the probable 1740s lozenge designs. Traces only white, off-white, black and brown/black paint were found on the Transept Ceilings. Evidence from the Nave ceiling suggests red, at least, would also have been used in the 1740s scheme.*

Of the 368 original boards remaining in the South Transept Ceiling 160 of them have an indication of a painted design remaining as a dark 'shadow' on the surface. However only on three of these boards were there actual paint fragments (see example in **Plate 93**). A sample of that paint indicated it was the same brown/black previously identified on paint samples from the Nave ceiling and that it was applied directly to the timber surface; there was no white lead ground layer.[15] This accords with the 1740s Nave ceiling repaint where for the lozenge border patterns white lead underpaint was found only along the edges. Obviously the painters avoided using any more paint than necessary by painting the white background first and in so doing only marginally overlapping the pattern. Thus the black patterning was largely applied to bare timber. The other probable 1740s black paint samples from the Transepts have a white lead ground but these were obtained from the pattern edges. The dark shadowing is therefore likely to result from the 1740s repaint, particularly as the thirteenth century decoration is thought to be linear in design. No dark shadowing was found on the 1660s intermediate boards; however those boards have smooth un-weathered surfaces making it easier to remove all traces of overlying paint in the 1880s.

The North Transept Ceiling has 68 original boards but only 8 of them have similar dark shadowing on the surface and one has a fragment of 1740s paint.

6.4.2 1820s Repaint

In papers from the Cathedral archives, now held at the Northampton Records Office, Don Mackreth, the Cathedral archaeologist, has found two vouchers (receipts) relating to the repainting of the Transept Ceilings between 1826 and 1829.[16] Mackreth notes:

- Bundle 4 (1826-1827)
  i. Charles Layton, 30-4-1825 to 22-5-1825, painting at the Cathedral ceiling [S Transept], only 4lbs of white paint mentioned, total paint used 98 ¾ lbs. £7.5/2, Receipt 11-7-1826.

- Bundle 5 (1828-1829)
  vii. Charles Layton, 20-6-1827 to 10-10-1827, painted boards behind picture in Morning Prayer Chapel; Ceiling painting [N Transept] paint 7 ½ lbs [unspecified colour unless to be included with next], 11lbs white, 8 ½ lbs umber, 5 ½ d°, 16 ½ lbs [no colour], 19 lbs d°, 7 lbs d°. 21 lbs d°, 2 ¾ lbs umber, 27 ½ lbs white, 7 lbs umber, 13 ¾ lbs white, 8 ½ lbs white. 4 lbs umber, 10 lbs white, 5 ½ lbs umber, 2 ½ lbs umber, 7 ½ lbs [no colour], 3 ½ lbs umber; 2 monuments cleaned and relettered 75 doz. at -/6; stone colour for spouts to match wall, 8 ½ lbs, d° 3 ½ lbs. £15.15/6 ¾, Receipt 9-7-1828.

These vouchers indicate the repainting of the South Transept Ceiling was completed approximately two years before the North Transept. They also suggest that the main colours used were white and umber. No 1840s paint has been positively identified in the samples obtained from the Transept Ceilings; although this is not particularly surprising given what little paint survives. Charles Layton was also responsible for the repainting the Nave ceiling in 1835.[17] It has been established that Layton made no significant alterations to the 1740s Nave ceiling scheme but simply repainted many elements. It is likely his intervention in the Transepts was similar.

6.4.3 1880s Intervention

Following the major structural works to the Crossing tower and Transepts only 368 original boards and 56 intermediate (1660s) boards remained on the south ceiling and a mere 68 original and 0 intermediate boards on the north. In 1887 estimates were sought from a Peterborough firm for '*painting Transept ceiling to correspond with the old Transept, £52.-/- for N Transept, £45.-/- for S Transept.*'[18] Clearly a decision was taken not to redecorate but instead to strip all remaining paint from the retained boarding leaving a natural oak finish. Paint remaining on the overlapped edges of boards and the smeared residue

[15] Davies, 2003: Sample 5
[16] NRO: Peterborough Cathedral Dean & Chapter Vouchers, Box 5052, Bundles 4 and 5.
[17] NRO: Peterborough Cathedral Dean & Chapter Vouchers, Box 5053, Bundle2.
[18] NRO: Peterborough Cathedral Dean & Chapter Vouchers, Box X 5097, PDC RP 42.

on some 1880s boards are evidence that the paint was removed after the structural work was complete. It is not known what paint stripping method was used but the smeared residue would suggest the process was solvent-based.

6.5 CONDITION SURVEY

Since very little paint has survived on the Transept ceilings, the condition of the painted decoration formed only a minor part of the condition recording process. Apart from the paint discovered on the overlapped edges of original and intermediate boards removed for dendrochronological dating, fragments of paint were found on only four boards across the two ceilings. Nevertheless, a great deal of related information was photographed and recorded graphically on photogrammetric drawings of the ceiling boards. Analysis of that information together with the findings of paint sample analysis and the research of archive documents has culminated in the detailed descriptions of the ceilings and their physical history contained in this document.

Structural aspects of the ceilings that have been recorded on the graphics such as nails, screws, ceiling bolts are discussed by Hugh Harrison earlier in this report. This section defines the categories of damage, surface accretions and other phenomena that were recorded and presented in graphic form in Part 10 of this document.

6.5.1 Categories of Ceiling Board (All Graphics)

Original standard boards – thirteenth-century	(S Transept = 243 N Transept = 42)
Original grooved boards – thirteenth-century	(S Transept = 105 N Transept = 25)
Original, cross grained boards - thirteenth-century	(S Transept = 20 N Transept = 1)
Intermediate boards – 1660s	(S Transept = 56 N Transept = 0)
Pearson boards – 1880s	(S Transept = 914 N Transept = 1,467)

6.5.2 Original Paint Scheme (shallow relief) (Graphic 4)

Designs visible in shallow relief on some of the early boards - particularly the cross motifs at the centre of lozenge compartments – and the parallel grooves on some original board edges are the only indications remaining of the thirteenth-century scheme. The shallow relief is thought to be due to the masking effect of the painted designs whereby the paint protected the underlying timber from a degrading factor such as weathering, while the surrounding, less protected timber has receded. The grooves were created to provide a lining-out guide for the early painters.

6.5.3 Surviving Paint (Graphic 4)

Fragments of paint were found on only four boards across the two ceilings. The three instances in the South Transept were apparently brown/black 1740s paint from dogtooth boarder patterns. In the North Transept 1740s paint fragments were found on apparent original, linear bun pattern decoration. All the surviving paint was stable.

6.5.4 Paint Shadow (1740s) (Graphic 4)

Dark shadowing indicating the 1740s paint scheme was recorded on 160 original S Transept boards and 8 original N Transept boards.

6.5.5 Graffiti (Graphic 4)

Relatively few instances of graffiti were found on the ceilings and these are listed below. The *HS Burleigh* signatures (ST Nos. 4 and 5) are in the south-west corner adjacent to the boiler flue (**Plate 95**).

Panel #	Identification # on Graphic	GRAFFITI TEXT
NT A7	1	Pencilled '*1ĥ*'
NT H8	2	White chalk '*80*'
NT J8	3	Pencilled '*Sam Buxton, July 7th 1888*'
NT J8	4	Pencilled unidentified signature
NT J9	5	Pencilled '*John ------*' (surname indistinct)
ST B8	1	Numbers in pencil
ST B9	2	Numbers in pencil
ST F3	3	indecipherable pencil marks
ST F9	4	Pencilled 'X and #' marks
ST N0	5	Pencilled signature '*HS Burleigh, Aug 21, 1924'*
ST N0	6	Pencilled signature '*HS Burleigh Whitesmith, Oct 26, 1911'*

6.5.6 Pencil and Incision Lines (Graphic 4)

These marks appear to date from the 1880s intervention. Most are simple lines or Xs probably drawn to indicate the position of structural elements above the boards.

6.5.7 Surface Glue (Graphic 5)

Liquid glue used in the 1920s as an adhesive for the hessian backing material had in many places on both ceilings penetrated between the boards and through empty nail holes. The glue and formed thick dark globules as it dried on the timber surface. These were particularly noticeable and distracting after the thick accretions of soot and dirt had been cleaned from the boards (see **Plates 14, 106, 107**). There are 2,902 and 3,793 glue deposits marked on the S and N Transept graphics respectively.

6.5.8 Surface Stains (not marked on graphics)

Having removed the thick layer of soot and surface dirt from the ceiling boards significant and widespread areas of different degrees of surface staining were noticeable on both ceilings. This had been hand plotted on the ceiling graphics under the overall category of Surface Stains. All the stains on resulted from liquid material penetrating down between the boards or through cracks in deteriorated boards. The treatment and recording of such stains were not included in the tender documentation. Treatment tests established that the most distracting darker stains could be removed relatively easily by swabbing with deionised water. However the time required to distinguish between the different types of stain and to record the treated stains graphically was not sustainable within the contract price. In consultation with the architect and consultant conservator it was decided that the hand plotted surface stains information would not be re-plotted digitally and the treated stains would not even be hand plotted. Any time available should be spent treating the most distracting stains.

6.5.9 Surface Splinters (Graphic 5)

Screws were inserted from above during Moore's 1920s restoration, and when they emerged through the underside of the ceiling boards, some splintered the surface. All instances of such splintering were recorded. Very few of these splinters were unstable and required treatment.

6.5.10 Splits in Ceiling Boards (Graphic 5)

Splitting of the boards both original and intermediate is a common occurrence. In a number of cases these splits extend over a considerable length of the board and in a few instances split the board in two. Most splitting is confined to board ends and is usually caused by nailing. A few boards have split due to shrinkage.

6.5.11 Wood Loss (Graphic 5)

Original Boards – Most wood losses can be attributed to acute infestation that has so weakened the timber that it has freckled away, or detached by contact or rough handling during previous restorations. The most common loss is that seen along board edges**.** Other losses have occurred when boards were cut back and moved around when the replacement boards were inserted. On the S Transept Ceiling 215 instances of wood loss were recorded on original boards. On the N Transept Ceiling, because there are so few originals, only 35 wood losses are recorded.

Replacement Boards – Most of the losses recorded on these boards occurred when fixings were removed and laminated joists were inserted above during the 1920 intervention. On the S Transept Ceiling 101 instances of wood loss were recorded on replacement boards; on the N Transept Ceiling 111.

PART 7: TREATMENT: THE PAINTED DECORATION & CEILING BOARDS

7.1 SURFACE CLEANING (Plates 97-105) (Graphic 6)

Although there was very little paint remaining on the ceiling boards he guidelines recommended by Howard for Wishab sponge[19] use on the Nave Ceiling were followed throughout[20]. Loose surface dust particles were brushed from the surface, using small and very soft brushes; the dust sucked into a vacuum cleaner nozzle held close by. Small, shaped pieces of the Wishab sponge were applied to the board surface with gentle circular strokes; with constant attention to guard against surface shine. Tests had shown that the 1880s boards particularly were prone to shine unless the guidelines were followed. The particles of Wishab remaining on the surface were removed with a soft brush. This method achieved a satisfactory and uniform level of clean.

Analysis if the dark residual coating and the associated semi-opaque whitish layer that had been smeared over 1880s boards adjacent to original boards established that they were simply residues not properly cleared during paint removal during the 1880s. Limited test were carried out to determine whether it will be possible or desirable to remove this residue. The coating was not affected by water or white spirit but could be removed by swabbing with Industrial methylated spirits and/or acetone: this resulted in a slight lightening in the colour of the underlying wood surface (see **Plate 98**).. Although it would not have been technically difficult to remove the coating from the 1890s boards it would have more than doubled the time involved and therefore the cost of the surface cleaning process. For this reason in consultation with the architect and consultant conservator it was agreed the residual coating should be left in place.

7.2 GLUE REMOVAL (Plates 106-107) (Graphic 6)

All glue drips were removed by swabbing with warm water. Care was taken to minimise the area of ceiling board in contact with water as it caused some lightening of the wood surface. In some instances it was necessary to tone down with water-colour paints the slightly 'blanched' or 'cleaner' areas of timber resulting from glue removal.

7.3 REMOVAL OF SURFACE STAINS (Plate 99)

Treatment tests established that the most distracting darker stains could be removed relatively easily by swabbing with deionised water. Although stain removal did not form part of the tender specification it

[19] Wishab™ sponges are cakes of self-abrading synthetic rubber granules.
[20] *Peterborough Cathedral Nave Ceiling - Tests to determine the effects of surface cleaning with Wishab* Helen Howard, unpublished notes, 1998.

was agreed that the most distracting stains would be removed/reduced within the time available. Only the stains that could be removed/reduced using water were treated. For the reasons discussed in item 6.5.8 above this treatment was not recorded on graphics.

7.4 CONSOLIDATION OF SURFACE SPLINTERS AND SPLITS (Graphic 6)

Where possible splinters of wood that had been displaced by protruding screw ends were repositioned and adhered with a solution of Plextol B500[21] (diluted 1:1). 12 splinters were thus stabilised on the N Transept Ceiling; 3 on the S Transept.

There was only one instance where it was considered necessary to stabilise a split. The was on the N Transept Ceiling where a large sliver of wood had lifted away from the board edge and was loose. This was injected with Plextol B500 by hypodermic syringe and a press was applied overnight to ensure a firm bond while the adhesive cured.

7.5 CONSOLIDATION OF WOOD LOSS (Graphic 6)

To prevent further wood loss from small areas of boarding that were unstable due to decay or infestation, exposed wood was consolidated with infusions of Paraloid B72[22] (10% in acetone). N Transept 13 areas consolidated; S Transept 3 areas.

In some instances, as an added precaution against loss of wood, a filler was inserted following consolidation treatment to secure vulnerable edges. All wood loss fills are identified in Graphic 6. The filler consisted of: 1 part Polyfilla, 1.5 parts fine oak dust, 1.5 parts Plextol B500 (10% solution). The filler was applied in thin coats (up to ca. 5 mm) to avoid cracking, gradually building up deeper losses. N Transept 12 fills inserted ; S Transept 1 fill inserted. On drying the filler was toned down with water colour to match the surrounding wood.

7.6 SURFACE COATING (Plates 41, 43, 44, 108)

Following the removal of loose rust particles a single coating of 10% B72 in acetone was applied as an isolation layer to all corroded metal exposed as a result of paint loss from metal fixings. No surface coating was applied to the ceiling boards.

7.7 REINTEGRATION

The 'blanched' or 'cleaner' areas of boarding resulting from glue or stain removal were toned down with water-colour paints to match the surrounding Wishab cleaned surfaces. Fills inserted to wood loss were similarly treated.

All visible stainless steel fixings inserted by Hugh Harrison's team to stabilise loose boards and to re-position boards that had been removed for dendrochronological dating were painted in neutral colours using acrylic-based paints.

[21] Plextol B500 is an aqueous dispersion of a thermoplastic acrylic resin. A product of Röhm.
[22] Paraloid B72 is an ethyl methacrylate co-polymer. A product of Röhm Hass.

PART 8: TREATMENT: THE UPPER WALLS

8.1 GENERAL

Only the vacuuming of the upper wall of both Transepts was specified in the contract. The other works were agreed as additional. No allowance was made for documenting the following treatment on graphics and therefore no graphics of the upper walls are presented with this report. Nevertheless, there are hand plotted graphic records of these interventions which will be stored with all the other source material for this project.

8.2 VACUUMING UPPER 2M OF WALLS (Plates 120-124)

Soot and surface dirt deposits were removed from all wall areas accessible from the two scaffolds by vacuuming using a soft brush so as not to damage any of the stonework or pointing.

8.3 MORTAR REPAIRS (Plates 111-118)

Periodic water ingress has resulted in considerable areas of deteriorated pointing mortar within the upper walls of both transepts. Much of the damage was only to the surface skin of the pointing and in that case vacuuming alone was. As an addition to the specified work it was agreed that all open joints should be filled and that joints where the existing mortar has lost coherence should be raked out and filled. All mortar repairs were made with an appropriate washed sharp sand/slaked lime mortar (3:1 mix) and toned down with powder pigment washes to match the surroundings.

8.4 GLUE REMOVAL (Plates 127-128)

Animal glue used to adhere the hessian backing to the ceiling boards during the 1920s intervention had in places dribbled down the upper walls. The dark glue drips were particularly visible after the walls had been vacuumed. As an addition to the specified work it was agreed the glue should be removed from the upper walls by swabbing with warm water.

8.5 WATER STAINS (Plates 125-126)

There were water stains all around the walls of both transepts but it was agreed that only larger areas of dark staining, more like thick ingrained dirt, should be cleaned. This was achieved by swabbing with warm water.

PART 9: REFERENCES

9.1 ARTICLES AND BOOKS

Leslie T. Moore ARIBA (11 Feb. 1925)	Peterborough Cathedral Roof and its Repair: The Architects Journal
Leslie T. Moore ARIBA, (21 Nov.1923)	Peterborough Cathedral Roof and its Repair: The Architects Journal Vol: 58 No.1507.
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Symon Gunton (1686)	The History of the Church of Peterborough
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Dean (1984)	Architecture at Peterborough in the 13th Century: J. Brit Archaeology Association 137, 114-129.
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9.2 UNPUBLISHED REPORTS

The Perry Lithgow Partnership and Hugh Harrison (1998-2001)	Peterborough Cathedral: The Nave Ceiling, Phase 1 to 4: Condition Surveys and Conservation Treatment Records Vols. I, II & III
Catherine Hassall (July 2002)	Peterborough Cathedral, South Transept Ceiling Report No. X442
Jane Davies Conservation (May 2003)	Peterborough Cathedral, Transept Ceiling: Investigation of Painting Materials and Technique
Helen Howard (1998).	Peterborough Cathedral Nave Ceiling - Tests to determine the effects of surface cleaning with Wishab
Dr Ian Tyers (Sept. 2002)	Interim Statement on Peterborough Transept Boards
C Groves (March 2000).	Tree-Ring Analysis of Timbers from Peterborough Cathedral, Peterborough, Cambridgeshire: Boards from the Painted Nave Ceiling - Phase 2
Dr J. A. Brewer (November	Observations on Wood Effects for the Nave Ceiling of

2000)	Peterborough Cathedral
Dr B Gilmour (2001)	Nails from the wood panelled nave Ceiling of Peterborough Cathedral. Technological investigation of nails from Bays 5 and 6
Tobit Curteis Associates (July 2001)	Peterborough Cathedral: Environmental Monitoring of the Nave Ceiling – June 2000 – May 2001
Jane Davies Conservation (October 2001)	Peterborough Cathedral, Nave Ceiling: Phase 3 Investigation of Painting Material and Techniques
Jane Davies Conservation (May 2002	Peterborough Cathedral, Nave Ceiling: Investigation of Painting Material and Techniques, Conservation Phase 4, Bays 9-17

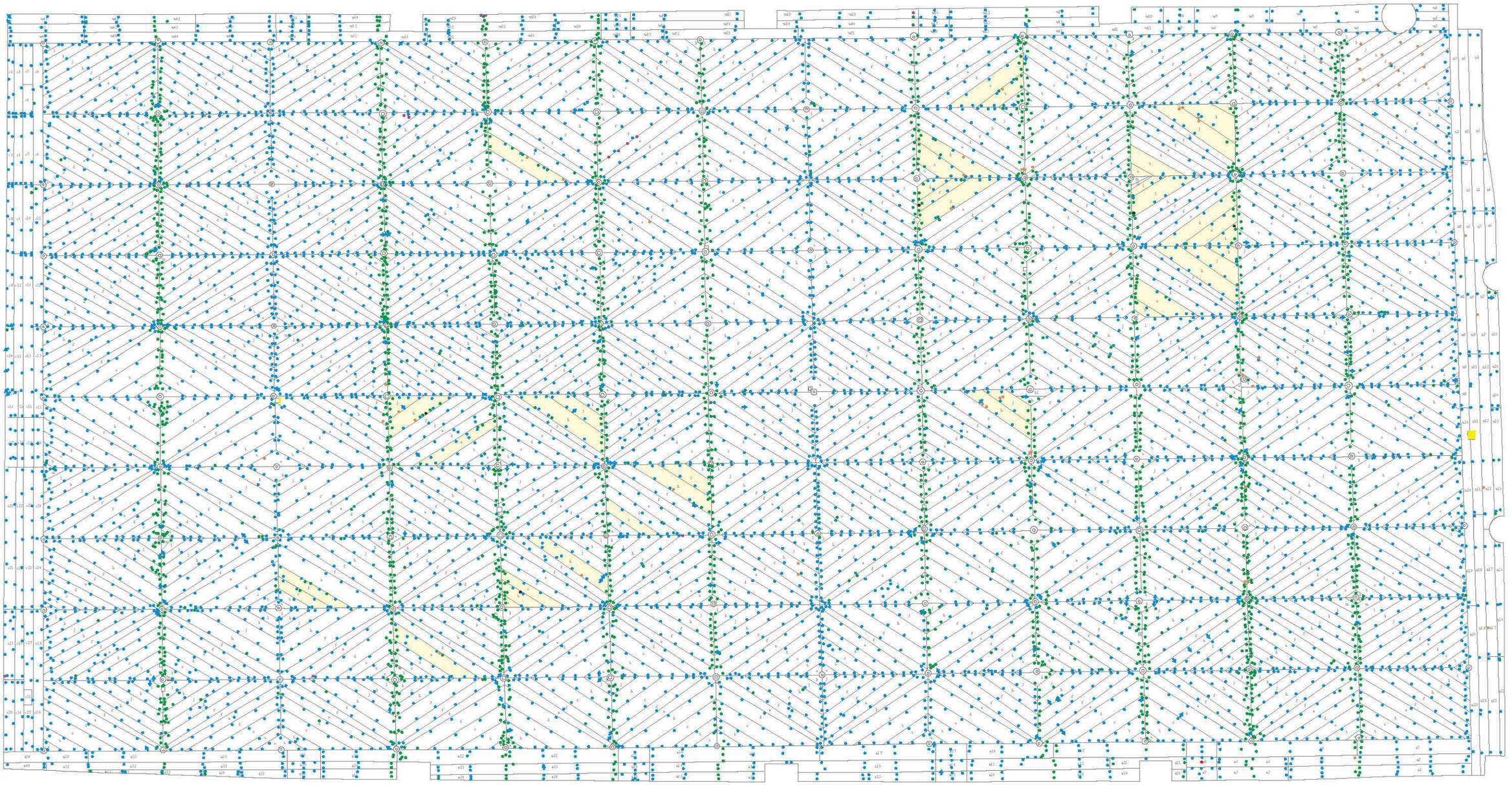
PART 10: CONDITION AND TREATMENT GRAPHIC RECORD

The following **Graphics 1 (NT & ST) – 6 (NT & ST)** constitute detailed condition and treatment records of the Ceiling structures and painted decoration.

WEST

N M L K J H G F E D C B A

0 1 2 3 4 5 6 7 8 9



EAST

PATTERN OF NAILING

Original Nail Heads
Other nail heads
1890s nail heads
Wire nail heads
Nail holes (ex original nail heads)
Nail holes (ex other nail heads)

Original boards
1660s replacement boards
Timber inserts

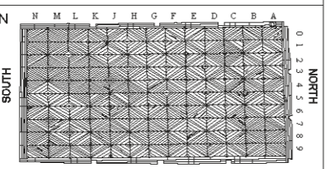
Edges of ceiling boards

N

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



GRAPHIC: 1 (NT)

TITLE: PATTERN OF NAILING

PROJECT: PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA: NORTH TRANSEPT CEILING

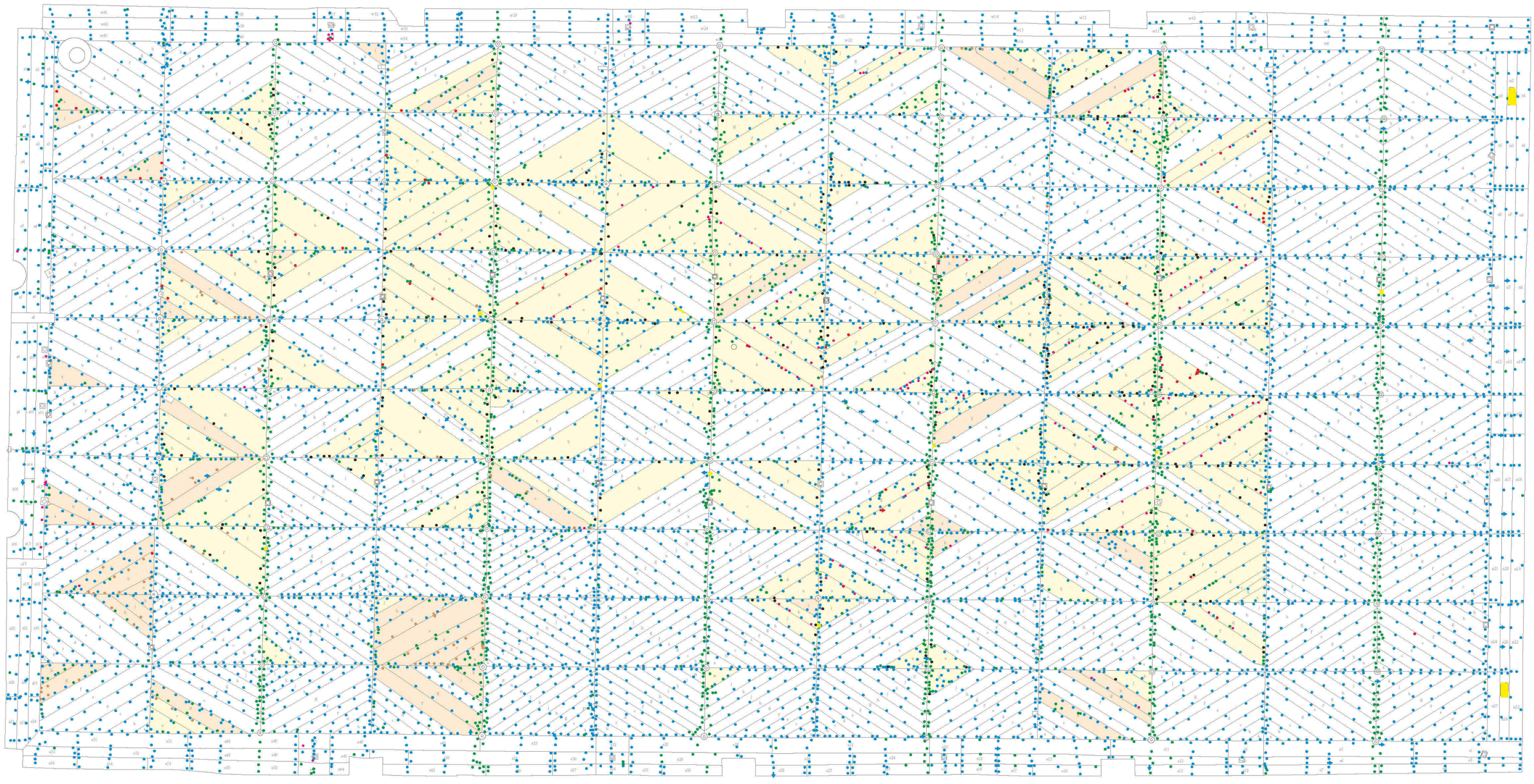
0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

WEST

N M L K J H G F E D C B A

0 1 2 3 4 5 6 7 8 9



EAST

PATTERN OF NAILING

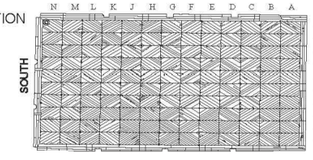
- Original Nail Heads
- Other nail heads
- 1890s nail heads
- Wire nail heads
- Nail holes (ex original nail heads)
- Nail holes (ex other nail heads)

- Original boards
- 1660s replacement boards
- Timber inserts
- Edges of ceiling boards

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



GRAPHIC: 1 (ST)

TITLE: PATTERN OF NAILING

PROJECT: PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA: SOUTH TRANSEPT CEILING

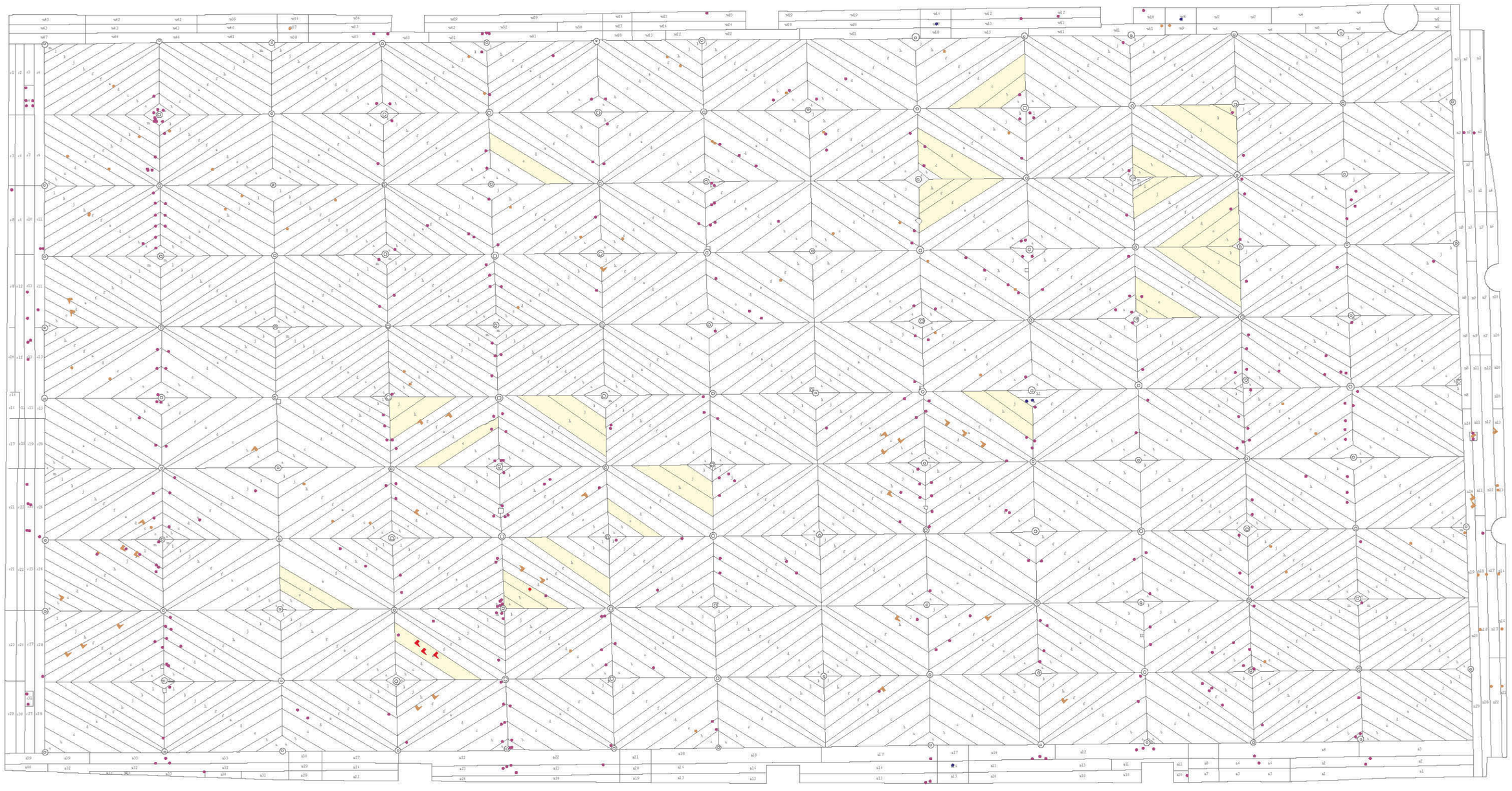
0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

WEST

N M L K J H G F E D C B A

0 1 2 3 4 5 6 7 8 9



EAST

ADDITIONAL METAL FIXINGS

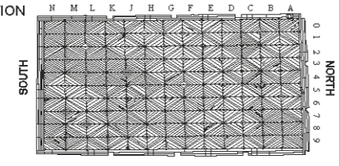
Screw heads
Screw ends
Original nail ends
Other nail ends
Ceiling bolts
Staple straps
Original boards
1660s replacement boards
Edges of ceiling boards

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

POSITION



GRAPHIC: 2 (NT)

TITLE
ADDITIONAL METAL FIXINGS

PROJECT
PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

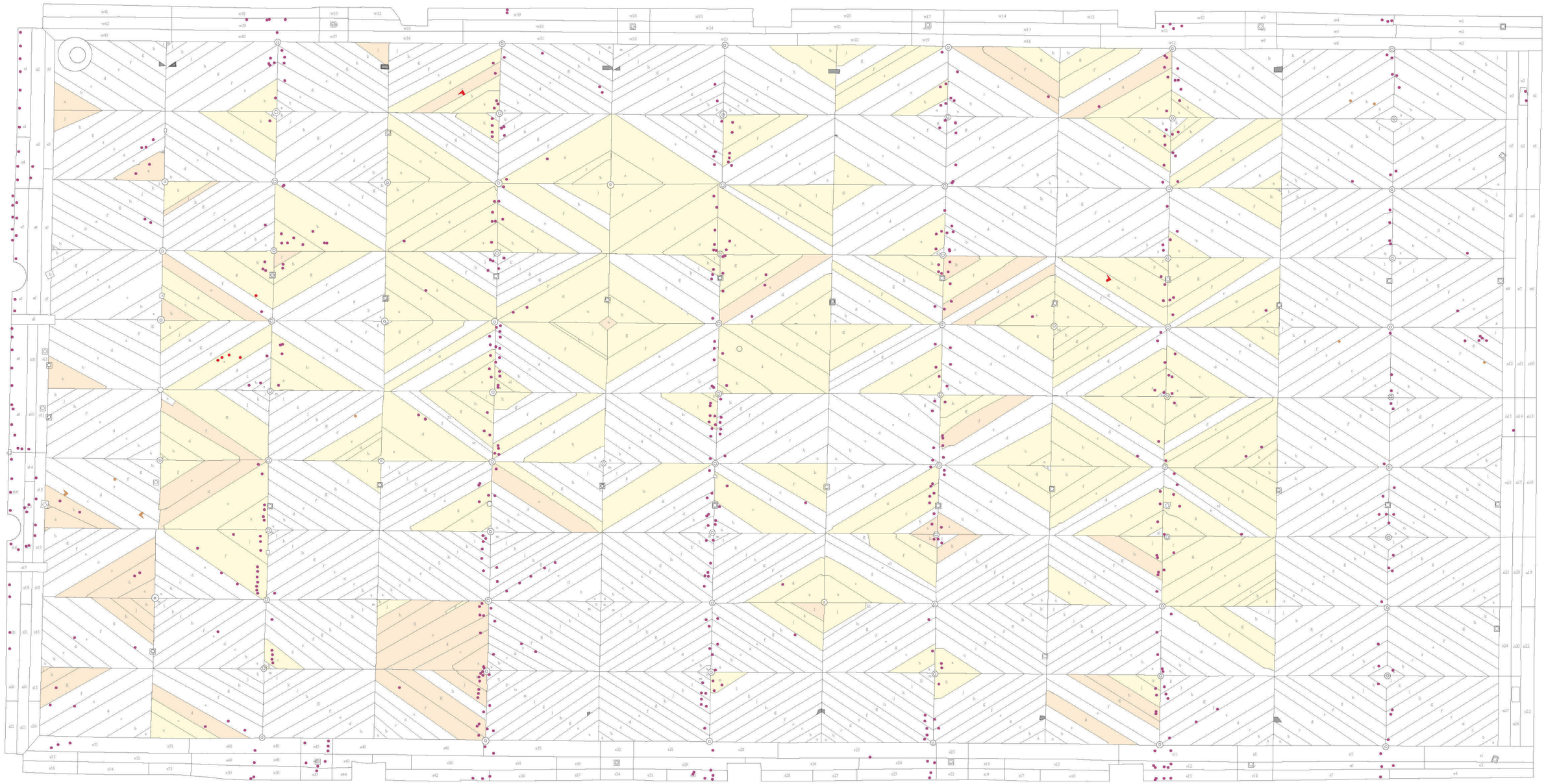
AREA
NORTH TRANSEPT
CEILING

0 1m 2m 3m 4m

WEST

N M L K J H G F E D C B A

0 1 2 3 4 5 6 7 8 9



EAST

ADDITIONAL METAL FIXINGS

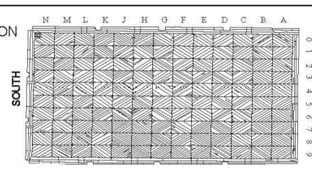
Screw heads
Screw ends
Original nail ends
Other nail ends
Ceiling bolts
Staple straps
Original boards
1660s replacement boards
Edges of ceiling boards

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

POSITION



GRAPHIC: 2 (ST)

TITLE ADDITIONAL METAL FIXINGS

PROJECT PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

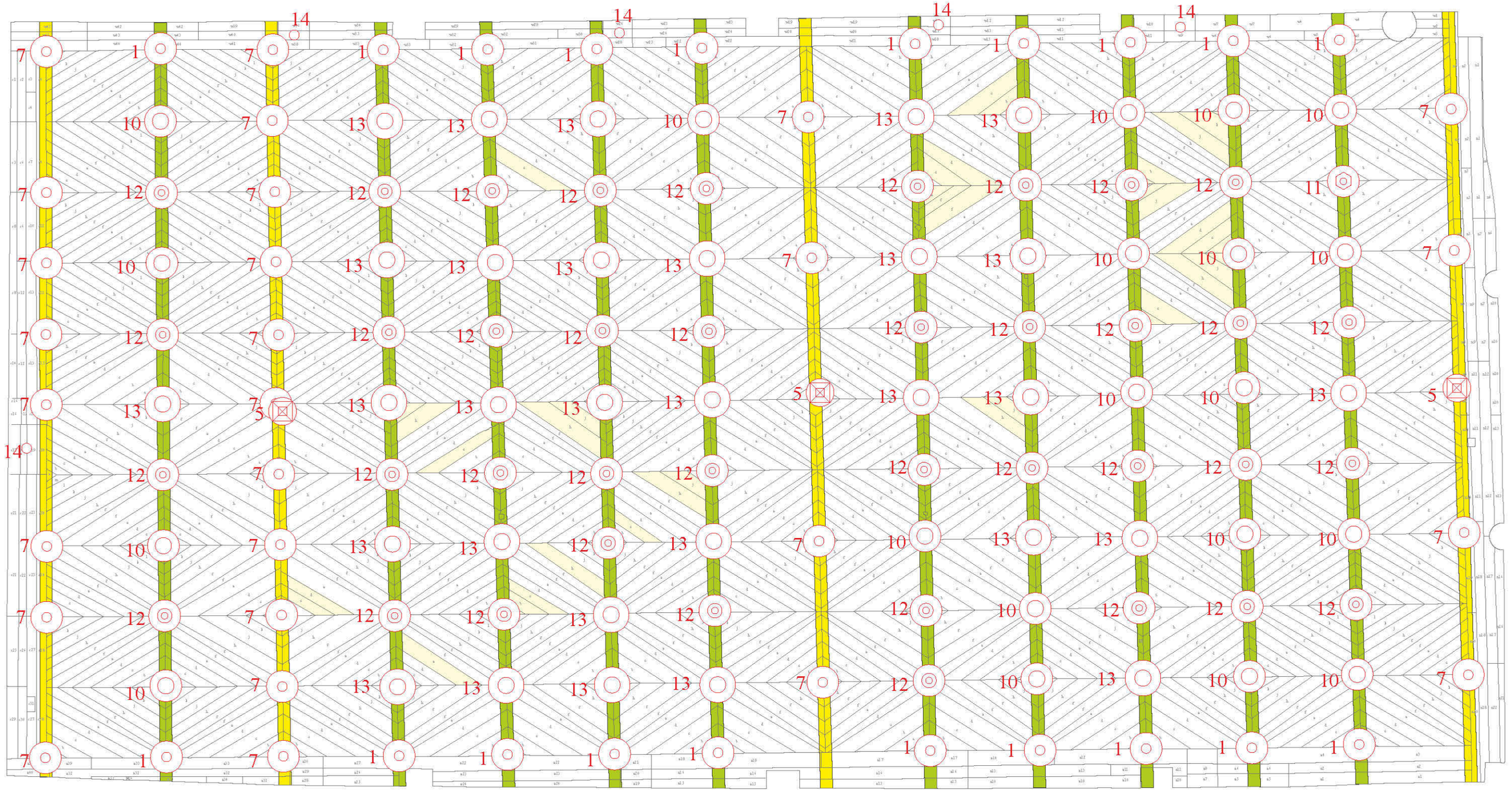
AREA SOUTH TRANSEPT CEILING

0 1m 2m 3m 4m

WEST

N M L K J H G F E D C B A

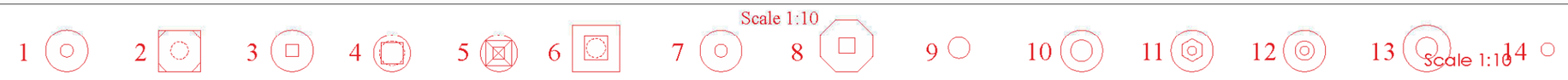
0 1 2 3 4 5 6 7 8 9



EAST

SCHEDULE OF BOLT TYPES

Categories of bolts as in **Drawing 11** 'Schedule of bolt types'



Scale 1:10

Scale 1:10

CEILING BOLT CATEGORIES

1666s joist and bracket

Pearson (1880s) joists

Moore (1920s) joists

Original boards

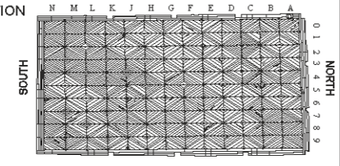
1660s replacement boards

Edges of ceiling boards

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



GRAPHIC: 3 (NT)

TITLE: CEILING BOLT CATEGORIES

PROJECT: PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

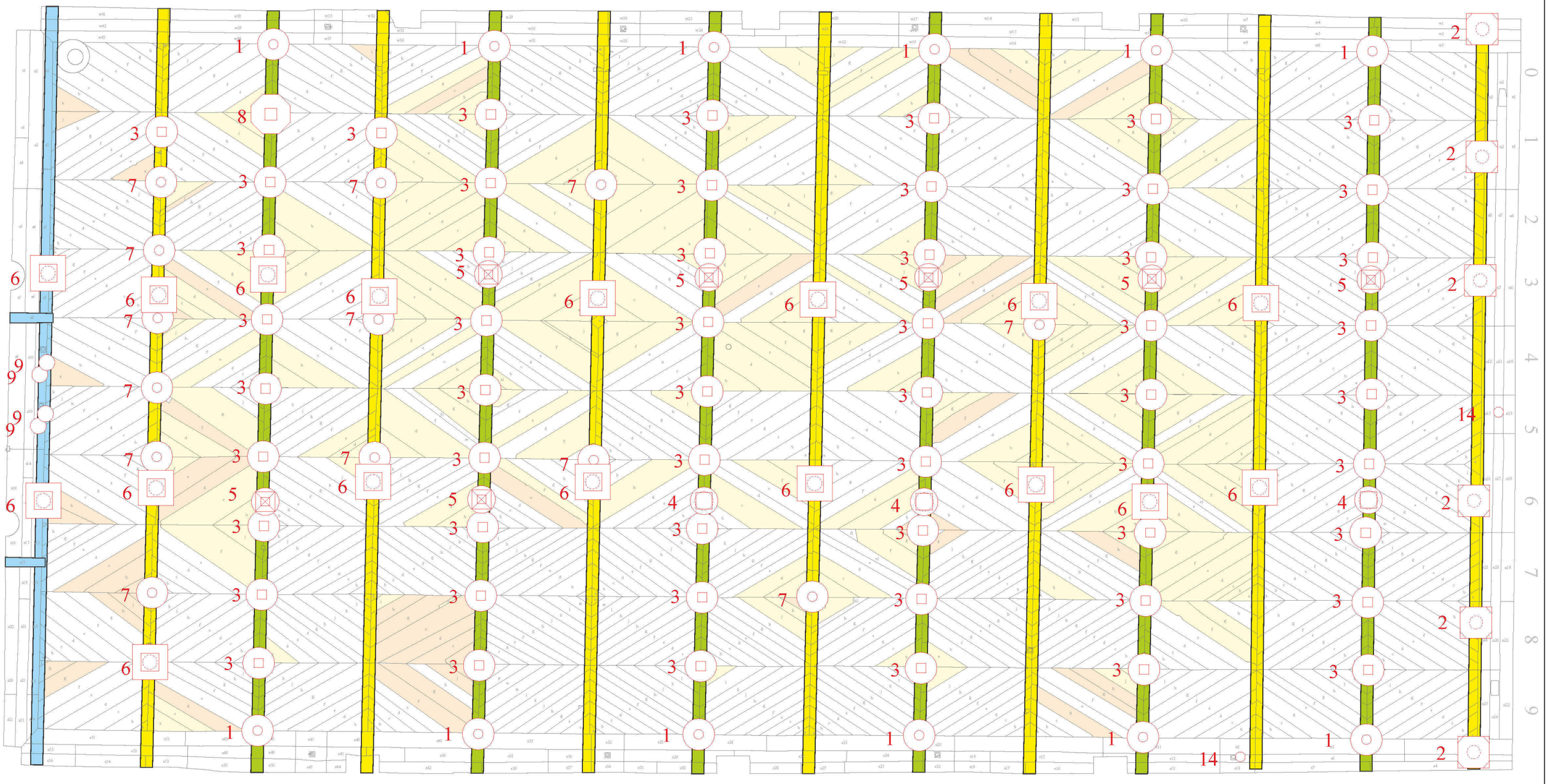
AREA: NORTH TRANSEPT CEILING

0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

WEST

N M L K J H G F E D C B A



EAST

SCHEDULE OF BOLT TYPES

Categories of bolts as in **Drawing 11** 'Schedule of bolt types'

Scale 1:10

CEILING BOLT CATEGORIES

1666s joist and bracket

Pearson (1880s) joists

Moore (1920s) joists

Original boards

1660s replacement boards

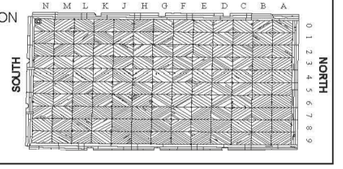
Edges of ceiling boards

N

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



GRAPHIC: 3 (ST)

TITLE: CEILING BOLT CATEGORIES

PROJECT: PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

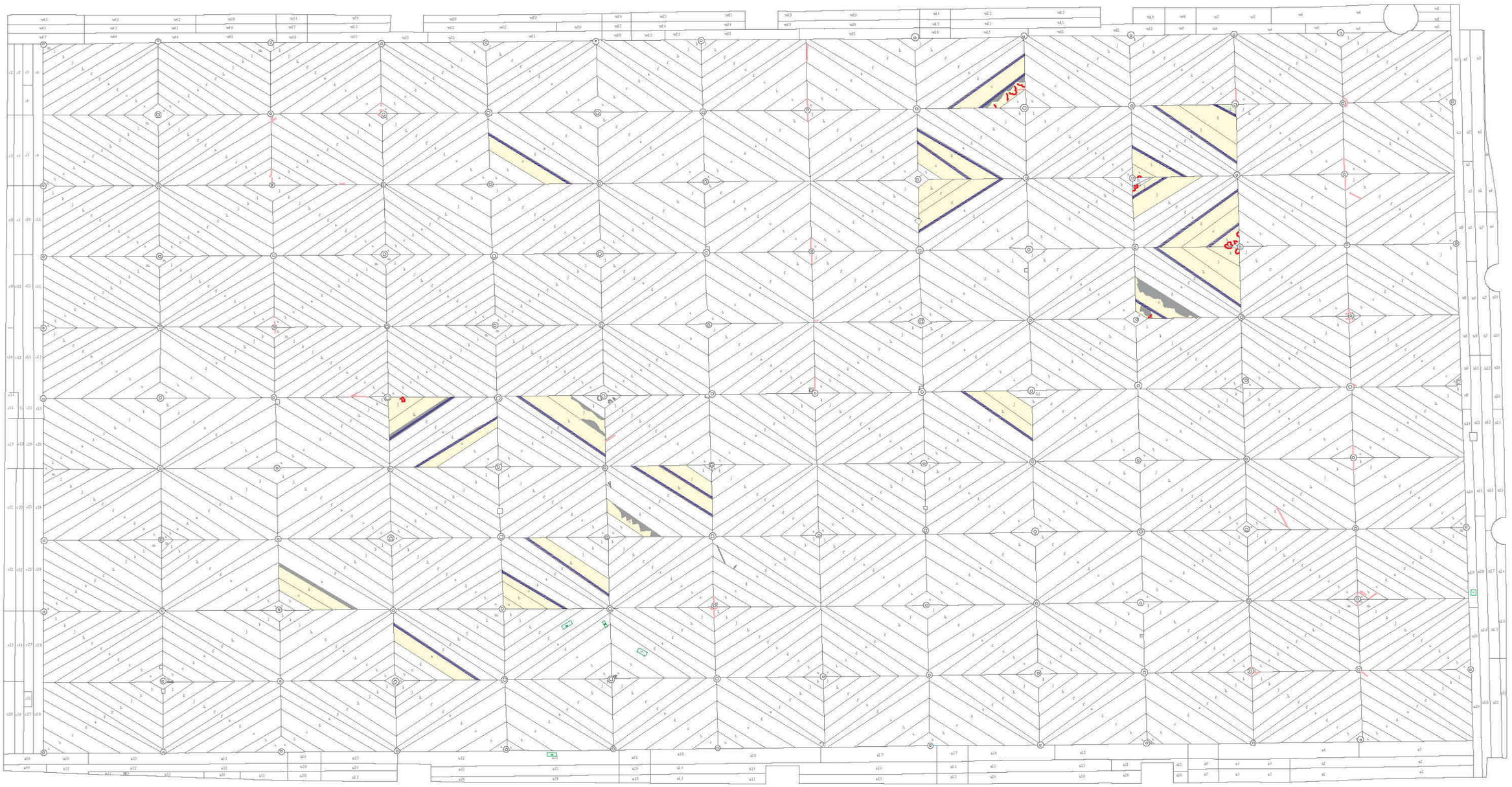
AREA: SOUTH TRANSEPT CEILING

0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

WEST

N M L K J H G F E D C B A



0 1 2 3 4 5 6 7 8 9

EAST

EVIDENCE OF PAINT & GRAFFITI

Grooves

Shallow relief (original paint scheme)

1740s paint shadow

Surviving paint

Graffiti

Pencil lines

Incision lines

Original boards

Cross-grain original boards

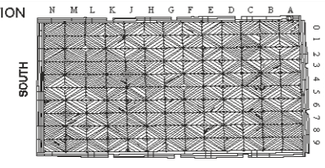
1660s replacement boards

Edges of ceiling boards

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



GRAPHIC: 4 (NT)

TITLE: EVIDENCE OF PAINT AND GRAFFITI

PROJECT: PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

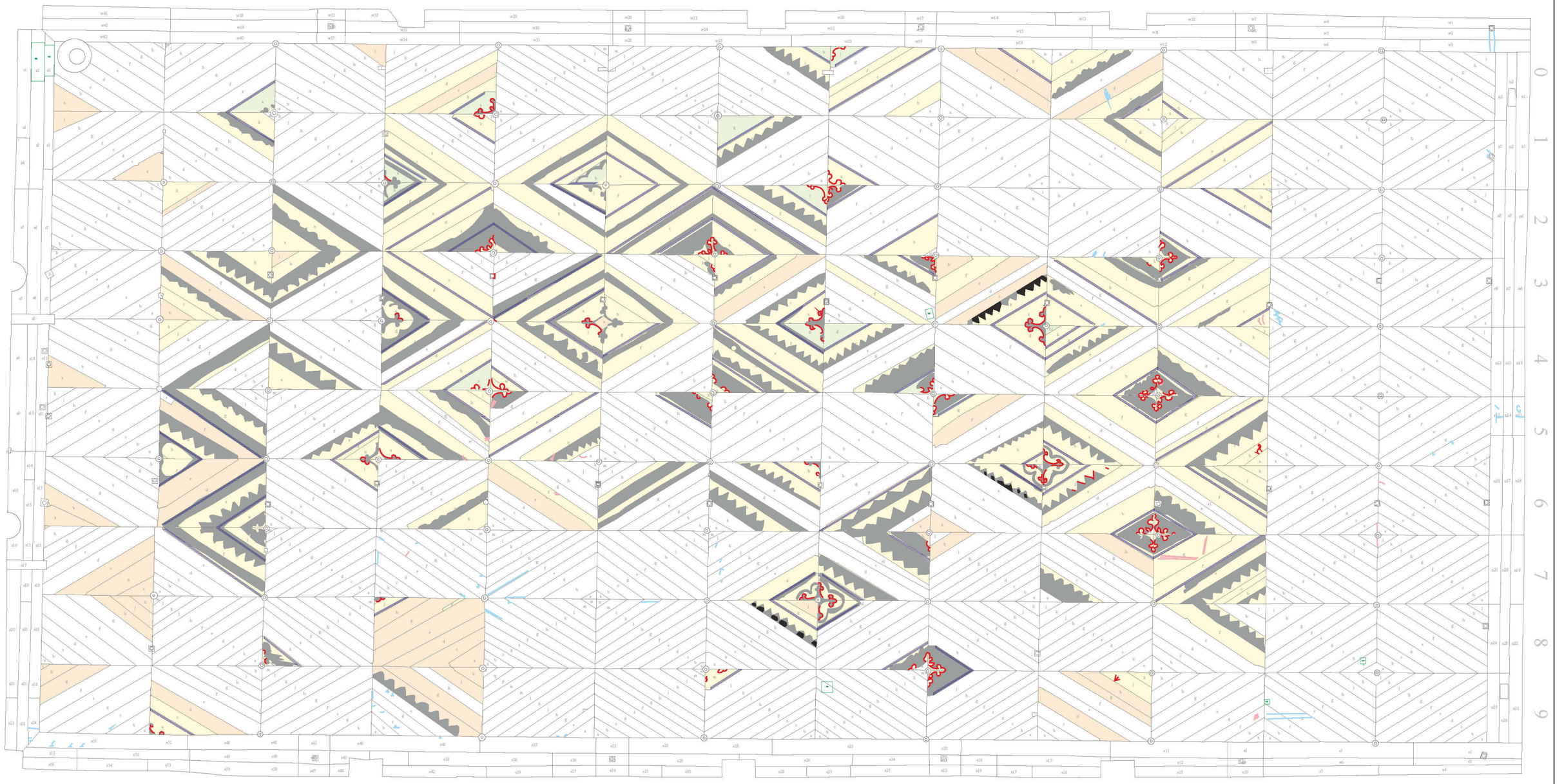
AREA: NORTH TRANSEPT CEILING

0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

WEST

N M L K J H G F E D C B A



EAST

EVIDENCE OF PAINT & GRAFFITI

Grooves

Shallow relief (original paint scheme)

1740s paint shadow

Surviving paint

Graffiti

Pencil lines

Incision lines

Original boards

Cross-grain original boards

1660s replacement boards

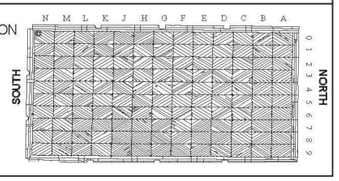
Edges of ceiling boards

N

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



GRAPHIC: 4 (ST)

TITLE
EVIDENCE OF PAINT AND GRAFFITI

PROJECT
PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA
SOUTH TRANSEPT CEILING

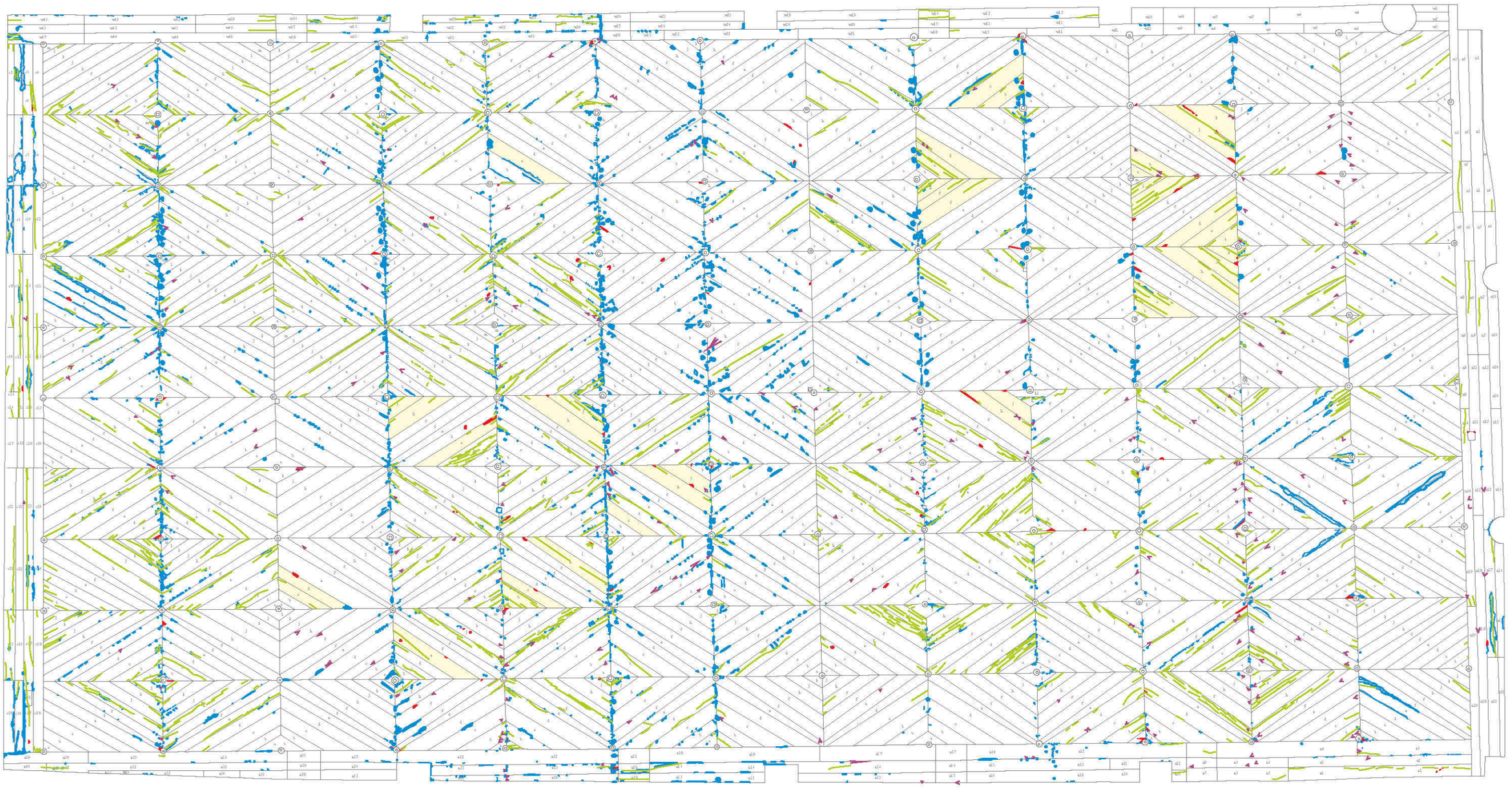
0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

WEST

N M L K J H G F E D C B A

0 1 2 3 4 5 6 7 8 9



EAST

CONDITION OF CEILING BOARDS

Surface glue

Intended wood loss

Wood loss

Surface splintering

Splits in boards

Original boards

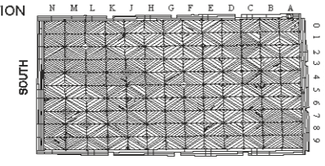
1660s replacement boards

Edges of ceiling boards

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



GRAPHIC: 5 (NT)

TITLE
CONDITION OF
THE CEILING BOARDS

PROJECT
PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA
NORTH TRANSEPT
CEILING

0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

WEST

N M L K J H G F E D C B A

0 1 2 3 4 5 6 7 8 9

EAST

CONDITION OF CEILING BOARDS

Surface glue

Intended wood loss

Wood loss

Surface splintering

Splits in boards

Original boards

1660s replacement boards

Edges of ceiling boards

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION

SOUTH — NORTH

GRAPHIC: 5 (ST)

TITLE
CONDITION OF THE CEILING BOARDS

PROJECT
PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

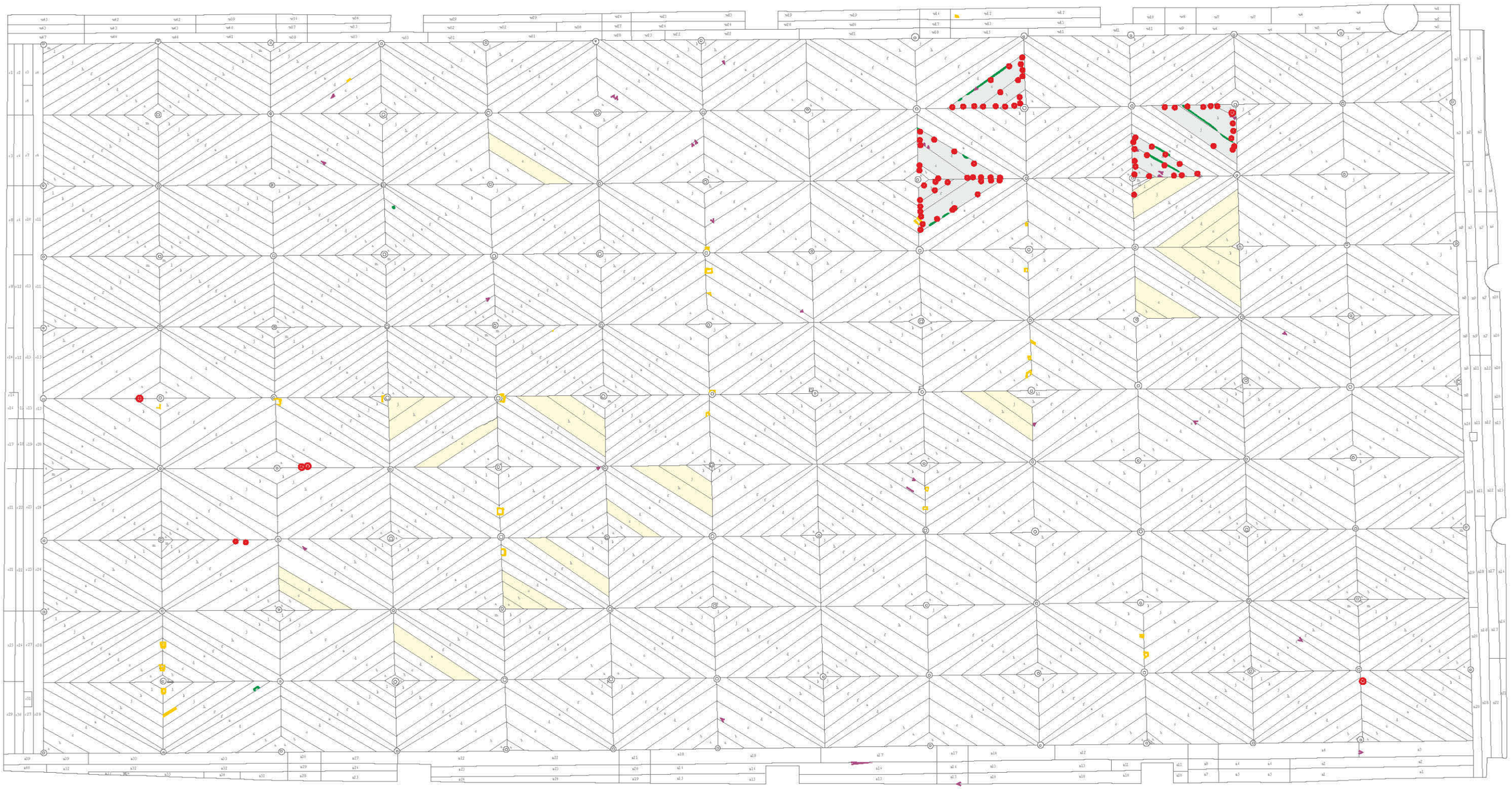
AREA
SOUTH TRANSEPT CEILING

0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

WEST

N M L K J H G F E D C B A



EAST

TREATMENT TO THE CEILING BOARDS

- Stainless Steel Screw
- Stainless Steel Screw & Washer

Consolidation:

- B72
- Fills
- B500 Adhesive

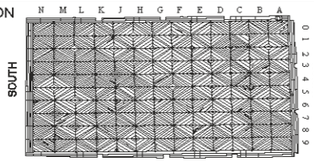
- Original boards
- 1660s replacement boards
- Boards removed for dendro

Edges of ceiling boards

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



GRAPHIC: 6 (NT)

TITLE: TREATMENT TO THE CEILING BOARDS

PROJECT: PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA: NORTH TRANSEPT CEILING

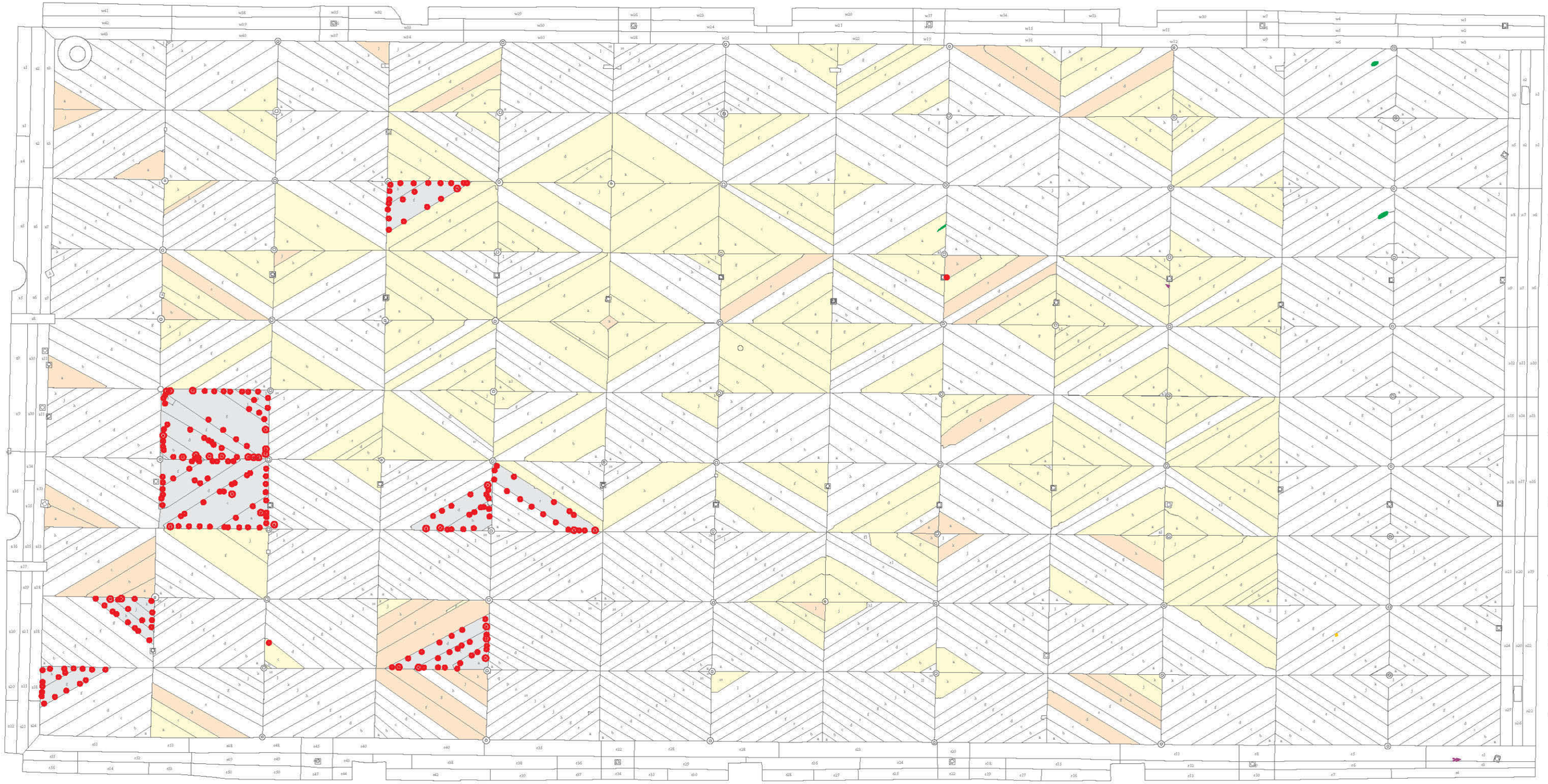
0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

WEST

N M L K J H G F E D C B A

0 1 2 3 4 5 6 7 8 9



EAST

TREATMENT TO THE CEILING BOARDS

- Stainless Steel Screw
- Stainless Steel Screw & Washer

Consolidation:

- B72
- Fills
- B500 Adhesive

- Original boards
- 1660s replacement boards
- Boards removed for dendro

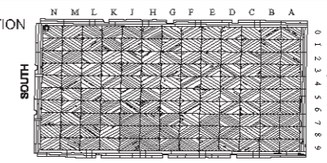
Edges of ceiling boards

N

SCALE 1:55

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



GRAPHIC: 6 (ST)

TITLE
TREATMENT TO THE CEILING BOARDS

PROJECT
PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA
SOUTH TRANSEPT CEILING

0 1m 2m 3m 4m

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

West

N M L K J H G F E D C B A

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

0 1 2 3 4 5 6 7 8 9

South

North

① ② ③

East

① board fragment re-attached
② board fragment re-attached
③ loose boards screw fixed.

0 1 2 3 4m.

PETERBOROUGH CATHEDRAL North Transept ceiling plan from above

HUGH HARRISON CONSERVATION drawn Peter Ferguson October 2002

1

West

N M L K J H G F E D C B A

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

0 1 2 3 4 5 6 7 8 9

South

North

board edge strengthening
oak battens added

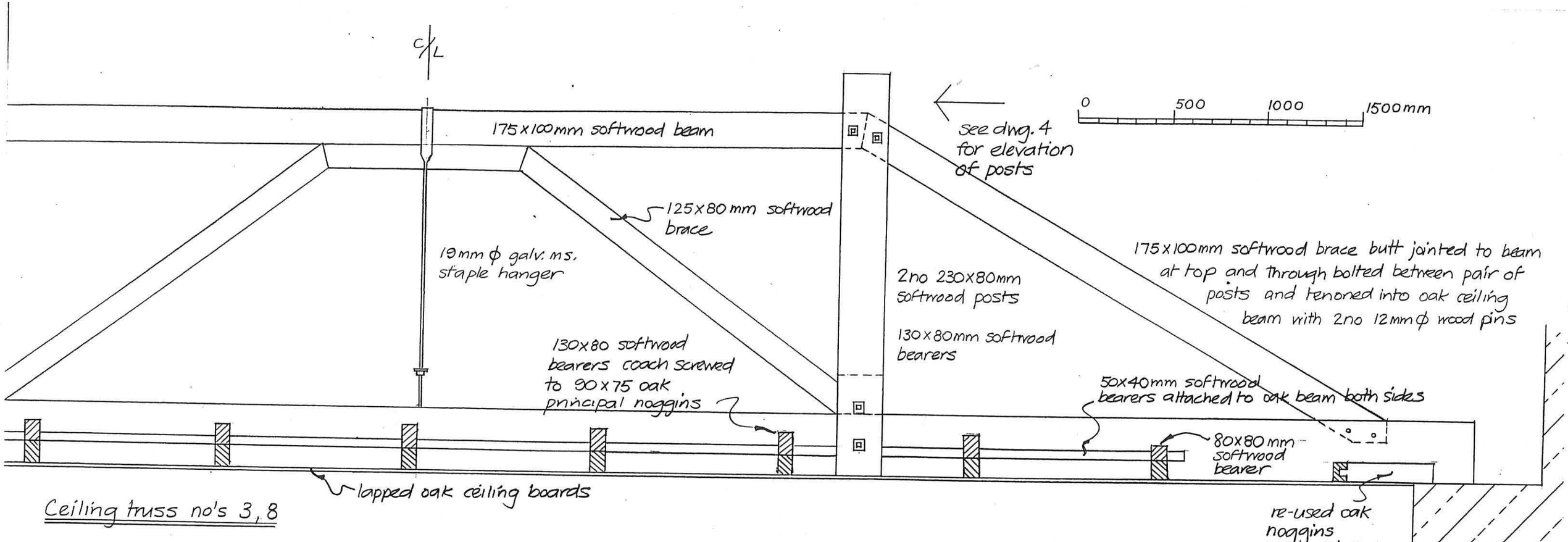
East

0 1 2 3 4m.

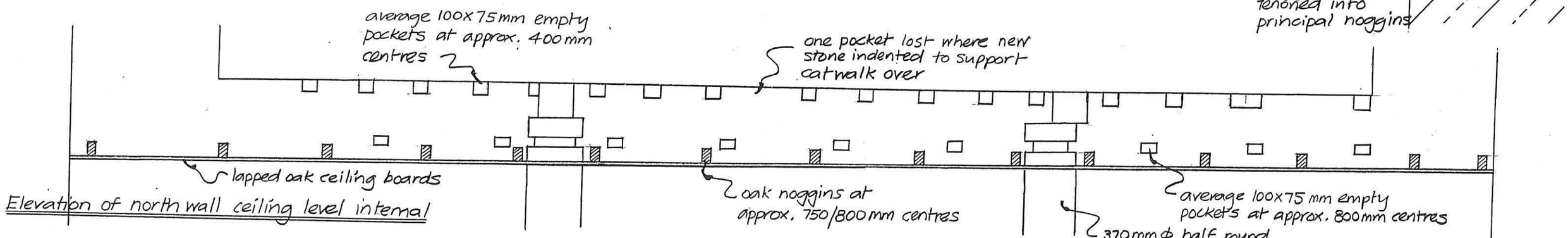
PETERBOROUGH CATHEDRAL South Transept ceiling plan from above

HUGH HARRISON CONSERVATION drawn Peter Ferguson October 2002

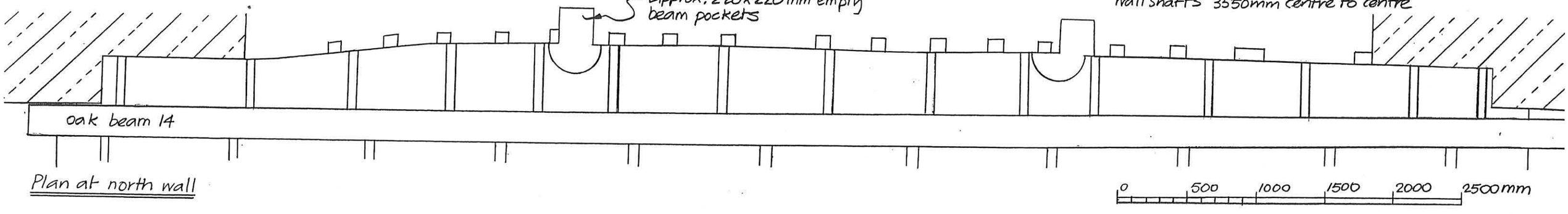
2.



Ceiling truss no's 3, 8



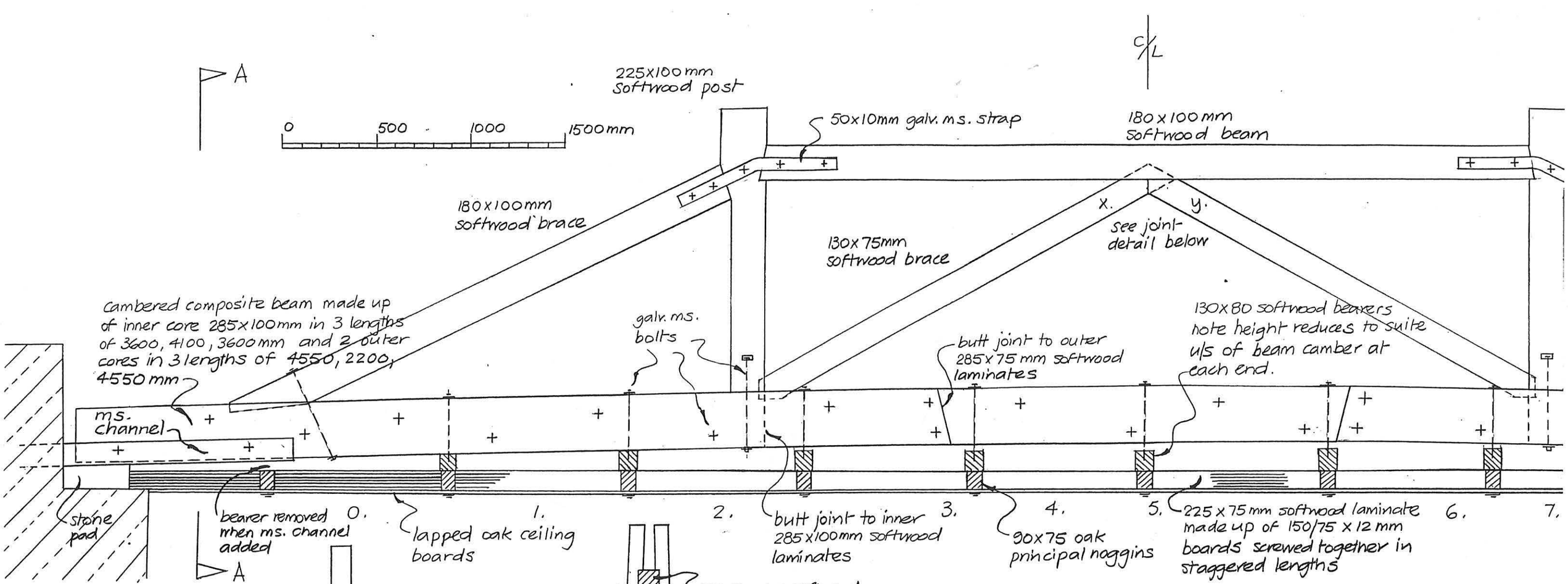
Elevation of north wall ceiling level internal



Plan at north wall

PETERBOROUGH CATHEDRAL North Transept ceiling details

HUGH HARRISON CONSERVATION drawn Peter Ferguson November 2002

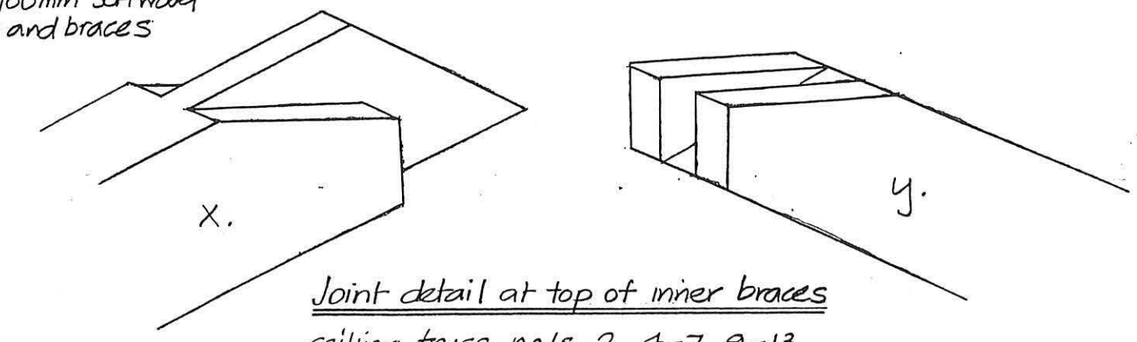


Ceiling truss no's 2, 4-7, 9-13.

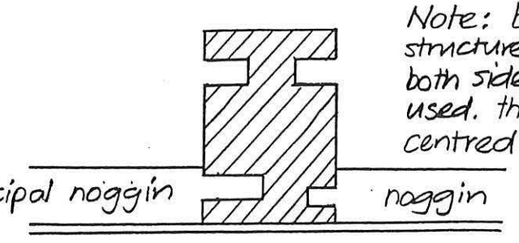
Section at A-A.

composite beams 2, 4-7, 9-13

beams 3, 8. 320x210x11030 mm oak.



Joint detail at top of inner braces ceiling truss no's 2, 4-7, 9-13.

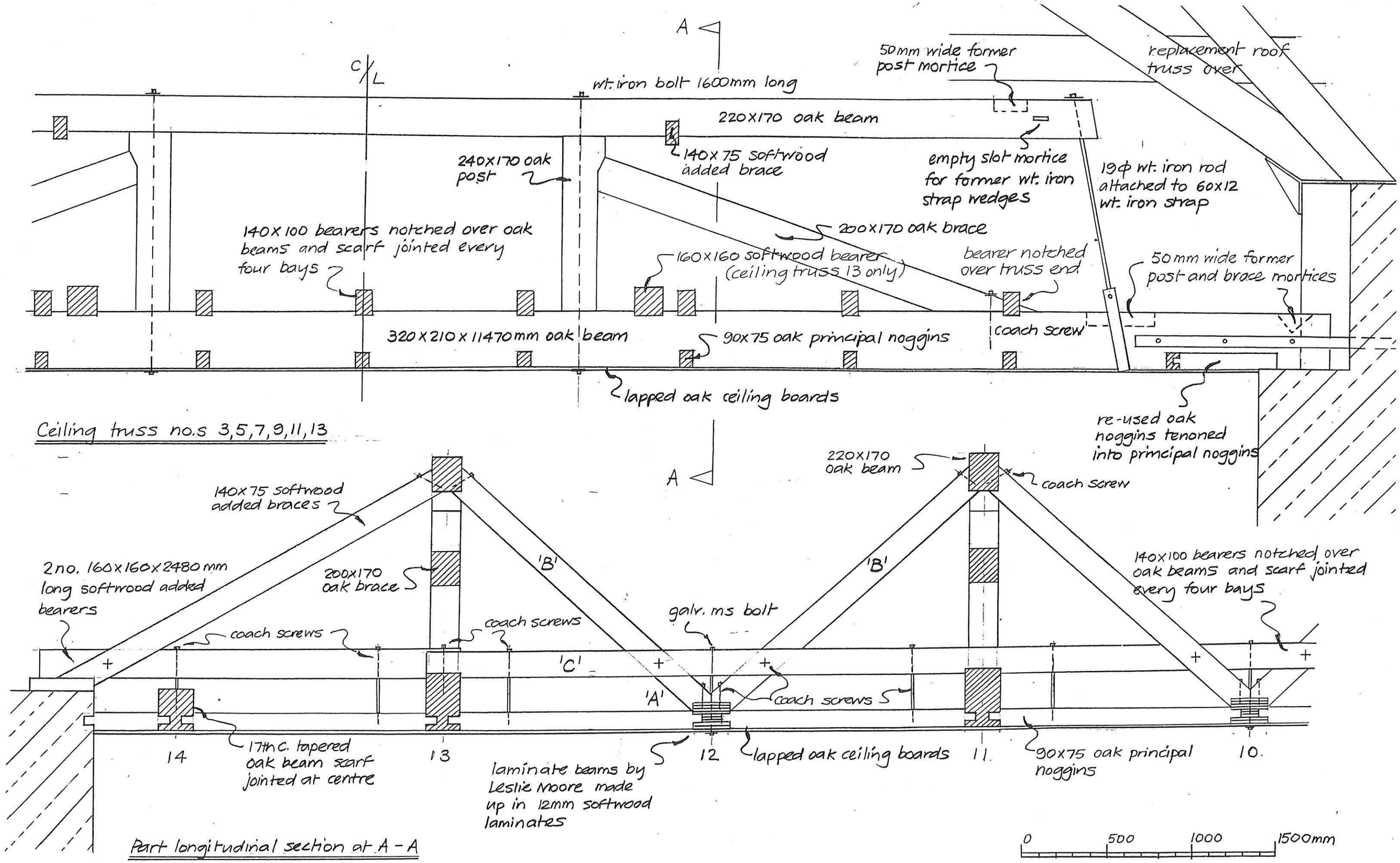


Note: beam 14 has no supporting structure and has mortices cut on both sides at top which have not been used. these are 980mm apart and centred over principal noggins below.

Section thro' beam 14.

PETERBOROUGH CATHEDRAL North Transept ceiling details

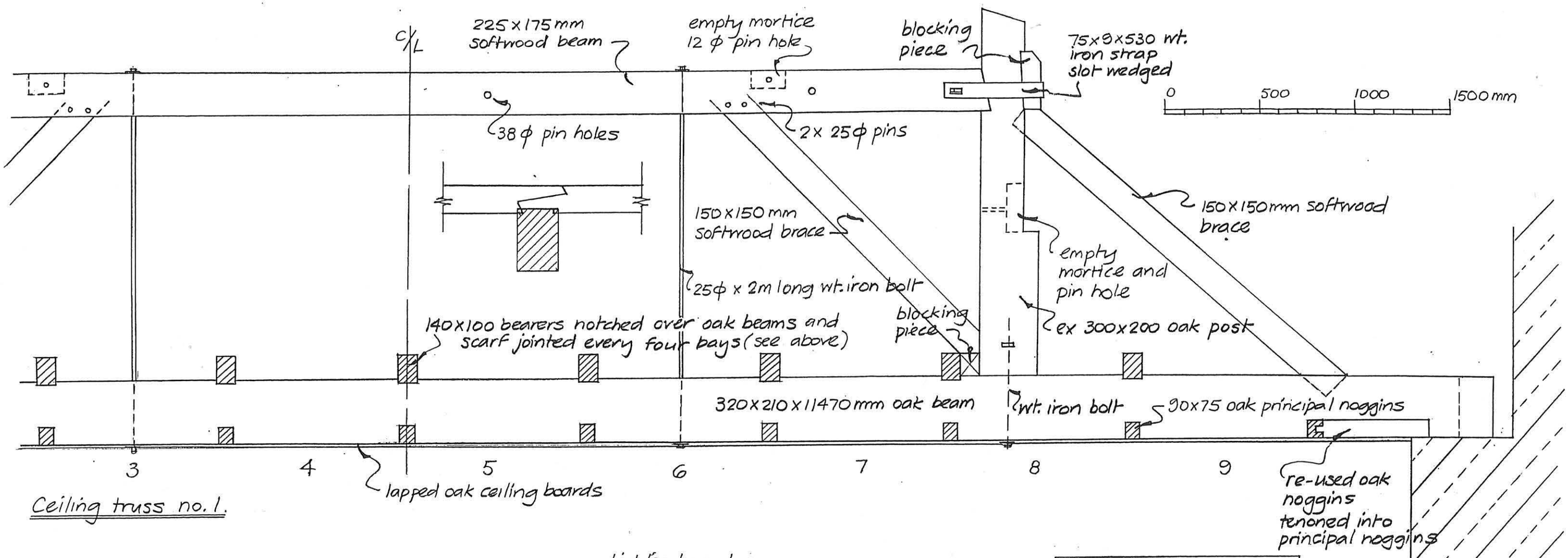
HUGH HARRISON CONSERVATION drawn Peter Ferguson November 2002



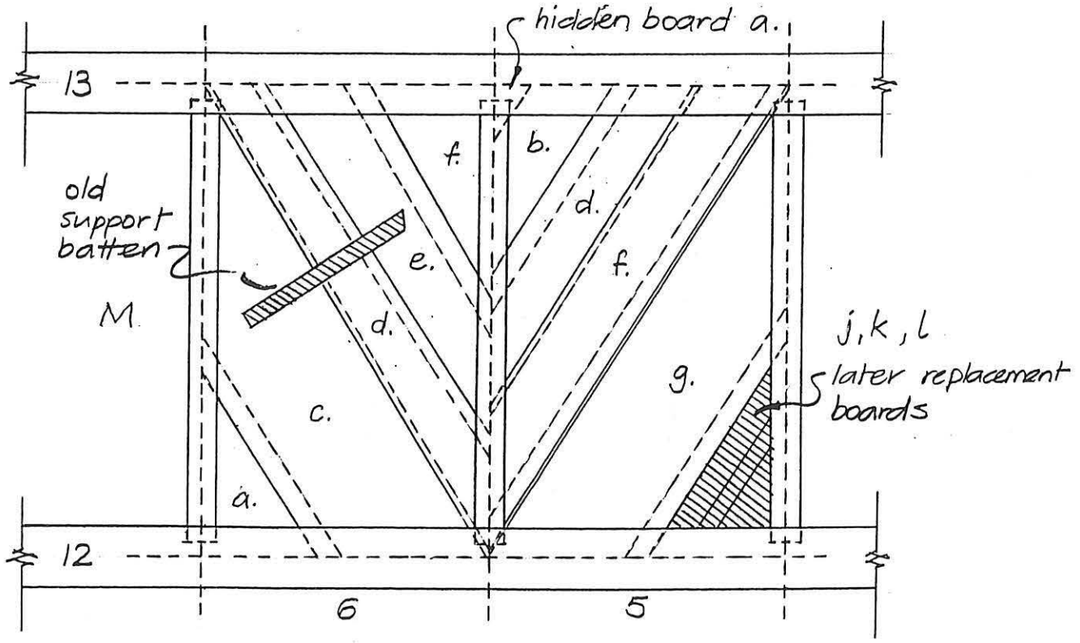
Part longitudinal section at A - A

PETERBOROUGH CATHEDRAL South Transept ceiling details

HUGH HARRISON CONSERVATION drawn Peter Ferguson November 2002

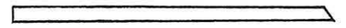


Ceiling truss no. 1.

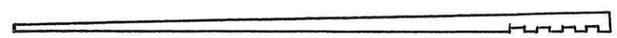


Part plan from above showing typical board layout as reconstructed from re-used boards. see dwg. 2 for location, and dwg. 9 to sections.

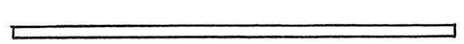
approx 320mm wide grooved, medieval



approx 260mm wide, chamfered on one edge, 17th C.



approx 490mm wide, tapered and grooved, medieval

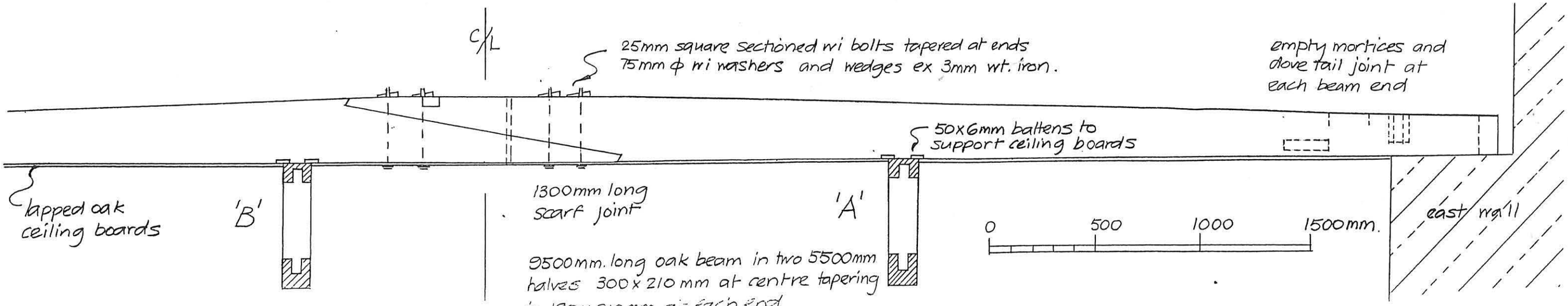


approx 360mm wide plain, medieval / 17th C.

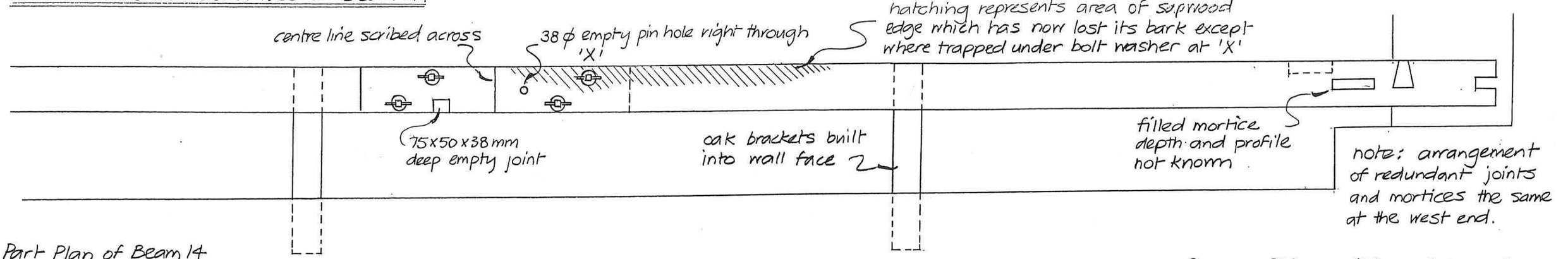
Original and Intermediate Board Profiles

PETERBOROUGH CATHEDRAL South Transept ceiling details

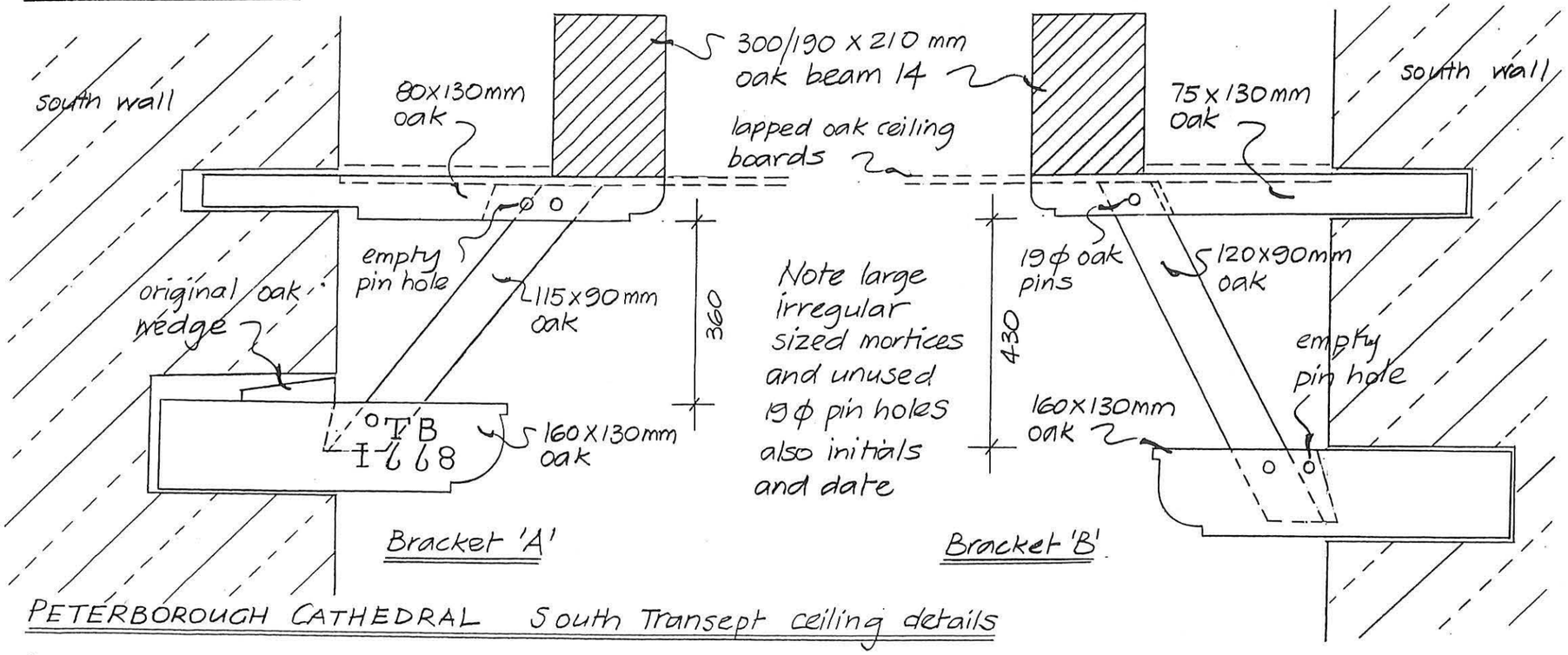
HUGH HARRISON CONSERVATION drawn Peter Ferguson November 2002

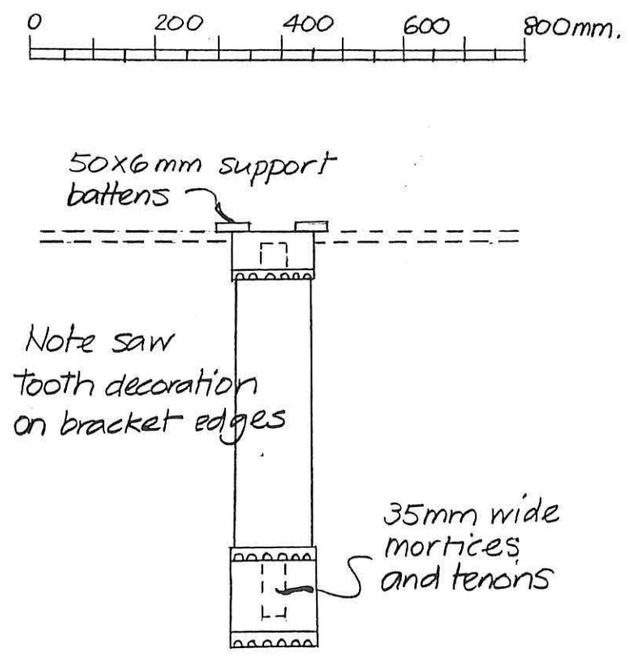


Part Elevation of South face of Beam 14.



Part Plan of Beam 14

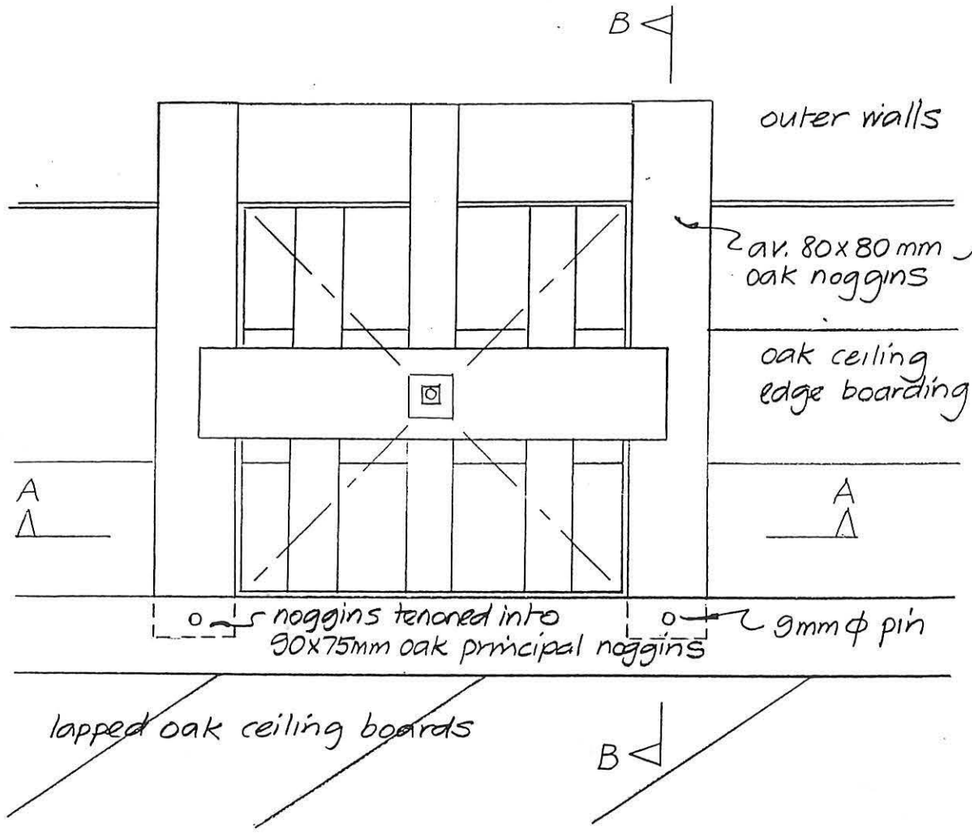


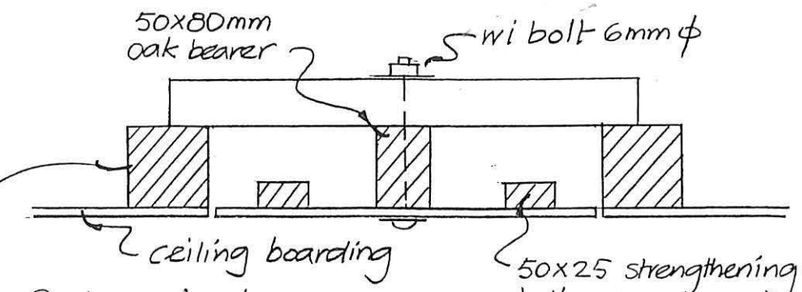


End elevation of bracket

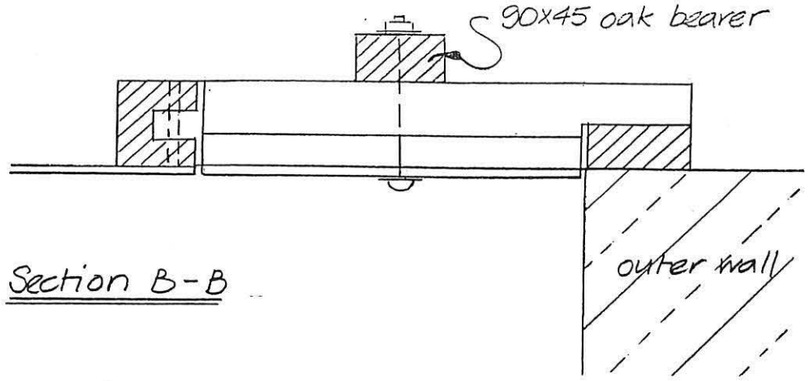
PETERBOROUGH CATHEDRAL South Transept ceiling details

HUGH HARRISON CONSERVATION drawn Peter Ferguson November 2002

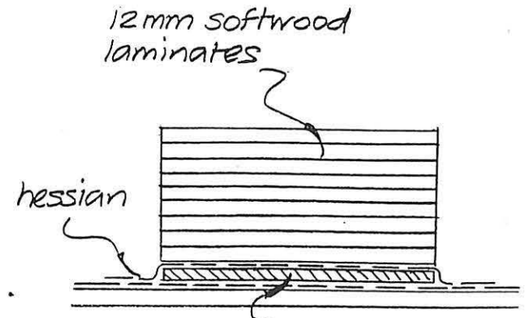


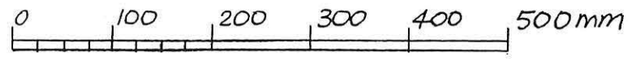


Section A-A



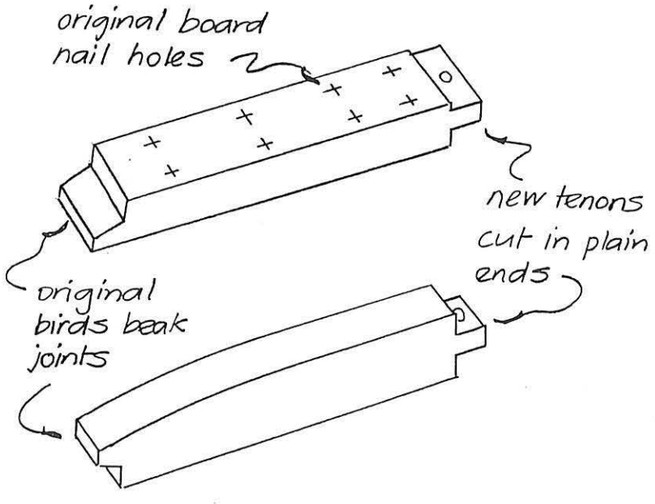
Section B-B



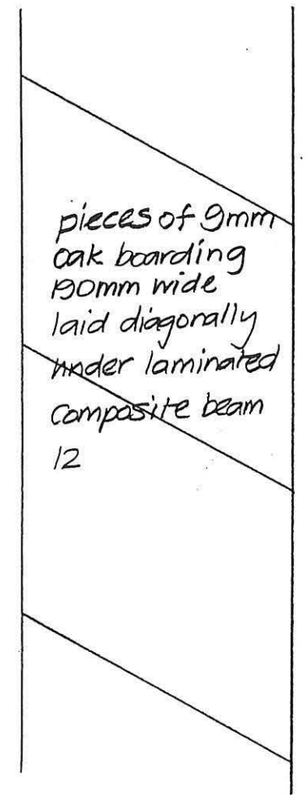


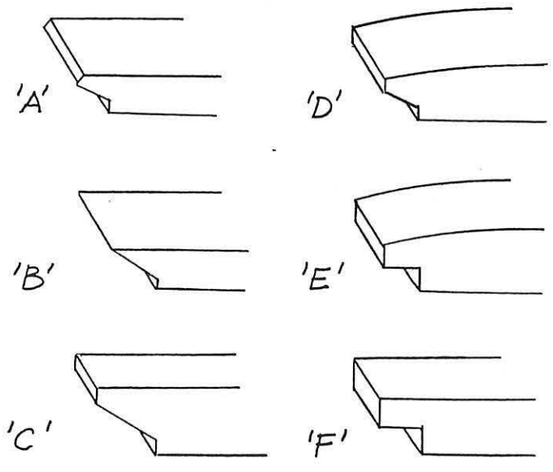
Plan of typical perimeter ceiling trap

Note; access traps are arranged 4no down each long side and one centrally adjacent to the tower, they vary slightly in size and timber section being made up mostly of re-used timber, they are the same for each transept. variations in oak noggins are shown right, they vary in length between 570-700mm with average girth 100x60mm. some are re-used original medieval noggins with new tenons cut at one end but retaining original birds beak joint at the other end and where laid upside down exposing the original nail holes for board fixing.



End variations noted in re-used noggins

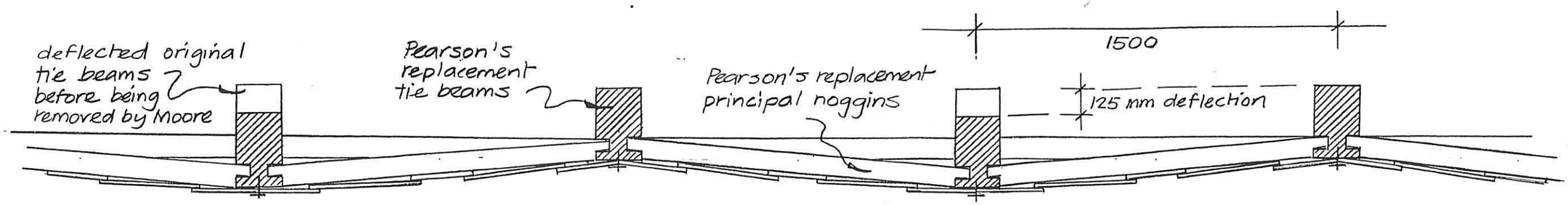




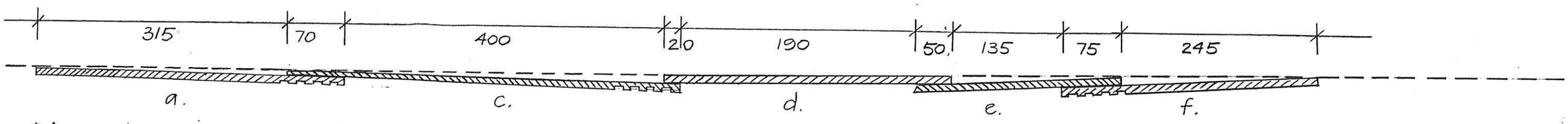
Detail plan and section showing Moore's Composite Beam 12, South Transept.

PETERBOROUGH CATHEDRAL — Transept ceiling details

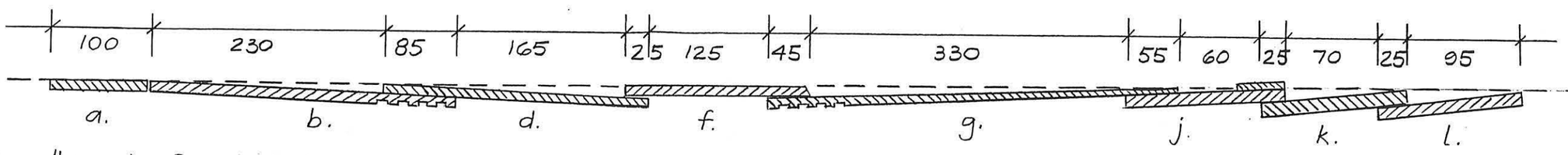
HUGH HARRISON CONSERVATION — drawn Peter Ferguson November 2002



Reconstructed longitudinal c/L section to show typical underside board profile at point of maximum deflection before Moore's intervention



Diagonal Section through Panel M5 South Transept see drwg. 6.



Diagonal Section through Panel M6 South Transept see drwg 6.

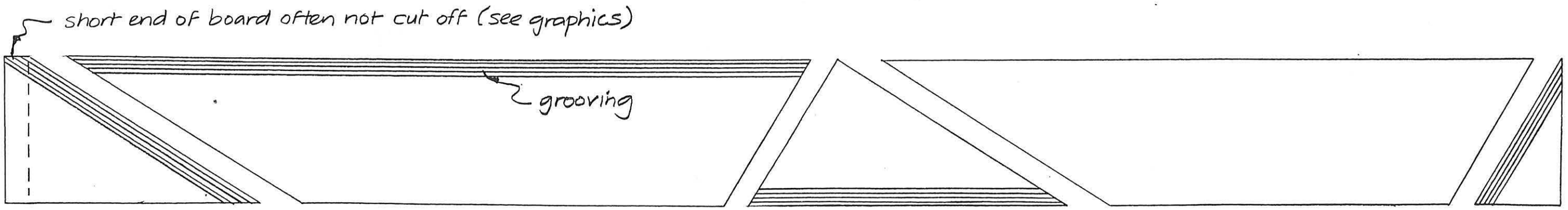


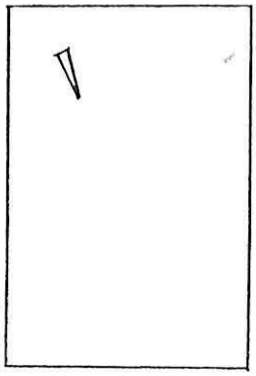
Diagram to show the Different Types of Panel Board Profiles extractable from a Complete Board Length

suggests that grooving was done after panel boards were cut and shows why some central lozenge boards are grooved across the grain.

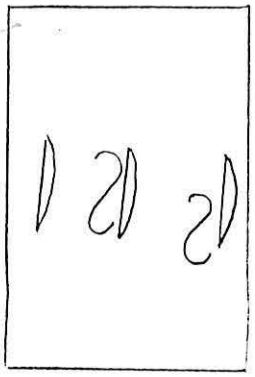
PETERBOROUGH CATHEDRAL Transept Ceilings board and ceiling details

HUGH HARRISON CONSERVATION

drawn Peter Ferguson November '03

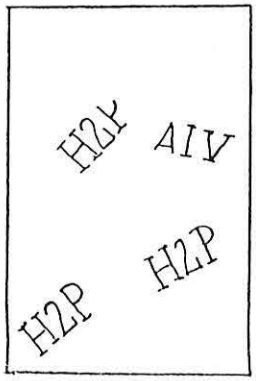


S3E
hauling hook mark

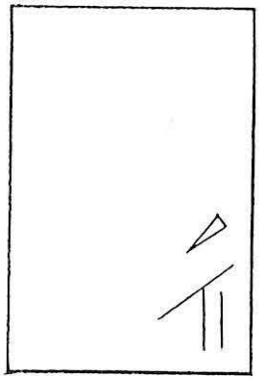


S3W
cut out slots iron re-inforcing cramps

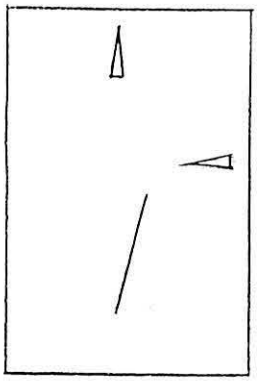
S7W
brand mark iron re-inforcing cramp



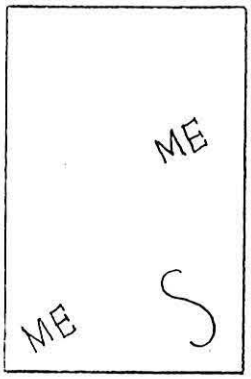
S7E
brand marks



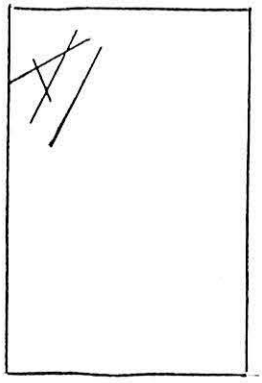
S11W
hauling hook mark and cargo mark



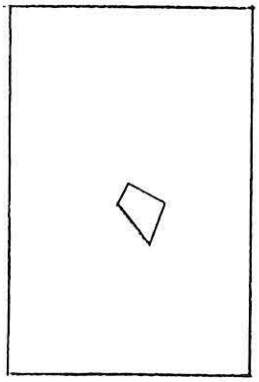
S11E
hauling hook marks and cargo mark



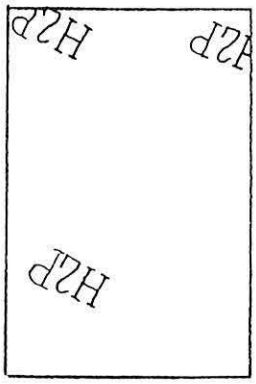
S13W
brand marks iron re-inforcing cramp



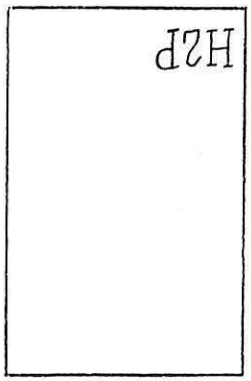
S13E
cargo mark



N3W
cut out slot



N8W
brand marks

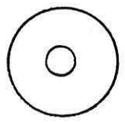
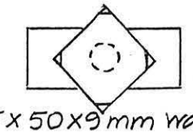
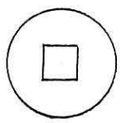
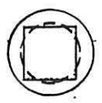
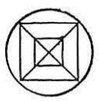
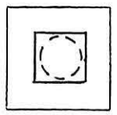
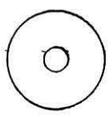
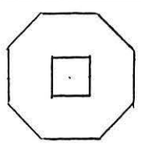


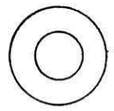
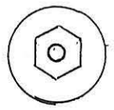
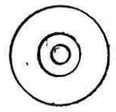
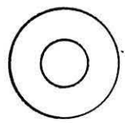
N14E
brand mark

various marks recorded on ends of Baltic Oak tie beams shipped from Poland/Latvia for Pearson's re-construction late 1880s. N1, S1, S5 and S9 have no marks or re-inforcement

HUGH HARRISON CONSERVATION Peterborough Cathedral

East and West Transept drawn Peter Ferguson Dec'03

type.		notes.
1.	 25mm head 80mm washer	Moore 1924 and 1927
2.	 60/80 mm head  25mm  125x50x9mm washer	used on truss adjacent to tower Pearson 1886
3.	 30mm head 80mm washer	Moore 1927 used under composites
4.	 40 mm head 70mm ring washer	4, 5 and 6 are all variations of structural bolts and are mostly Moore 1924 and 1927. types 5 and 6 also occur on Pearson's work.
5.	 45mm head	
6.	 40mm head 80/110mm washer	
7.	 up to 20mm head 80mm re-used washers	large 19th C dome headed nails and re-used washers (probably 17th C.) under Pearson tie beams
8.	 30 mm head 100mm washer	one only - washer variation of type 3. Moore 1927

type.		notes.
9.	 40mm head no washer	17th C. structural bolts through tie beam S14.
10.	 38mm head 80mm washer	Moore 1924
11.	 9mm bolt 80mm re-used washer	re-used washer as type 7 Moore 1924
12.	 9mm bolt with 2no threaded washers 80mm washer	Moore 1924
13.	 38mm head 90mm washer	Moore 1924 bolt as type 10 with larger washer (replacement for earlier now missing)
14.	 25mm head no washer	Pearson late 1880s used for perimeter traps only.

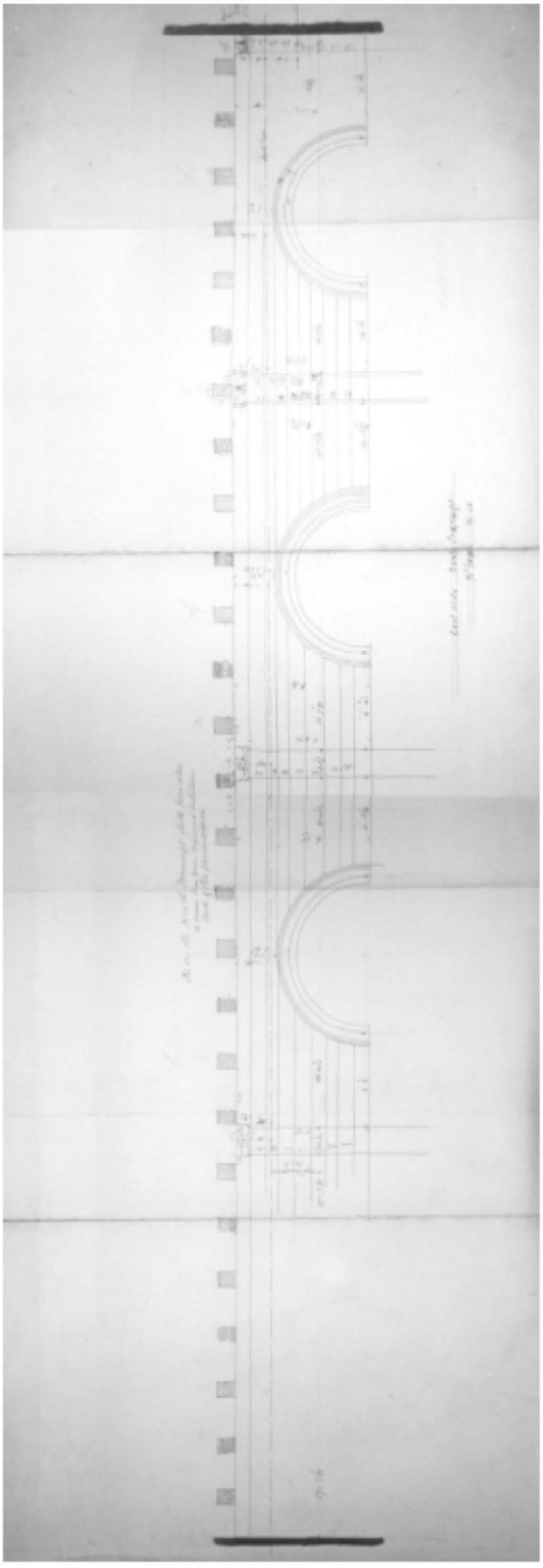
For location of bolt types see graphics Plates 46, 48-51 refer

Survey limited to visible elements on underside of ceiling and are drawn to scale.

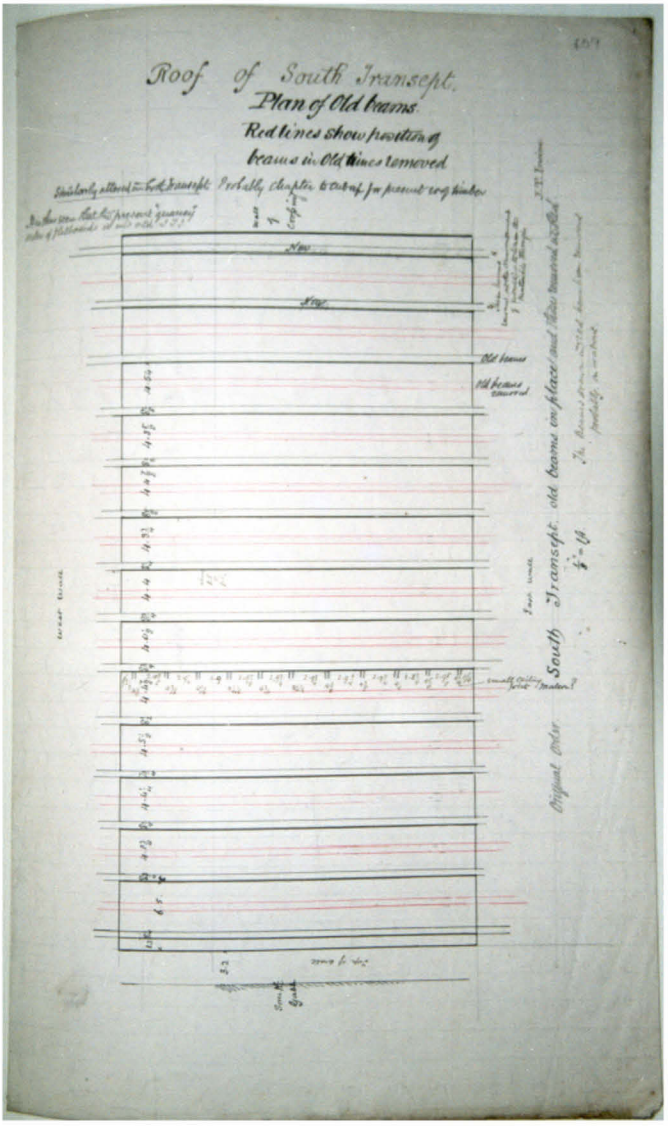
PETERBOROUGH CATHEDRAL Transept Ceilings schedule of bolt types.

HUGH HARRISON CONSERVATION

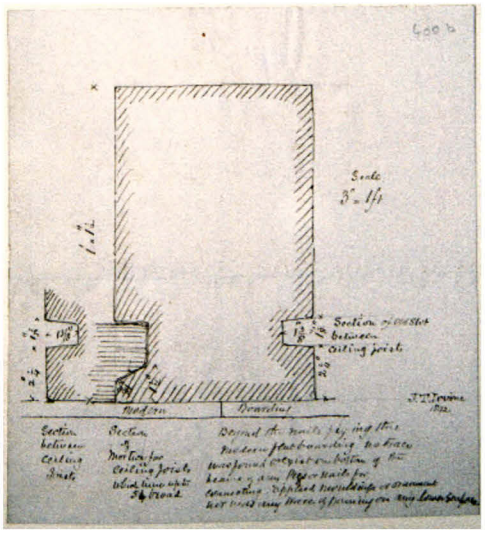
drawn Peter Ferguson Dec. 2003



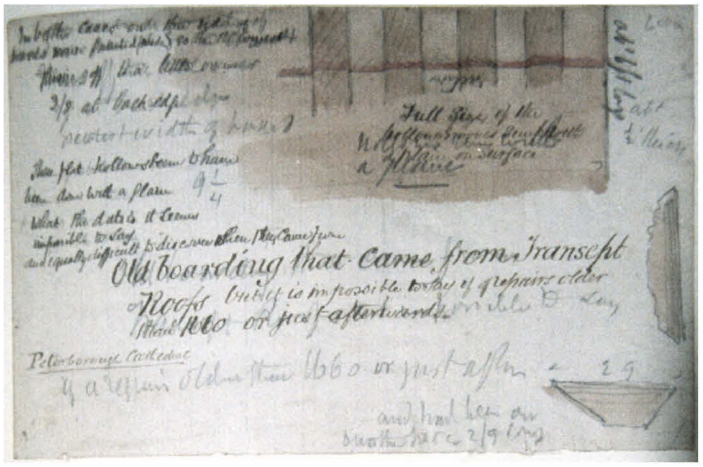
Arch Draw 1. J.T. *Irvine's archaeological record drawing of the side of the South Transept showing the masts which would have supported the First Coffered Ceilings and the closely spaced tie beams of Robert de Lindsey's reconstruction.*



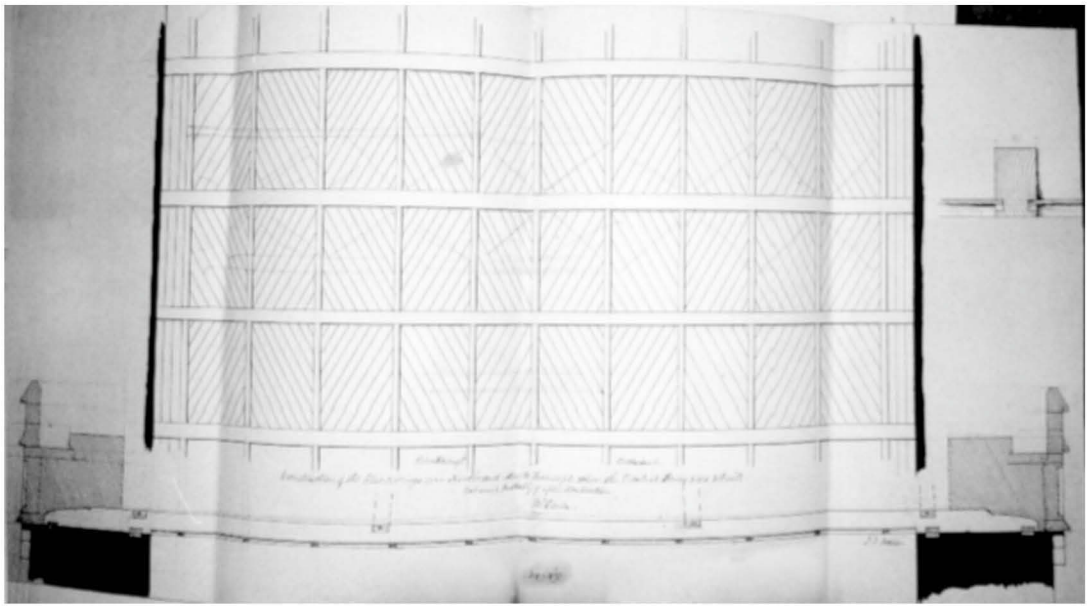
Arch Draw 2. *J.T. Irvine's plan showing the layout of Robert de Lindsey's closely spaced tie beams. The red lines indicate, "those in old times removed" as Irvine states it. In probability these were removed during Blore's reconstruction of 1826.*



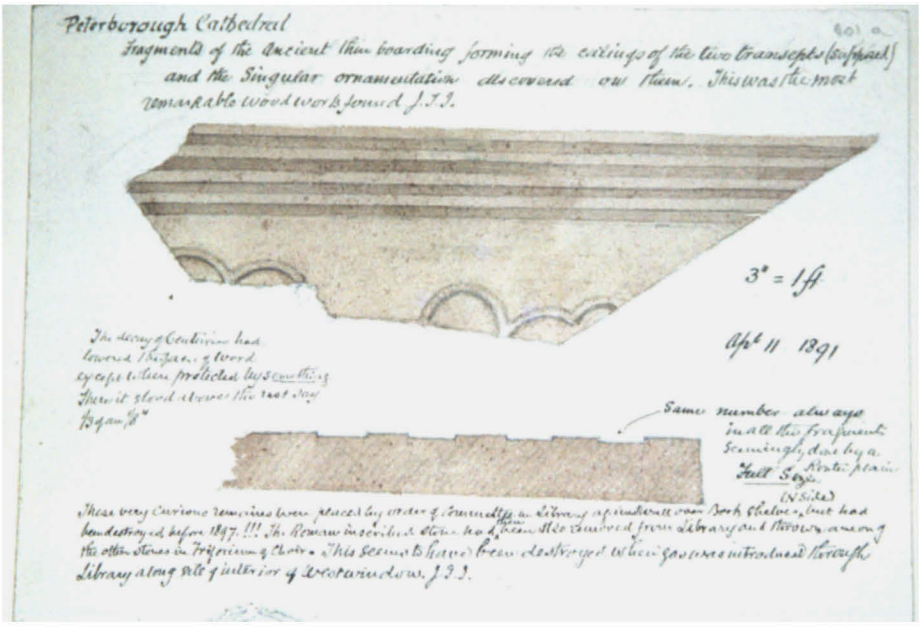
Arch Draw 3. *J.T. Irvine's archaeological record of Robert de Lindsey's tie beams in cross section showing the end of a ceiling joist mortised into the tie beam and the slot between.*



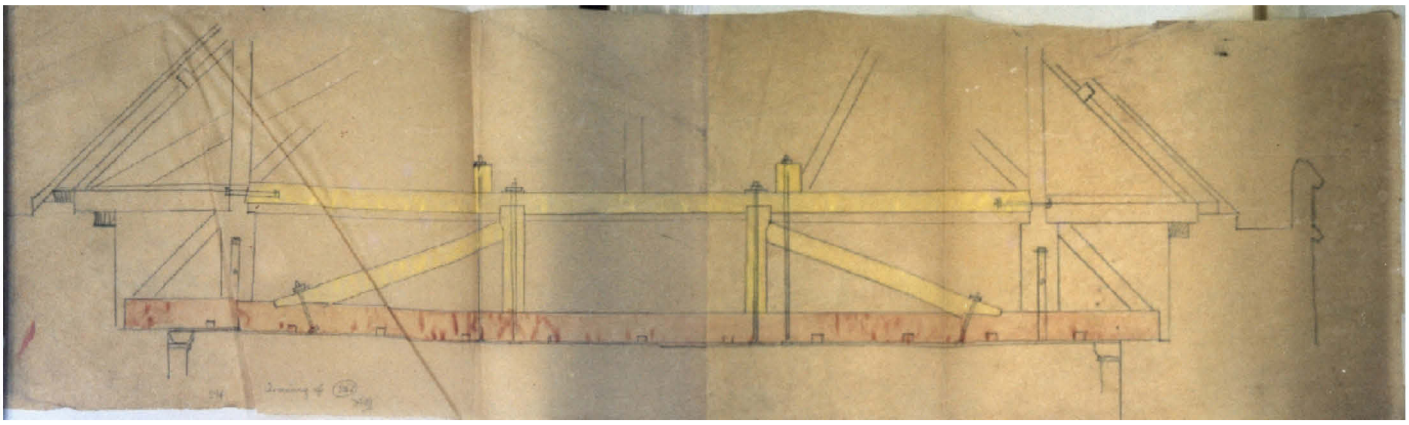
Arch Draw 4. *Also shown are details of fragments of original boarding found in the roof which show the 4 parallel board grooves along the edge of the board.*



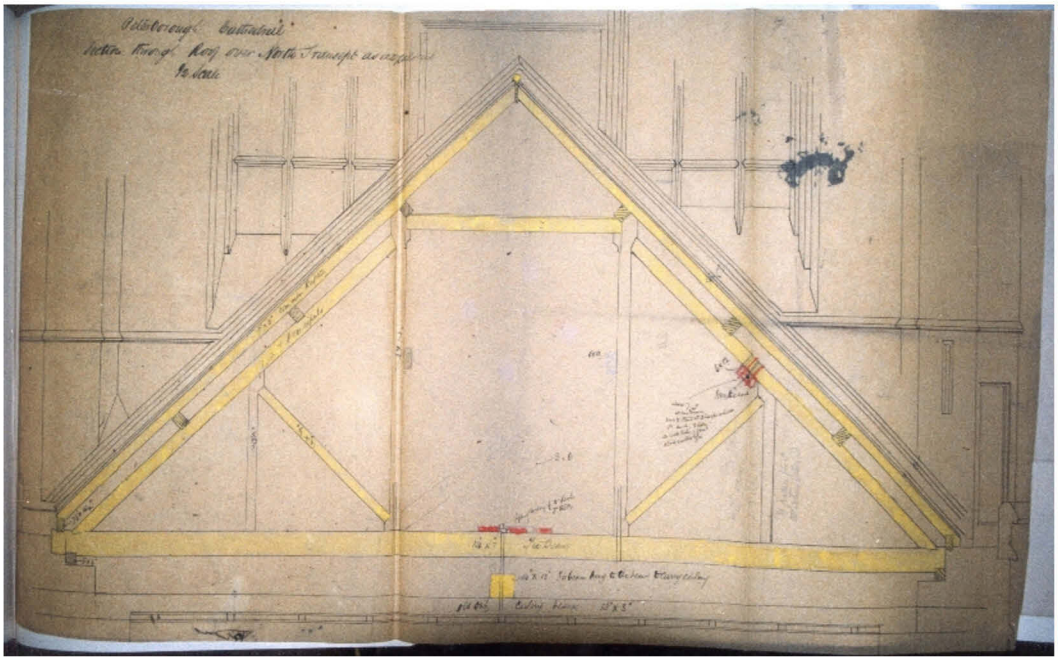
Arch Draw 5. *J.T. Irvine's drawing showing North and South Transept ceiling plan and section when central tower was rebuilt suggesting work probably after restoration.*



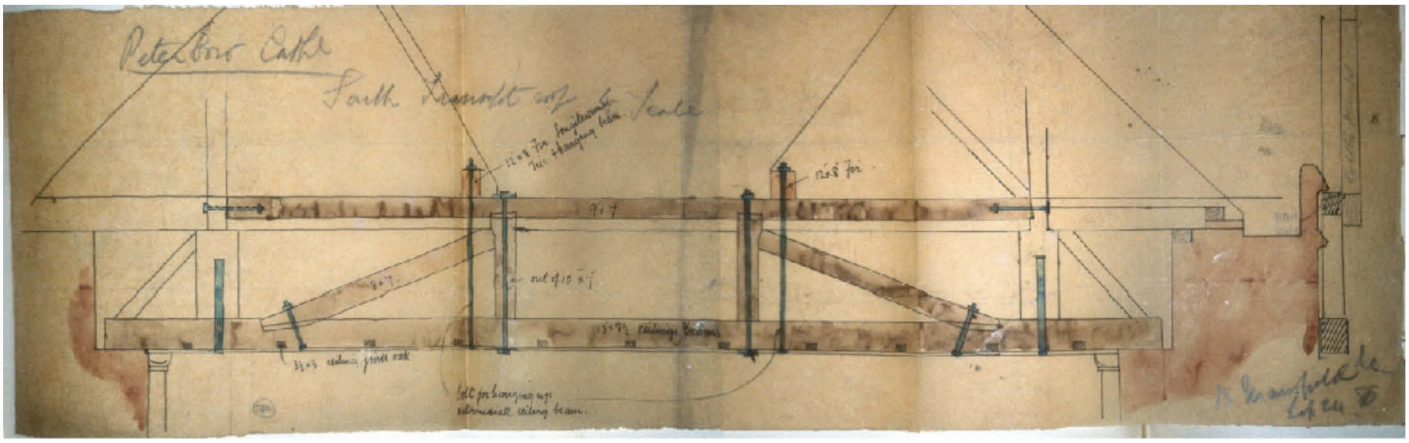
Arch Draw 6. *J.T. Irvine's archaeological record drawing showing fragments of mediaeval boards from the transept roofs with original grooves and painted decoration.*



Arch Draw 7. *South Transept J.T. Irvine's drawing showing Pearson's replacement ceiling beam shown pink and it's new supporting structure shown yellow worked in along side the 1761 roof.*



Arch Draw 8. *North Transept - J.T. Irvine's drawing showing Blore's roof structure shown yellow with the Robert de Lindsey ceiling beams suspended from a softwood longitudinal beam shown yellow hung from the post tie beams. Note Irvine's curious inclusion of what appears to be an upper layer of ceiling boarding above the noggins. This is probably a mistake in interpretation.*



Arch Draw 9. *South Transept - J.T. Irvine's second drawing showing Pearson's replacement ceiling structure.*

THE PERRY LITHGOW PARTNERSHIP
CONSERVATORS OF WALL PAINTINGS AND POLYCHROME DECORATION
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Catherine Hassall
5 Patshull Road
London
NW5 2JX

1 July 2002

Dear Catherine,

Peterborough Cathedral, Transept Ceilings

Enclosed are three samples from the South Transept ceiling as discussed together with a two sheets of photographs and captions prepared for a report on my findings following treatment tests. You may find the following extracts from the report useful:

- *From our inspection from clerestory level we had the impression that many of the smooth-faced oak ceiling boards were seventeenth-century boards partially re-faced or sanded down in the 1890s, when it is known that the painted decoration on the ceiling was removed. Closer inspection has revealed the smooth-faced boards are in fact 1890s boards. The confusion arose because there is a darkened coating and/or white ground partially smeared over many of the 1890s boards adjacent to early boards (see **Plates 1, 3, 4 and 5**). The reason for the coating is unclear.*

- *So far we have found no residual traces of paint on the ceiling boards, even though photographic evidence exists showing painted decoration on the transept ceilings in the late nineteenth-century. From what we have seen so far we anticipate a budget figure of £1,000 for paint sample analysis will be more than sufficient. There are the samples of unidentified coating and/or ground to be analysed. In addition, we propose to obtain samples for analysis of paint traces found on surviving limewash fragments in at least one area of the west wall immediately below ceiling level.*

- *The early boards appear to be of two different ages typified by less surface weathering and quite different grain characteristics. However the majority are early oak boards – easily distinguishable from the 1890s boards by their weathered appearance. Close examination has confirmed our observations in the tender regarding the parallel grooves and the original paint scheme visible in shallow relief on the timber surface (see **Plates 8 and 9**).*

- *Limited test were carried out to determine whether it will be possible or desireable to remove the darkened coating and/or white ground partially smeared over many of the 1890s boards adjacent to early boards. The coating is not affected by water or white spirit but may be removed by swabbing with Industrial methylated spirits and/or acetone: this results in a slight lightening in the colour of the underlying wood surface (see **Plate 4**). It would not be technically difficult to remove the coating from the 1890s boards but it would more than double the time involved and therefore the cost of the surface cleaning process. Samples of the coating have been sent for analysis. When the findings are available the project team must decide whether or not we should conduct more extensive tests for its removal.*

We would like you to identify the coatings or coating in Samples 1 and 2. At present I am uncertain whether thay are the same coating or different – Sample 2 perhaps having some form of white filler added. As it says in the caption, Sample 3 is of white residue taken from the open grain of an original board. Is this the same as Sample 2 or might it be residue of an original preparatory layer?

Ring me if you have any queries.

Yours sincerely,

Richard Lithgow
Enclosures

Plate 1. A typical lozenge showing the smooth-faced 1890s oak boards that are partially smeared with an darkened coating and/or some form of white ground where they are adjacent to early boards.

Plate 2. A surface cleaning test using wishab sponges to remove the thick accretions of soot and surface dirt.across original and 1890s ceiling boards.

Plate 3. (left) An 1890s board that has been partially smeared with the unidentified coating/ground where it is adjacent to an original board.

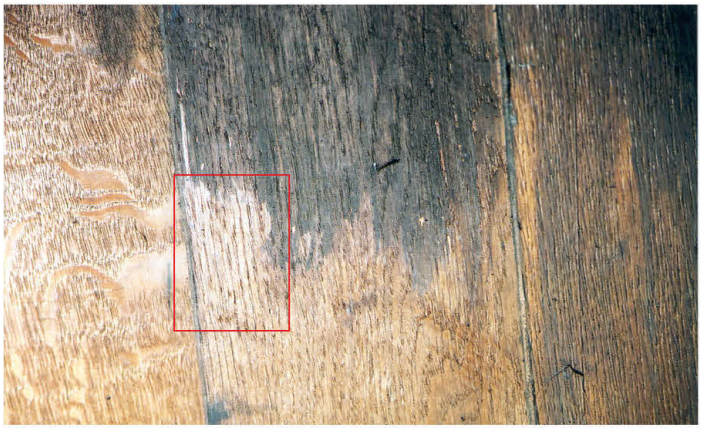


Plate 4. Detail of an area of the darkened coating, following soot and dirt removal, from which samples were obtained for analysis(Sample 1). The red square shows the location of a small test to remove the coating with IMS. The underlying wood surface is marginally lighter that the uncoated surface.

Plate 5. Detail of an area of the on the edge of an 1890s board. Samples were obtained for analysis from this area (Sample 2).

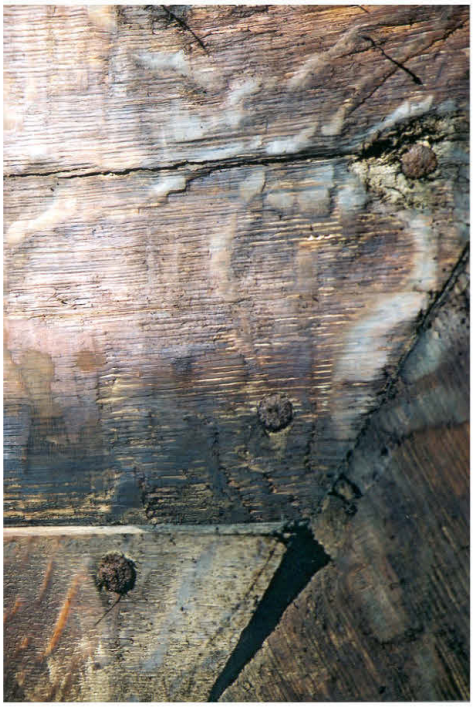


Plate 6. (right) Detail of a weathered original board showing possible residue of a preparatory layer within the grain. Samples were obtained for analysis from this area for comparison with the light ground/coating found on some 1890s boards (Sample 3).

Plate 7. Detail of glue drips on the edge of 1890s boards. Removal tests indicate the glue may be removed by swabbing with warm water. On drying the underlying wood appears slightly lighter than if it were cleaned with wishabs only.

Plates 8 & 9. Raking light details showing some of the original painted decoration now showing as relief within the weathered timber surface.

PETERBOROUGH CATHEDRAL

South transept ceiling

As well as original oak boards there are boards replaced in the 1890s. Where these newer boards are adjacent to weathered original boards, their edges have been toned with irregularly applied dark and light coatings. Some white residue can also be seen on the original boards.

Three samples were taken by Richard Lithgow

I darkened coating from 18%s board, next to small cleaning test [plate 4]
2 white coating from edge of 1890s board [plate 5]
3 white residue on weathered original board [plate 6]

Examination

The fragments were examined under low magnification, then some were mounted in resin to be cut and polished as cross-sections.
The sections were viewed in halogen and UV fluorescent light to compare the layers.
Material from the white smear and the dark stain in samples I and 2 was dispersed on glass slides and examined with a polarising light microscope.
The surface of all three fragments was analysed using a scanning electron microscope.

RESULTS

SAMPLE 1

The cross-section shows oak with a blackened upper surface. Some of this blackening is due to surface dirt, but the discoloration penetrates through several layers of wood cells. There is no iron in the layer and no iron oxides particles visible in dispersion, and the colour must be due to an organic stain or dye. The only elements picked up by the SEM analysis were tiny amounts of sulphur, calcium and potassium.

The layer has a slight fluoresence in UV which suggests that it has a resin content.

SAMPLE 2

In this fragment, the wood has a similar dark-stained upper surface to that seen in sample 1, but here it is overlaid by a film of semi-opaque, whiteish material. Analysis found this to contain lead, calcium and iron and consists of lead white, calcium carbonate and iron oxide. The layer has a white fluorescence which may indicate resin, but the calcium carbonate content would also produce this effect.

SAMPLE 3

These fragments show a lead white layer, tinted with a few particles of charcoal black and iron oxide, and mixed with a little calcium carbonate. These materials are the same to those making up the ground of the original decoration.

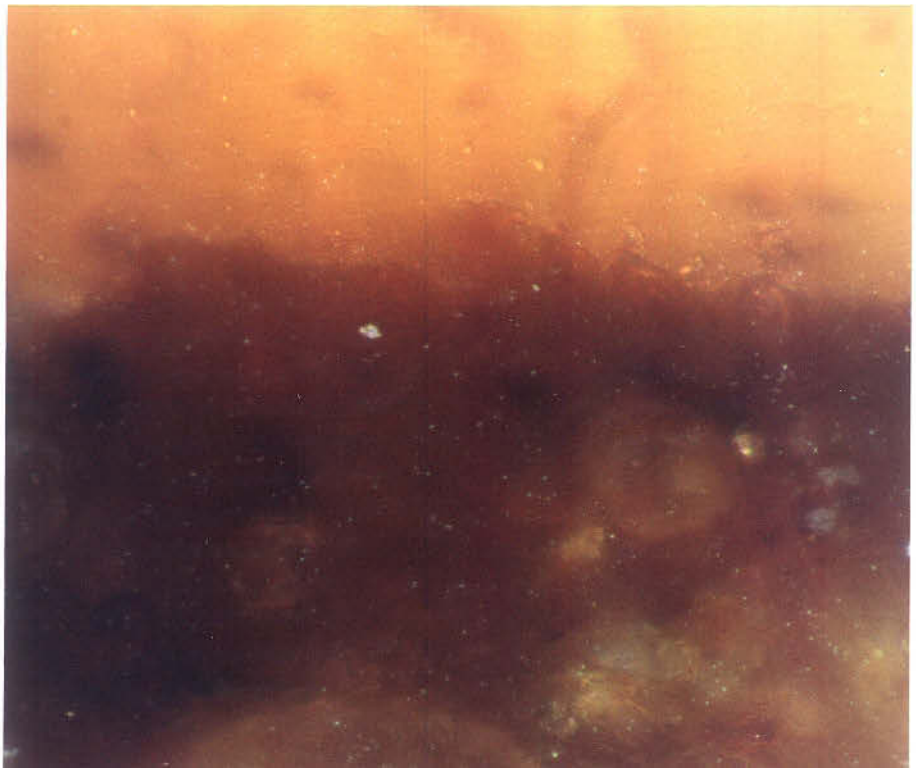
SAMPLE 1
Dark stain

Showing wood with dark stain penetrating the top few cells.

[x200]

No pigment particles are visible, and the coating is tinted with brown organic stain or dye.

[x500]

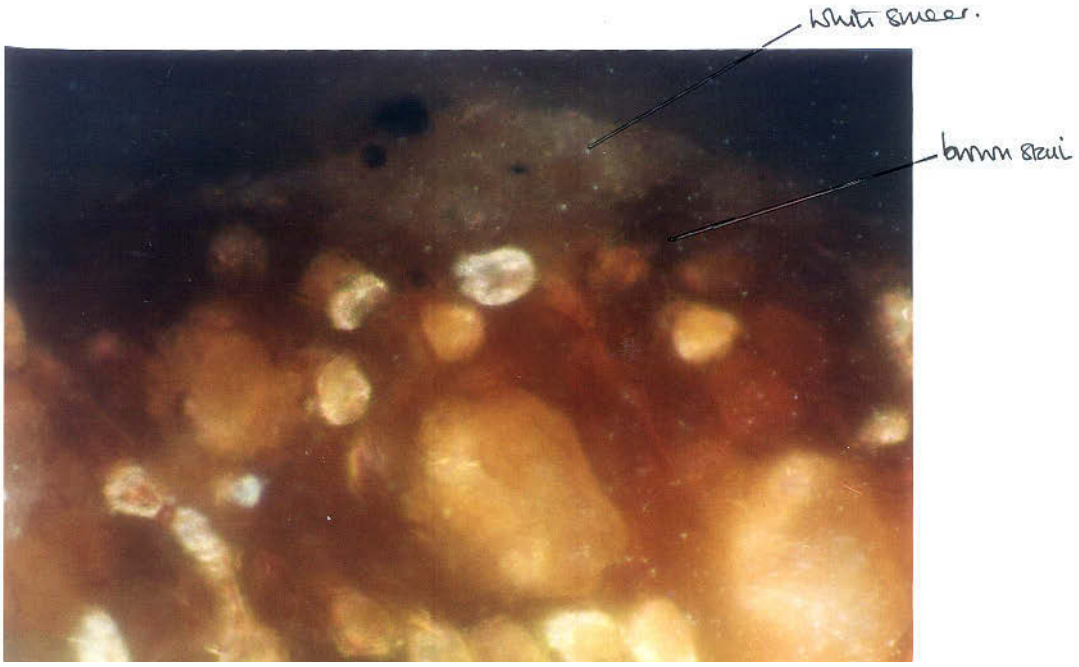


SAMPLE 2
White coating

The white does not sink into the wood cells, but rests on top of the dark-stained surface.

[x200]

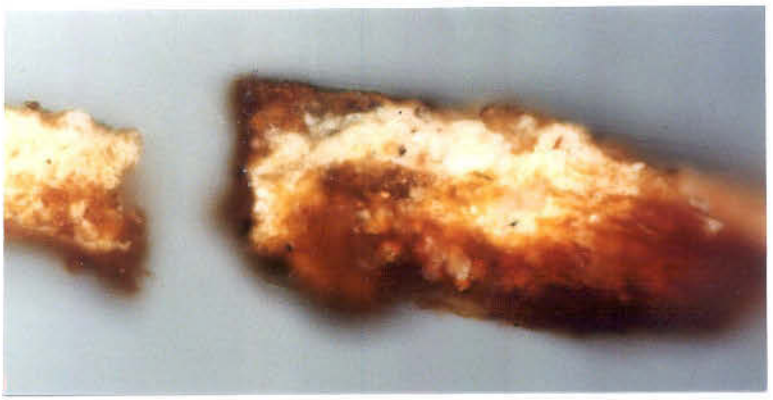
[x500]



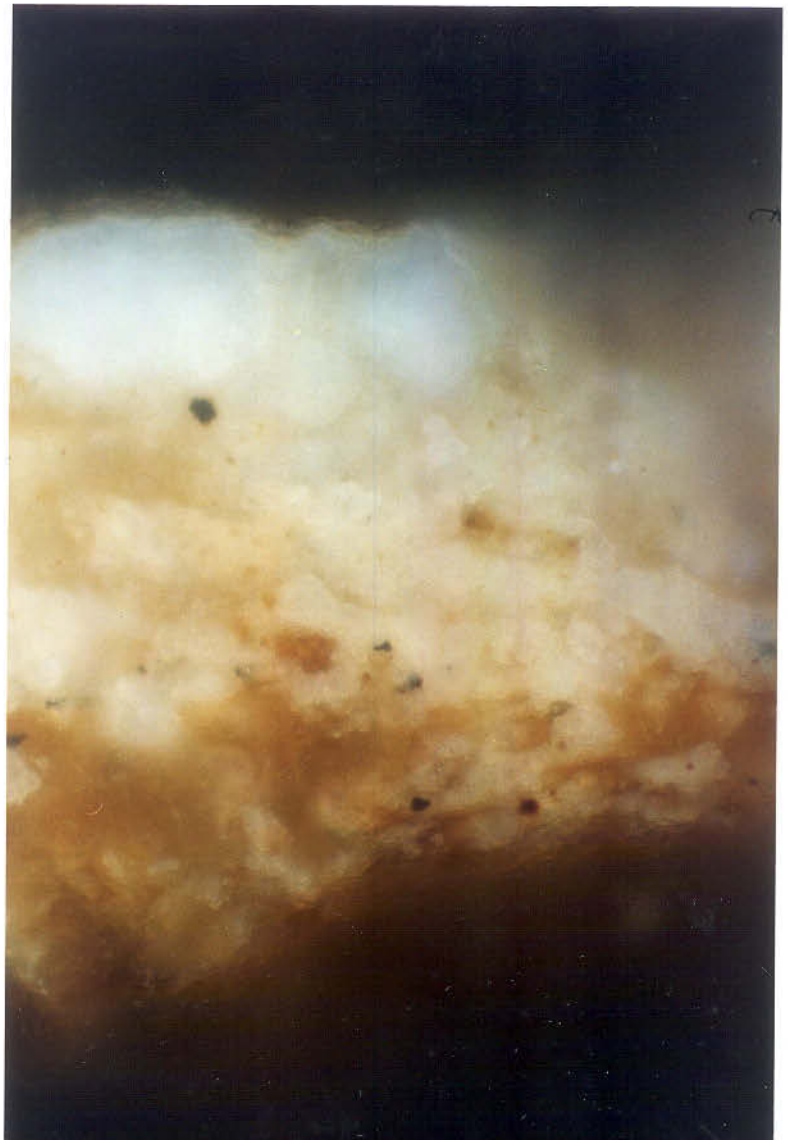
SAMPLE 3

The white penetrates the clean wood surface, and is therefore contemporary with it. The opaque brown layer over the top is seen in all the fragments from sample3, whether they are a thick layer of white or just a white smear, and is probably a combination of degraded lead paint and dirt.

[x200]

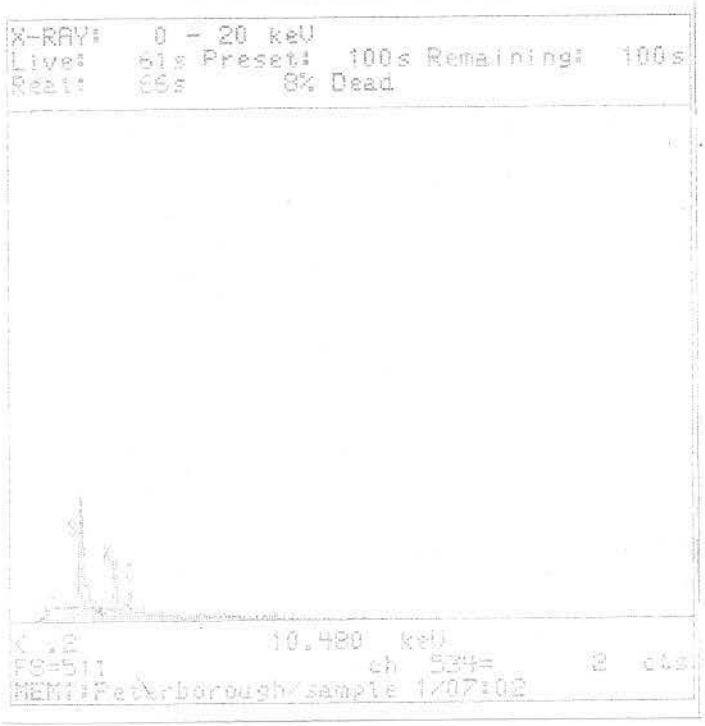


[x500]



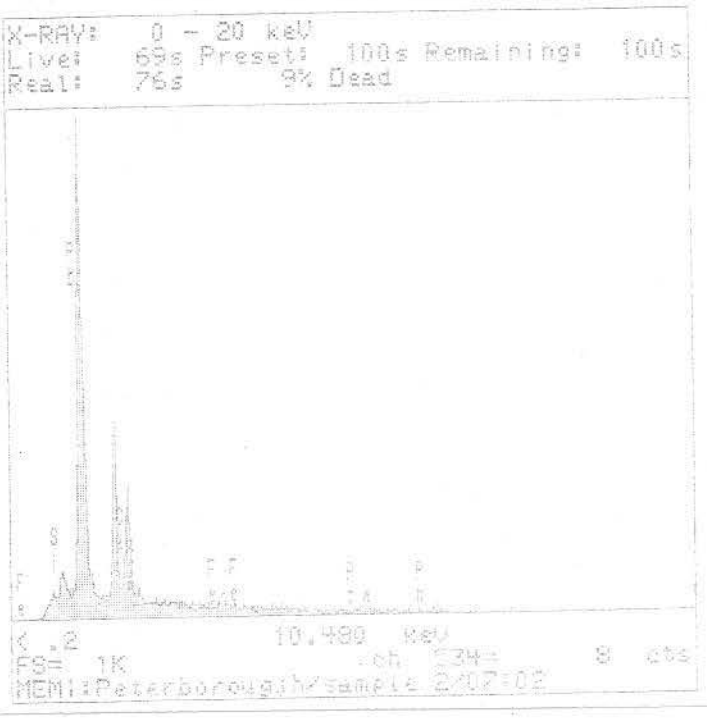
SEM Analysis of surface of
Sample 1

Calcium [Ca], sulphur [S] and potassium [K]



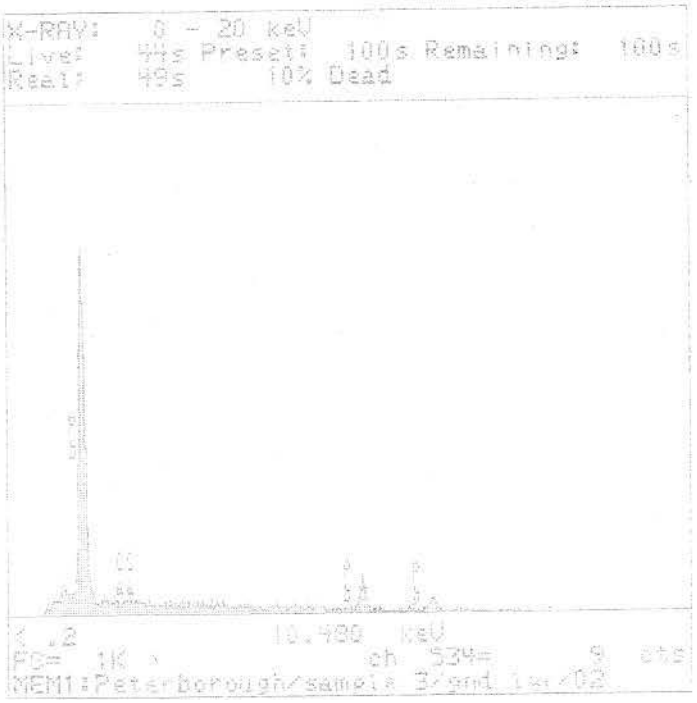
SEM Analysis of surface of
Sample 2

Leas [Pb], calcium [Ca] and iron [Fe]



SEM Analysis of surface of
Sample 3

Lead [Pb] and calcium [Ca] are the prinicipal elements detected.



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Jane Davies
69 Albert Terrace
Wolstanton
Newcastle-under-Lyme
Staffs
ST5 8AY

1 October 2002

Dear Jane,

Peterborough Cathedral, Transept Ceilings

Enclosed are nine paint samples from the South Transept ceiling as discussed together with a sheet of photographs and captions describing each sample. I appreciate that you may well have numerous queries since I have provided only limited general information about the ceiling.

Essentially the original oak ceiling boards are early thirteenth century: slightly earlier than the Nave ceiling boards. They are heavily weathered and in places have outlines of what must be the original paint scheme in relief, similar to the 'visible underpaint' on the Nave ceiling. We know there was a significant intervention in the 1660s. This from carved graffiti and from dendro results. A number of ceiling boards were replaced at that time. The replacement boards are also oak but easily distinguishable from the original boards. We do not know whether the ceilings were repainted at that time but hope you may find evidence one way or another.

The next intervention, as far as we are aware involved redecoration of the ceilings in the 1825/6: in the Cathedral accounts there is a document mentioning 98.75lbs of paint purchased for redecorating the Transept ceilings by the same firm that painted the Nave ceiling in 1835. In the 1890s all the ceiling boards were taken down so that much of the structure above could be renewed. The boards were repositioned but a large percentage of them were replaced at this time. The replacements being of machined oak. Our investigations suggest the surviving original and intermediate boards retained their painted decoration at the time they were fixed back into position. The archives tell us an estimate of £52 for the redecoration of the ceilings was submitted at that stage but the work was never carried out. Instead the surviving paint was stripped off the boards. Very little remains now. The best survival being found under overlapping edges when boards were taken down for dendro dating. In these instances it is clear that the overlaps were slightly increased when the boards were reattached in the 1890s: hence, when the paint was stripped off the exposed surfaces a band of decoration was protected by the overlap.

Obviously, we would like you to investigate the stratigraphy of the paint layers: particularly comparing the layer structure on the original and intermediate boards. Also the pigments and materials involved and how they compare with those on the Nave ceiling.

Do please ring me when you have had an initial look at the samples so we can discuss the matter.

With best wishes.
Yours sincerely,

Richard Lithgow
Enclosures

PETERBOROUGH CATHEDRAL, TRANSEPT CEILINGS: FIRE DAMAGE RESTORATION

SAMPLES OBTAINED BY M PERRY (AUG. 02) & R LITHGOW (SEPT. 2002)

Sample #	Location	Photo Neg #	Description of Areas Sampled
1	ST M5 f	2/21a	(detached intermediate board): Paint surviving under overlap proving that, in the 1890s, the paint was stripped from the surviving original and intermediate boards after the ceiling boards had been nailed back into position. Black from the tip of a black chevron (?). The residual painted decoration consists of a thin strip of white ground with a series of tips of black chevrons on an intermediate board. The decoration only became visible when the adjacent original board g was removed for dendrochronology. The black paint is very gritty and therefore similar to the 1740's paint found on the nave ceiling.
2	ST M5 f	2/21a	(detached intermediate board): White ground to the black chevron (see sample 1). This paint is also gritty in this area.
3	ST M/N/4/5	2/19a	Black paint on ceiling bolt & washer at junction of M4/5 & N4/5. The washer has remains of a white ground with black drawing.
4	ST M/N/4/5	2/19a	White ground from washer (as sample 3).
5	ST G8 j	2/18a	(original board) Black paint of faint chevron. The paint has been largely removed from the board surfaces in the 1890's and only faint traces remain of a chevron design on some original boards. This is often only a shadowy image. The residual paint on this board is quite thick and is flaking and crazing.
6	ST M5 g	2/16a	(detached original board): White paint from under lost nail head in an original groove. This sample is to identify both the visible white paint and any possible earlier paint layer that may remain in the groove.
7	NT E0 b	4/16	(detached original board): White paint surviving under overlap.
8	NT E0 b	4/16	(detached original board): Black paint surviving under overlap.
9	NT E0 b	4/15	(detached original board): Brown/black paint surviving on raised bun pattern design.
10	ST L/M/2/3	4/8	(original board) Paint showing around ceiling washer displaced slightly during 1920s intervention. Sample of the black paint apparently under the white and directly on the wood.

A typical lozenge showing the machined 1890s oak boards, some partially smeared with residue resulting from the stripping of painted decoration from the early thirteenth century original boards and the seventeenth century 'intermediate' boards.

A surface cleaning test using wishab sponges to remove the thick accretions of soot and surface dirt.across original and 1890s ceiling boards.

Six samples taken on 14 August 2002

1. Board M5 f (detached intermediate board): Paint surviving under overlap proving that, in the 1890s, the paint was stripped from the surviving original and intermediate boards after the ceiling boards had been nailed back into position. Black from the tip of a black chevron (?). The residual painted decoration consists of a thin strip of white ground with a series of tips of black chevrons on an intermediate board. The decoration only became visible when the adjacent original board (g) was removed for dendrochronology. The black paint is very gritty and therefore similar to the 1740s paint found on the nave ceiling. However, archive documents suggest the ceilings were redecorated in the 1830s.

2. Board M5 f (detached intermediate board): White ground to the black chevron (see sample 1). This paint is also gritty in this area.

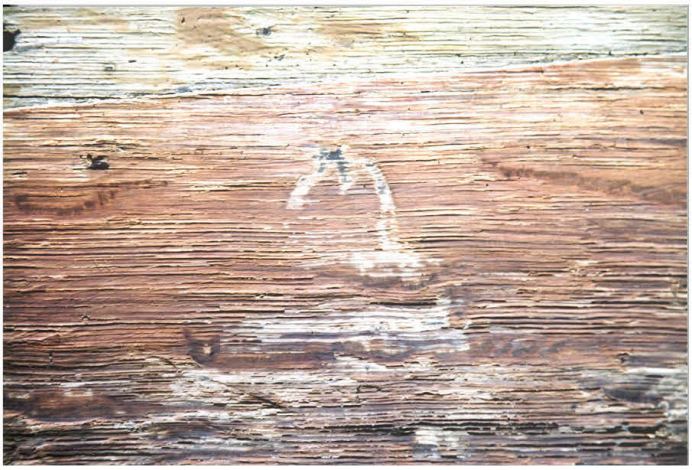
3. Black paint on ceiling bolt & washer at junction of M4/5 & N4/5. The washer has remains of a white ground with black drawing.

4. White ground from washer (as sample 3).

5. Board G8 j: Black paint of faint chevron (original board). The paint has been largely removed from the board surfaces in the 1890's and only faint traces remain of a chevron design on some original boards. This is often only a shadowy image. The residual paint on this board is quite thick and is flaking and crazing.

6. Board M5 g (detached original board): White paint from under lost nail head in an original groove. This sample is to identify both the visible white paint and any possible earlier paint layer that may remain in the groove.

Three samples taken on 3 September 2002



7 Board E0 b (detached original board): White paint surviving under overlap.

8. Board E0 b (detached original board): Black paint surviving under overlap.

9. Board E0 b (detached original board): Brown/black paint surviving on raised bun pattern design.

Raking light details showing some of the original painted decoration now showing as relief within the weathered timber surface.

APPENDIX 6: LIST OF PLATES

1. STRUCTURE ABOVE THE TRANSEPT CEILINGS

Plate 1 North Transept roof space, north wall showing top of mast cap which would have supported the first coffered ceilings together with empty board groove and noggin mortises possibly indicating original height of ceiling.

Plate 2 South Transept, west wall Bay J, showing filled pockets in masonry for Robert de Lindsey's tie beams to the second ceiling.

Plate 3 South Transept, west wall Bay D, showing filled pockets in masonry from Robert de Lindsey's tie beams to second ceiling. Also shown is one of J.L. Pearson's replacement tie beams and re-used medieval noggins from the second ceiling. Note type 'E' end condition. (**Drawing 8**)

Plate 4 North Transept, west wall Bay H. One of J.L. Pearson's ceiling traps showing re-used medieval noggin from second ceiling. Note type 'F' end condition (**Drawing 8**) also shown part of one of Leslie Moore's replacement laminated tie beams.

Plate 5 South Transept, west wall L. One of J.L. Pearson's ceiling traps using former medieval noggins from Robert de Lindsey's second ceiling. Note disused birds beak joints in ends, types 'D' and 'F'. (**Drawing 8**)

Plate 6 South Transept trap on east wall L, showing re-used medieval timber. Note disused joist on end.

Plate 7 South Transept west side Bay H, showing re-used medieval noggin as perimeter board joint. Note type 'C' birds beaked end condition and double row of original nail holes on upper surface indicating that this was originally in use the other way up as a board noggin in Robert de Lindsey's second ceiling. (**Drawing 8**)

Plate 8 South Transept west side, Bay 'D' showing re-used medieval noggin placed on its side as perimeter board joist. Note type 'E' end condition and single row of nail holes in original underside. (**Drawing 8**)

Plate 9 South Transept west side, Bay 'B' showing re-used medieval noggin as perimeter board joist. Note type 'E' end condition. (**Drawing 8**)

2. BOARDS, SOUTH TRANSEPT

Plate 10 Bay G, panels 3-4. Detail of ends of two original boards showing with-grain grooves (G3) and cross grained grooves (G4). Note impression of large headed original nail in G4 which does not transfer to G3 indicating that boards might have been matched rather than replaced in original position.

Plate 11 Bay K panel 2 boards 'f' and 'h'. Detail of weathering without rays (f) and adjacent cross-grained grooved board (h). Note empty original nail holes and modern stainless steel wood screws replacing Pearson nails where boards removed for dendrochronological sampling. Also part of original nail head visible in situ at overlap with board h.

Plate 12 Bay K panel 2 board f detached for dendrochronological sampling. Note extent of overlap with board h and original nail head in situ.

Plate 13 Bay M panel 7 original grooved wide board (f), showing surface weathering with rays and saw marks.

Plate 14 Bay C panel 6 boards a-c. Detail showing relief decoration in original board, Pearson nails and empty nail holes. Note also the dark globules of animal glue used in the 1920s as an

adhesive for the hessian backing material. In many places on both ceilings it had penetrated between the boards and through empty nail holes.

Plate 15 Bays J/H panel's 1-2 boards a-c. Detail showing cross-grained grooved original board. Note grooves not in correct position. Also shown is "ceiling bolt" type 7, in reality probably a large nail as they do not penetrate through the beams above. Note also surface weathering of boards and Pearson nails and empty nail holes.

Plate16 Bay N panels 4-5. Detail of type 7 "ceiling bolt" (large nail). Note original re-used washer bearing traces of paint decoration.

Plate 17 Bay C panel 4 board c. Detail showing line of original nail heads still in place over two boards possibly indicating an original noggin position. Note grooves in top boards and incision marks adjacent to centre nail.

Plate 18 Bay D panel 5 board f. Detail showing Pearson nail hole (LHS) adjacent to original nail hole (RHS)

Plate 19 Bay D panel 6 board e. Detail showing Pearson nail head adjacent to original hole.

Plate 20 Bay C panel 4. Detail of large domed head nail head and Pearson nails.

Plate 21 Bay M panel 5 board f. Reverse side of original board after hessian removed prior to dendrochronological sampling showing in situ clenched board edge nails.

Plate 22 Bay M panel 6 board c. Detail of board surface from below showing two way nailing into old support batten above (see also **Plates 70** and **73**). Note grooves in board edge.

Plate 23 Bay M panel 6 boards e and d. Detail showing surface condition of intermediate boards including "branching" and stainless steel replacement screws.

3. C17th INTERVENTIONS ABOVE THE SOUTH TRANSEPT CEILING

Plate 24 South wall. Detail showing hessian removed from top of C17th bracket supporting beam 14. Note part exposed tenon showing that south wall has possibly bowed and pulled away from ceiling. Note timber patches, possibly contemporary, with application of hessian.

Plate 25 West wall end of C17th beam 14, showing various redundant empty and filled joints. Note the arrangement of these joints is the same at each end suggesting that they are the remains of the previous roof structure of which the tie beam would have been an integral part.

Plate 26 East wall end of C17th beam 14. Note open slot mortise on end, filled dovetail joint on north face, central filled mortise on upper side and filled open joint on north face.

Plate 27 Mid span of C17th beam 14, showing large original scarf joint. Note original square sectioned wrought iron bolts with washers and wedges, centre line scribed across upper side, empty open joint on south face and pin hole on upper side.

Plate 28 Close up view of C17th wrought iron wedged bolts to beam 14 scarf joint. Note original bark still in situ under washer to left hand bolt. The adjacent rough edge of the beam is not due to subsequent defrassing but is where the bark was originally left in situ, a common occurrence on structural timbers' by the C17th not found on earlier work of quality.

4. C17th INTERVENTIONS BELOW SOUTH TRANSEPT CEILING

Plate 29 South wall. C17th east side bracket supporting beam 14.

Plate 30 South wall C17th west side bracket supporting beam 14. Note initials and date carved in side of lower section.

5. C19th. & C20th INTERVENTIONS ABOVE THE NORTH AND SOUTH TRANSEPT CEILINGS

6. C19th. & C20th INTERVENTIONS BELOW THE NORTH AND SOUTH TRANSEPT CEILINGS

Plate 46 South Transept bay C panel 1 board j. cluster of screw ends from Moore's laminate beam construction above. Note one or two screws have been removed leaving splintered timber. Note also original nail head, empty nail holes and glue drips from laying hessian.

Plate 47 South Transept bay N panel 3. Cluster of five nails – purpose not known, probably from Moore's time to secure board loosened by major splits. Note associated empty nail holes and adjacent nail head.

Plate 48 South Transept beam 12 where board removed for dendrochronological dating, the stratigraphy of Moore's laminates and the hessian either side of the pieces of diagonally laid 9mm oak boarding beneath can be seen (see **Drawing 8**)

Plate 49 South Transept beam 12 as for **Plate 48** but showing detail of diagonally laid oak boarding. Note varnished surface. It appears to have been laid by Moore probably as packers but it's true significance is unknown. Note new stainless steel screw fixing in original board adjacent, suitably camouflaged with acrylic paint so as not to pick up light when seen from ground level.

Plate 50 South Transept beam 5 showing Moore's adaptation of Pearson's wrought iron Queen Post strap (see also **Plate 31**). Note filled Queen Post mortise on top of beam and vertical notch in side of beam to accommodate strap before being re-aligned by Moore out of the vertical.

Plate 51 North Transept beam 7 showing lapping arrangement for Moore's composite cambered beams, longitudinal beams and stepped laminated ceiling beams under (see **Drawing 4**).

Plate 52 North Transept beam 7. The same view as for **Plate 59** but photographed under raking light to pick up detail of Carpenter's assembly marks for composite beam cores.

Plate 53 North Transept. General view of Moore's composite ceiling trusses showing camber. Note Blore's independent roof trusses above.

Plate 54 North Transept beam 4 showing mild steel channel section inserted into west wall to pick up end of Moore's composite ceiling truss. These mild steel channels are of varying lengths and were inserted at both ends of beams 4, 5, 7, 9, 11 and 13 at some period after Moore's work was completed in 1924. Why this was deemed necessary is not known. Note: empty coach screw holes where softwood bearer removed from oak principal noggin to insert channel. Note empty mortise and cut end of re-used noggin where sample removed for dendrochronological analysis.

Plate 55 South Transept bay M panel 6 board c showing worm trails in the glue surface on the reverse of the hessian when board was removed for dendrochronological analysis.

Plate 56 South Transept as above.

Plate 57 South Transept bay M panel 6 board c, showing original board surface after removal of hessian preparatory to dendrochronological dating. Note worm tracks and blackened glue patches also surface wet rot damage.

Plate 58 South Transept bay N panel 9 board g. Detail of reverse of intermediate board removed for dendrochronological dating and showing evidence of wet rot damage in area covered by temporarily removed triangular shaped wooden patch which has been perimeter glued not nailed suggesting that it was covered with hessian application.

Panel 59 North Transept bay E panel 0 showing boards after cleaning but before original grooved boards b and c removed for dendrochronological dating.

Plate 60 South Transept bay E panel 2 after cleaning but before original plain and grooved boards h, g and f removed for dendrochronological dating. Note redundant hole below Moore composite beam 6 filled from behind with diagonal boarding. A number of these redundant holes remain

on both ceilings, rather more in the South Transept than in the North Transept, their purpose has not been identified.

Plate 61 South Transept bay M panel 5 after cleaning but prior to removal of boards for dendrochronological dating. Note original wide board and remaining paint shadow on original boards. Note Pearson's re-nailing using original nail holes, also empty nail holes.

Plate 62 South Transept bay M panel 6. Notes as for **Plate 61**.

7. TREATMENT TO THE STRUCTURE

Plate 63 North Transept – initial vacuum cleaning of exposed surfaces in roof space (Bob Chappell of Hugh Harrison Conservation team). Compare cleaned panels with uncleaned foreground panel.

Plate 64 North Transept Bay E, panel 1 after cleaning but before original grooved boards c and d were removed for dendrochronological dating. Note loose splinter identified for repair temporarily taped to board d.

Plate 65 South Transept. Bob Chappell of Hugh Harrison Conservation team removing ceiling bolts for condition inspection, greasing and insertion of Plasterzote washers. Note Acro prop in position to support ceiling panels during inspection operation.

Plate 66 South Transept. Bob Chappell of Hugh Harrison Conservation team releasing boards for dendrochronological dating after cleaning.

Plate 67 South Transept bay M panel 6. Cameron Stewart of Hugh Harrison Conservation team removing nails from cleaned boards prior to releasing the boards for dendrochronological dating.

Plate 68 North Transept bay C panel 1 after removal of original boards for dendrochronological dating. Note temporary ladder access to roof space above.

Plate 69 South Transept Bay M panel 6 viewed from below. The original boards have been removed for dendrochronological dating from below leaving the intermediate board and strengthening batten in situ together with the hessian over. The light colour indicates the glue backing which has taken the surface imprint of the wooden boards, the dark stains represent areas where glue did not adhere to the hessian permitting dirt discolouration to the fibres.

Plate 70 South Transept bay M panel 5 viewed from below. Notes apply as for **Plate 69**. Note also iron staining from clenched over edge fixing nails.

Plate 71 South Transept bay M panel 5 viewed from above. The hessian has been carefully lifted from the original boards preparatory to their removal for dendrochronological dating and cut out in large panels with a Stanley knife to be replaced and wax sealed later. Where later boards are not being removed the hessian has been left in place. Darkened areas show discoloured glue which did not adhere to the hessian when laid.

Plate 72 South Transept bay M panel 6 viewed from above. Notes apply as for **Plate 71**. Note that hessian can still be seen having been left on top of the boards which were not removed.

Plate 73 South Transept bay M panels 5 and 6 showing reinstatement repairs following removal of original boards for dendrochronological dating. Note new oak noggin inserted to support the boards after refitting. Battens were inserted above old nail holes where nails had been previously fitted to lock the edges of the boards together but in this case screws and washers were used to actually carry the boards from the new noggin. The boards were very fragile and the noggin was placed in the centre of the panel where the maximum support was required. Note that the hessian was replaced with trips of sail cloth covering the positions where the hessian had been cut.

Plate 74 South Transept bay K panel 8 showing reinstatement repairs following removal of intermediate boards for dendrochronological dating. Notes apply as for **Plate 73**.

Plate 75 North Transept bay M west side. Detail showing re-used medieval timbers as noggins. Note empty birds beak joint laid on its side and end of noggin in foreground removed for dendrochronological dating. After dendrochronological analysis by Sheffield University, these ends were refitted in their original position.

8. THE PAINTED DECORATION

Plates 76-79 South Transept bay M, panel 5, board f. All the boards in this panel were removed from the ceiling for dendrochronological dating. In **Plates 76 and 77** board f - a C17th (intermediate) replacement board - is still in place. Paint surviving under the overlap proves that, in the 1890s, the paint was stripped from the surviving original and intermediate boards after the ceiling boards had been nailed back into position. The residual painted decoration consists of a thin strip of white ground with a series of tips of black chevrons on an intermediate board. Paint sample analysis (Samples 1 and 2) indicates the paint is very similar to that used on the Nave ceiling in the 1740s restoration. It would seem likely the Transept ceilings were also repainted at that date; although no documentary proof has been found.

Plate 80 South Transept bay N, panel 8, board j. Following the removal of the adjacent board this intermediate board was found to have white background paint surviving under the overlap. The white paint appears similar to that shown in the previous series of plates. No paint samples were taken from this board.

Plates 81 & 82 North Transept bay E, panel 0, board b. This detached original board has white and black paint on the overlapped edge and what appears to be traces of a bun pattern (as on the Nave Ceiling) surviving on the exposed surface (see also **Plates 90 and 91**). The overlapped paint (Samples 7 and 8) is very similar to that found on the intermediate boards described above. Sample 9 from the bun pattern trace showed a white ground with a dark brown surface paint. The brown being characteristic of the coarse brown-black found extensively on the Nave Ceiling and attributed to the 1740s.

Plate 83 North Transept bay E, panel 2, board g. Detail in raking light showing more white and black paint on an overlapped edge. No paint samples were taken from this board.

Plates 84-86 South Transept bays L/M, panels 2/3. Paint showing around a loose ceiling bolt that must have moved slightly when the joist above was replaced in the 1920s restoration. In **Plate 84** a fragment of red paint is visible over the white and black paint. This may be red lead paint from the reverse of the washer. A sample (Sample 10) taken of the black paint apparently under the white and directly on the wood showed no evidence of paint.

Plate 87 South Transept bays F/G, panels 7/8. The painted design follows the arrangement of the Ceiling boards to form interlocking rows of diamond-shaped compartments, with alternate rows ending with half compartments. The inner boards of each compartment are decorated with a cross. Embellished versions of the Cross Fleurie and the Cross Treflée are used. The compartment shown in this photograph has the shadow of a cusped frame around a Cross Fleurie. Around this a plain, dark coloured lozenge shaped band is just visible and then a dogtooth pattern in black.

Plate 88 South Transept bay C, panel 7, board a. A central lozenge board with the faint shadow of dogtooth border design. The decoration proves this original board must have been cut down and moved during the 180s restoration works.

Plate 89 South Transept bay D, panel 6, board f. Raking light detail of this heavily weathered original board showing the prominent medullary rays. Some of these rays resemble exactly the masking effect of the painted designs whereby the paint protects the underlying timber from a degrading factor such as weathering, while the surrounding, less protected timber has receded. Consequently it was not easy to determine what constituted evidence of the original paint

scheme and what was the effect of weathering. In fact, within the outer half of this board there is the shadow of a black dogtooth pattern.

Plates 90, 91 North Transept bay E, panel 0, board b. This detached original board has white and black paint on the overlapped edge and what appears to be traces of a bun pattern (as on the Nave Ceiling) surviving on the exposed surface (see also **Plates 81 and 82**). The bun pattern outline is raised, as are some of the outlines of the crosses, suggesting the original scheme was linear.

Plate 92 South Transept bay G, panel 0, board j. Original board with a black, dogtooth paint shadow. There is a characteristic light halo effect outside of the teeth. We have no explanation for this effect

Plate 93 South Transept bay G, panel 8, board j. The paint had been largely removed from the board surfaces in the 1890's and only faint traces remain of a chevron design on some original boards. This is often only a shadowy image. This detail of an original board with a black, dogtooth paint shadow shows tiny fragments of a full thickness paint layer. The residual paint on this board is quite thick and is flaking and crazing. A paint sample was obtained and analysed from this area. The results showed this brown/black paint to be very similar to that used on the Nave ceiling in the 1740s restoration.

Plate 9 South Transept bay M, panel 5, board g. Detail of a detached original board, where white paint is present in an original groove, below a lost nail head. A sample was taken in order to identify both the visible white paint and any earlier paint layer which may remain in the groove (Sample 6). No upper white layer was found in the sample but a beige layer similar to that present on Sample 2 mingled with the medium rich deep brown layer. The apparent mingling of these layers suggests they are of the same date. The fact that they were found under a missing nail head suggests they are from an early scheme.

Plate 95 South Transept bay N, panel 0, board s2. Pencilled graffiti found on an 1880s board adjacent to the boiler flue. The inscription reads '*HS Burleigh Oct. 26th 1911*.'

Plate 96 South Transept, north wall. Detail of the 1886 date stone and underneath graffiti written in blue '*S Bird 1887*.'

Plate 97 South Transept, bay J, panel 3. A surface cleaning test using Wishab sponges to remove the thick accretions of soot and surface dirt across original and 1890s ceiling boards.

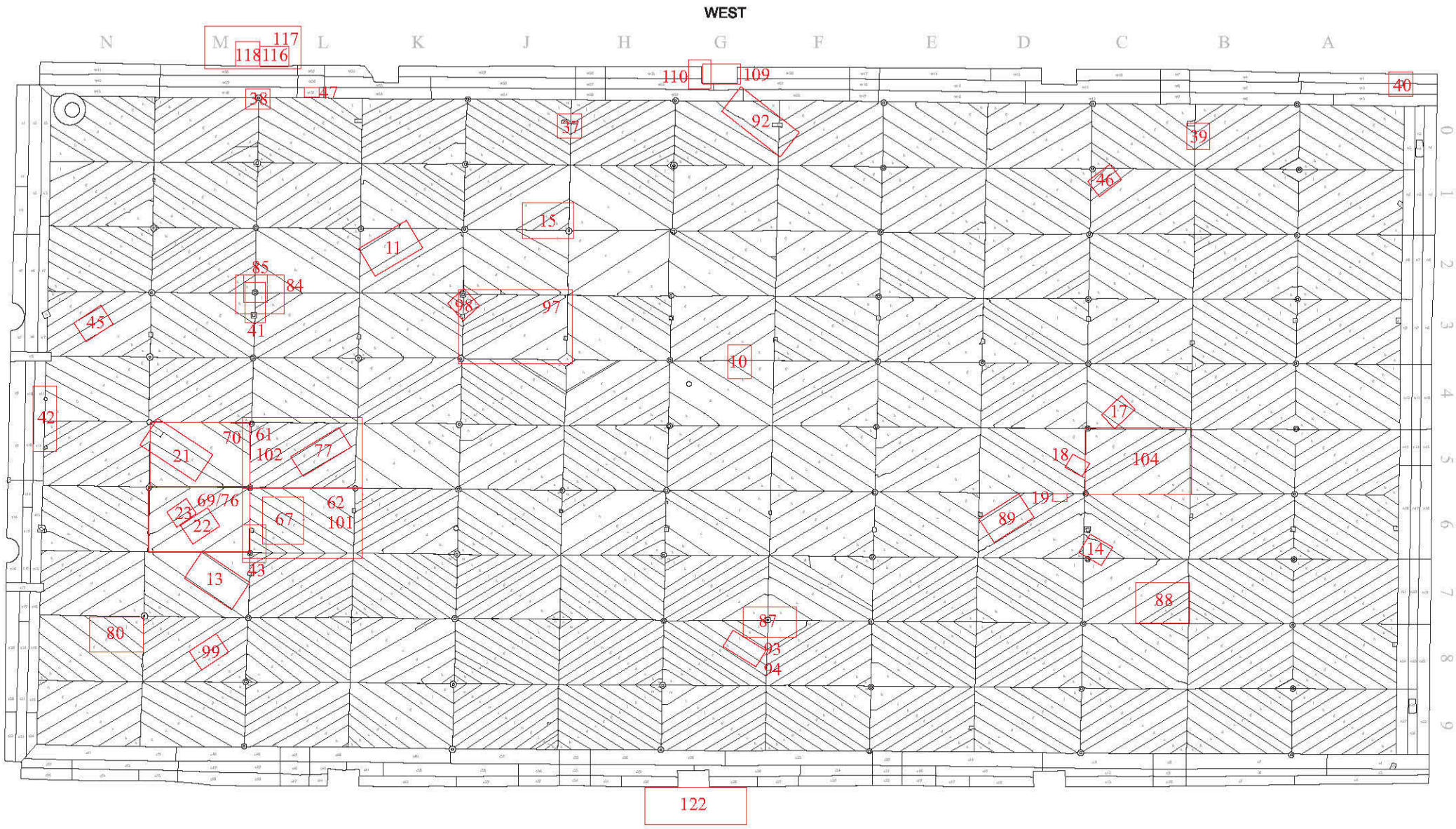
Plate 98 South Transept, bay K, panel 3, boards g,h,i. Detail of a cleaning test carried out to determine whether it will be possible or desirable to remove the darkened coating and what was thought to be a white ground partially smeared over many of the 1890s boards adjacent to early boards. From preliminary analysis of samples of these coatings and subsequent observations it became clear these were residues from the 1890s paint stripping process.

Plate 99 South Transept, bay M, panel 8, board d. Detail showing a cleaning test using deionised water to remove a dark stain remaining on the wood after removal of the soot and surface dirt. The staining was successful removed leaving the affected wood only marginally lighter.

Plates 100-105 Photographs of panels that have been partially cleaned with Wishab sponges. These serve to illustrate the discolouration that had resulted from the thick surface dirt and soot accretions. The Wishab cleaning was effective on original, intermediate and 1890s.

Plate 106 South Transept, bay M, panel 1. Detail of an original board, after surface cleaning with Wishab sponge, showing an accumulation of glue on the edges of a split in the board. The water-soluble animal glue was used to adhere hessian to the Ceiling boards upper side during the 1920s intervention. In many places the liquid glue penetrated between gaps in the boards forming drips on board edges and in empty nail holes etc.

Plate 107 A conservator at work removing glue from a board edge. The glue was effectively removed by swabbing with warm water. On drying the underlying wood appeared slightly lighter than if it were cleaned with Wishab sponges only.



KEY

Sheet Number: 1 Location of Plates: 1 - 130

SCALE c. 1:70

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

The Perry Lithgow Partnership
1 Langston Lane, Station Rd, Kingham,
Oxon OX7 6UW Tel. 01608 658067

POSITION

TITLE: PLATE REFERENCE SHEET

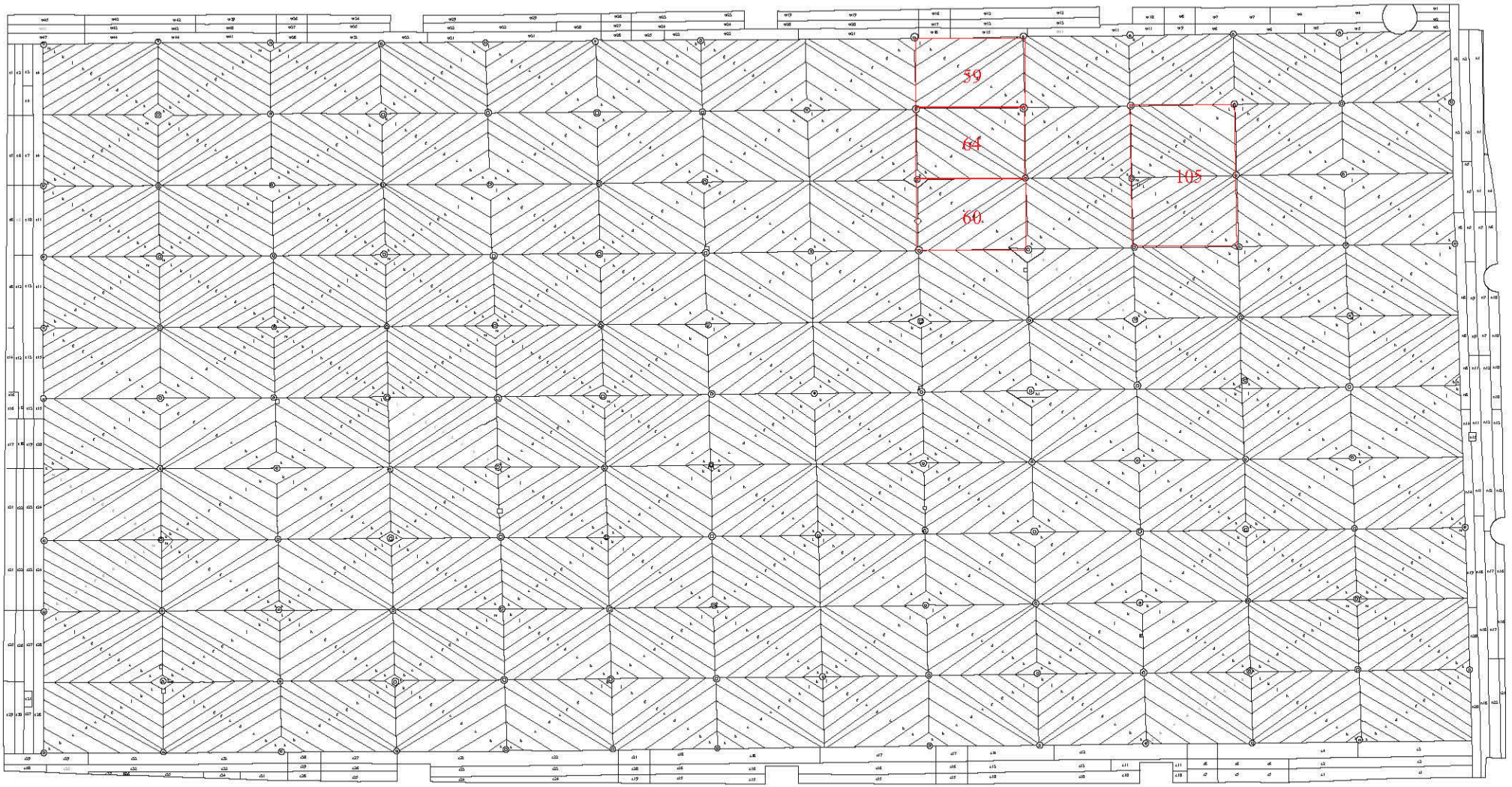
PROJECT: PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA: SOUTH TRANSEPT CEILING

0 1m 2m 3m

WEST

N M L K J H G F E D C B A



EAST

KEY

Sheet Number: 2 Location of Plates: 59, 60, 64, 105

SCALE c. 1:70

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION

SOUTH NORTH

TITLE PLATE REFERENCE SHEET

PROJECT PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA NORTH TRANSEPT
CEILING

0 1m 2m 3m

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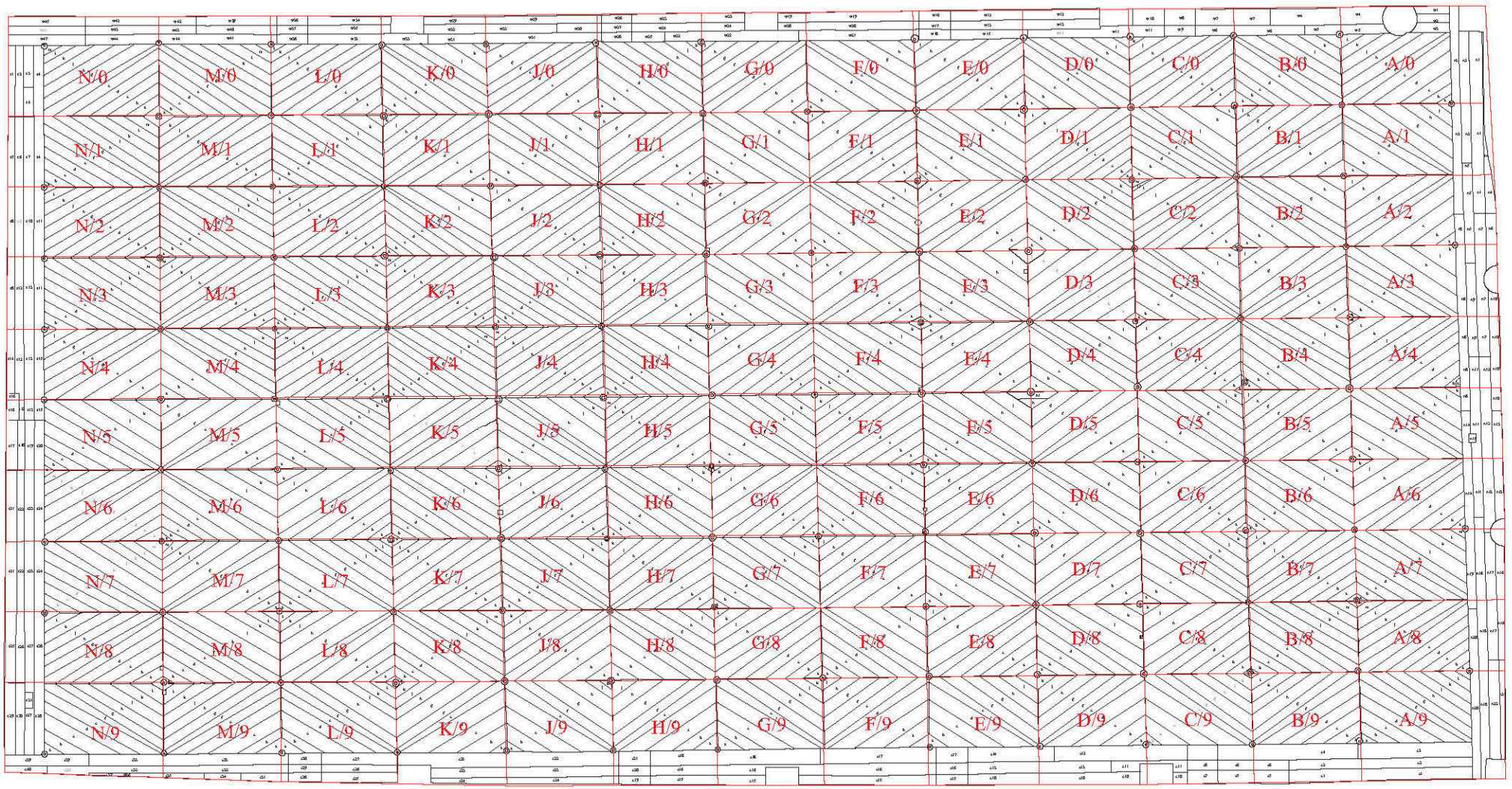
WEST



EAST

KEY

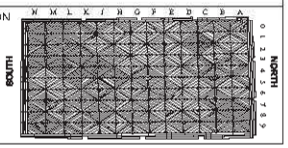
Sheet Number: 3

Location of Plates: North Transept ceiling panels after treatment

SCALE c. 1:70

Photogrammetry by:
The Downland Partnership
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



TITLE
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PROJECT
PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA
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CEILING

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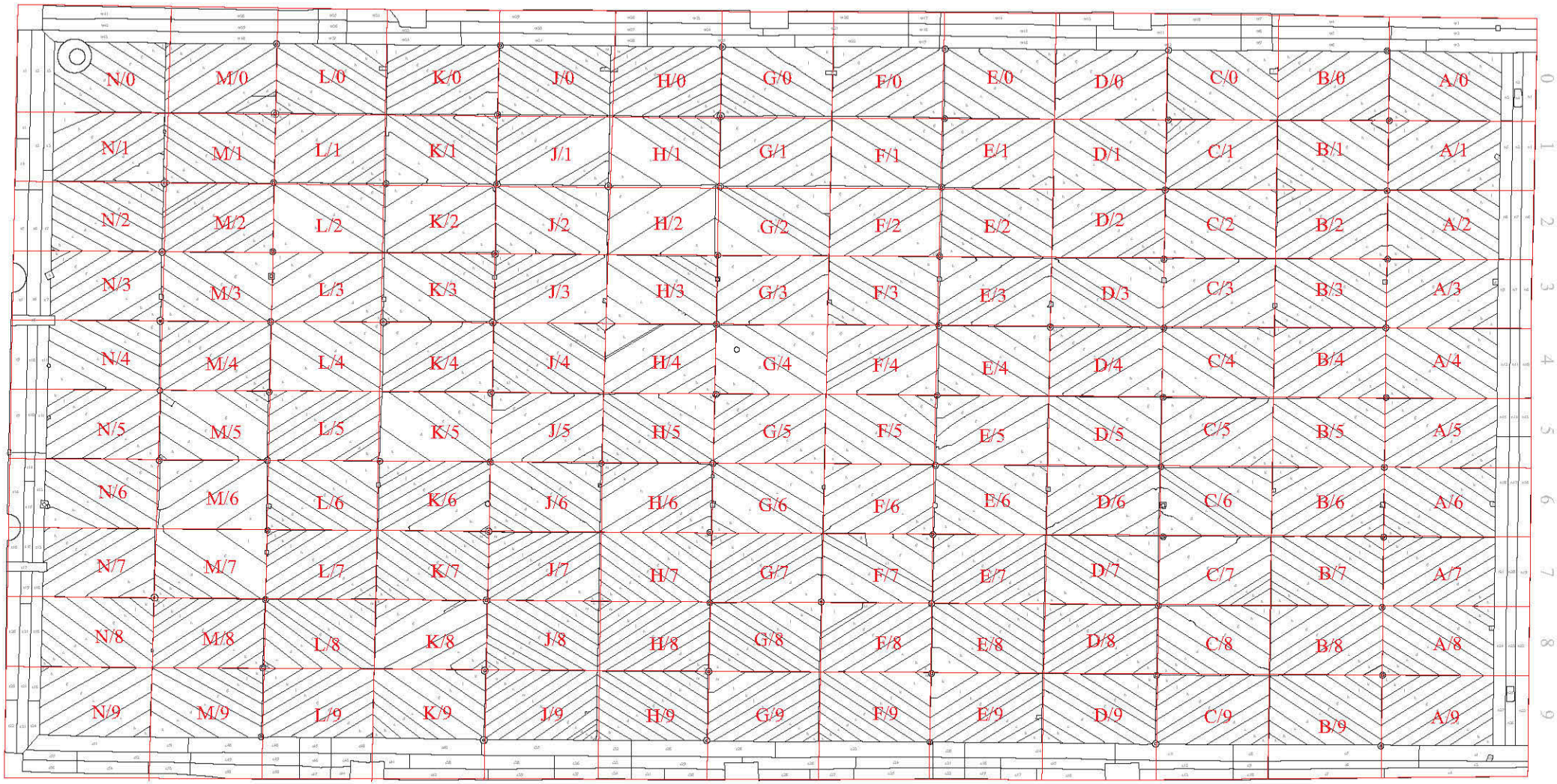

EAST

KEY

Sheet Number: 4

Location of Plates: South Transept ceiling panels after treatment

SCALE c. 1:70

Photogrammetry by:
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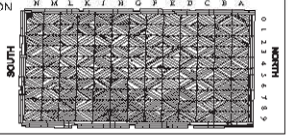
Lychgate House, Ramsbury
Wiltshire SN8 2PB

POSITION



TITLE: PLATE REFERENCE SHEET

PROJECT: PETERBOROUGH CATHEDRAL
Restoration of Fire Damage
July-October 2002

AREA: SOUTH TRANSEPT CEILING

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