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Condition survey of the wall paintings within the Chantry Chapel, Church of St Michael and All Angels

Skelbrooke, Diocese of Sheffield

January 2017

SKELBROOKE
SOUTH YORKSHIRE

Summary

Project	Condition survey of the wall paintings within the Chantry Chapel, Church of St Michael and All Angels.
List Entry Number:	1314783
Listing:	Grade II
Date first listed:	05-Jun-1968
National Grid Reference:	SE 51118 12088
Name and address of Client	Dr Ruth Roche Church Warden c/o Church of St Michael and All Angels Straight Lane Skelbrooke South Yorkshire DN6 8LX
Name and address of Conservator	Hirst Conservation Laughton, Sleaford Lincolnshire NG34 0HE
Date of survey	27th October 2016
Authors and date of condition survey report	Amanda White and Sabina van de Bruck ACR Hirst Conservation November 2016-January 2017
Methods employed	Visual inspection of the exterior of the Chantry Chapel; Visual inspection of the wall paintings in visible light; Moisture profiling of the wall paintings and surrounding areas; Preliminary analysis of surface salts; Paint analysis; Mortar analysis; Cleaning tests; Digital photography; Written and diagrammatic documentation.

Contents

1. Introduction

At the request of Dr Ruth Roche, Hirst Conservation were commissioned to undertake an investigation into the condition of the wall paintings within the Chantry Chapel at the Church of St Michael and All Angels, Skelbrooke, South Yorkshire, Diocese of Sheffield.

The assessment was undertaken by Sabina van de Bruck ACR and Amanda White on the 27th October 2016. The assessment was undertaken from ground level and utilising an inspection ladder. Moisture profiling and analysis of surface salts were carried out in the areas visibly affected by salts and moisture and limited paint and mortar samples were taken for analysis back at Hirst Conservation's laboratories.

The following document encompasses the results of the on-site inspection and analysis results, as well as recommendations for further investigation and treatment.

2. Brief history and description

The information including in this section of the report is taken from numerous sources: Historic England's List Entry Summary (see Appendix 1); Pevsner's *Buildings of England*; Wiles and Maguire's 2015 Quinquennial Inspection; Ronald Sims' 1991 Report on the Conservation of Wall and Roof Paintings (see Appendix 3); the CARE file for the Church held at the Church of England Record Centre (see summary report by Karen Averby of Archangel Heritage in Appendix 2) and from various archival documents supplied by Dr Ruth Roche. Some of the information contained within the various documents is contradictory, but an outline summary is provided below.

2.1 Church of St Michael and All Angels

Skelbrooke is a small village or hamlet located approximately seven miles north-west of Doncaster. The Grade II listed Church of St Michael and All Angels is medieval in origin but was largely rebuilt in 1872 by Leicestershire architect Joseph Goddard following a major fire. According to the Yorkshire Archaeological Journal, it was originally built sometime between 1180 and 1220, dedicated to St Michael, and in the patronage of St Mary Magdalene.

Figure 1: Exterior of the Church of St Michael and All Angels (north elevation). The Chantry Chapel can be seen to the left of the photograph.[1]

Following the fire, work to rebuild the church started on 5th September 1871 and was completed in 15 months, with the Archbishop of York delivering the sermon at the opening service on 6th December 1872. The church consists of an aisleless nave, chancel with vestry to the south and Chantry Chapel to the north side, west tower and south porch. Much of the original stonework is believed to have been used during the rebuilding. Most of the internal features are Victorian, including stained glass windows by Heaton, Butler and Bayne, although there are medieval remains including

[1] Taken from website: http://mapio.net/pic/p-51246740/, accessed 22/11/2016.

the chancel piscina, thought to date to the 14th century[2], a carved decorated canopy on the north wall of the nave and the rood loft stairs in the south wall of the nave.

2.2 The Chantry Chapel

The chantry chapel is on the north side of the church, separated from the chancel by a double chamfered arcade which has an octagonal pier with a broach-stopped base[3]. This arcade is thought to be associated with a chantry dedicated to St John the Evangelist, which Hunter (*History of South Yorkshire,* 1831 Vol.II p.459) records as having been founded in 1338: *"On 4th June, 1338, at Skelbrooke a chantry was ordained in the chapel there by Agnes le Boteler, sometime wife of Edmund le Boteler…".* The Butlers were the early Lords of Skelbrooke, and the present Skelbrooke Hall is thought to be on the site of the former home of the Butlers.

According to the Yorkshire Archaeological Journal, the Chantry was destroyed during the reformation and the site occupied by a mortuary chapel. Percival Arthington was the incumbent at the Chantry Chapel when Henry VIII's Commissioners confiscated Agnes Butler's endowment and the goods of the Chantry in 1549, and had the Chapel pulled down and the arches bricked up.

When the Church was rebuilt in 1872 following the fire, the Chapel was restored by the Neville family who owned the estate at that time. The dedication reads:

Until the day breaks
Here rests the body of
Rhode Marwood Nevile
Daughter of Harry Farr Yeatman of Stock Gaylard, Dorset
Wife of P.S. Nevile JP of Skelbrooke Park.

Born 2 April 1841, married 3 October 1865, died 3 October 1866

This chapel was built and beautified by her mother brothers and
sisters in memory of her gentle life.

The walls and roof timbers of the chantry are richly adorned with finely detailed high Victorian paintings, which include gilding and applied stars. No information regarding the artist and the exact date of painting has been found to date. The small windows in the chantry depict the opening verses of the book of Revelation, and most are in memory of members of the Neville family.

2.3 Relevant previous interventions

Although during the course of research for this current phase of investigation, no information relating to direct interventions to the wall paintings was found, details of limited works to the building envelope were outlined in a selection of previous reports.

[2] Historic England List Entry Summary from website: https://historicengland.org.uk/listing/the-list/list-entry/1314783, accessed 10/11/2016.
[3] Historic England List Entry Summary from website: https://historicengland.org.uk/listing/the-list/list-entry/1314783, accessed 10/11/2016.

RG Sims' August 1991 *Report on the Conservation of Wall and Roof Paintings to the North East Chapel* (see Appendix 3) describes how the plaster to the walls has deteriorated through water penetration, causing much of the base to come away or loosen. This was particularly noticeable on the east and west walls and above the valley gutter between the Chapel and Chancel. According to Sims:

> *"Roof repairs have been carried out in the recent past and precautions taken to ensure the water in the valley gutter can be discharged through overflow chutes in the event of a blockage. The walls have had some two years in which to dry out. Salting has virtually ceased."*

Sims goes on to make recommendations to stabilise and repair the plaster, which includes careful removal of the cement repair to the east wall, followed by cleaning and restoration of the paintings.

The CARE file for the Church (35/181 Skelbrooke St Michael and All Angels) also contained an extract from a 1997 quinquennial inspection report that commented as follows:

> *"The decorative murals in the North-East Chapel together with the polychromatic decoration of the ceiling joists and panels is of the highest quality. Unfortunately, it has suffered due to damp penetration from the defective lead-lined inner gutter which has since been repaired. Whilst the plaster itself is still eroding, extensive salting has mostly disappeared indicating that the walls are now relatively dry. It is of the greatest importance that the gutter is kept well cleaned out as any back-up will cause the problem to reoccur."*

At the time, both reports were sent to Andrew Argyrakis of the Council for the Care of Churches, but on both occasions, concerns were raised regarding the proposed conservation works, and in September 1997 Mr Argyrakis writes to recommend the parish commission a detailed technical survey and condition report from experienced conservators. A summary of the correspondence relating to the paintings can be found in Appendix 2 of this document.

The latest quinquennial inspection report dated 2015 by Wiles and Maguire, records widespread damage to the plaster surfaces in the Chantry Chapel, but also states that it does not look as if they have significantly deteriorated since the last inspection. The report also notes that minor repairs to the external stonework and internal decorations have been carried out in the last five years.

3 Condition survey

3.1 Building envelope

The church is located centrally to the small hamlet of Skelbrooke and the surrounding land is relatively level, but drops down to the river further away from the church. There are numerous large trees in relatively close proximity to the church.

The church is constructed of regular coursed limestone and as the geology of the area is magnesian limestone, it may be assumed this local material was used in the construction of the church. The condition of the stonework and pointing generally appears to be good. The pointing is of the moulded type and looks cementitious in most parts, although there are small patches of more recent pointing repairs which appear to be lime based.

Figure 2: Overview of the Chantry Chapel roof, showing slipped and damaged tiles.

The Chantry Chapel is located on the north wall of the Chancel and it appears to be constructed of the same materials as the main body of the church. The roof is constructed of red terracotta tiles with ornamental ridge tiles, see figure 2. There is some moss growth and a few broken and split tiles, but generally the roof appears to be in good condition. There is also evidence that individual tiles have been replaced in the past.

Figure 3 & Figure 4: Detail of damaged stone slabs to east gable (left) and west gable (right).

The edges of the roof at the gable ends are constructed of stone slabs carved to slot into each other forming a stepped ridge to shed water. On the east gable end, several of the stone slabs have losses and fractures, see figure 3, which may be causing water to run down the face of the elevation, possibly causing some of the damage to the stonework and pointing noted below. The lowest stone slab on the west gable end has also got a crack through to the bottom, see figure 4, which may be allowing moisture to ingress. The flashing material appears to be cementitious and an area mid-way up the west end of the roof has detached from the gable end, see figure 5.

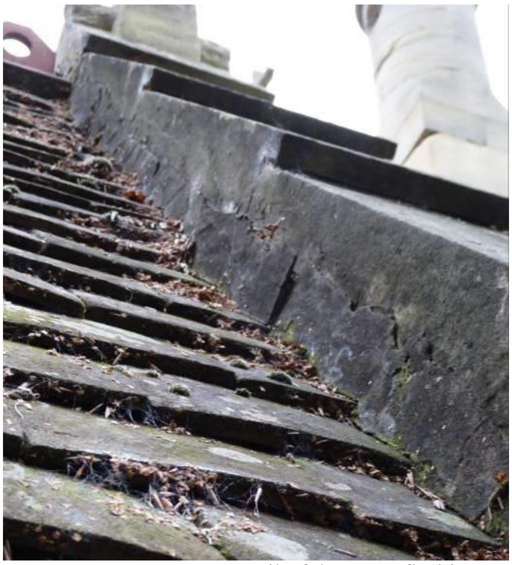


Figure 5 & Figure 6: Detail of damages flashing to west end of roof (left), and west elevation (right)

There is a string course on all three elevations of the Chapel at about 1.20m height and there is a projecting plinth at the base of the wall. The floor height of the interior of the chapel comes mid-way up the exterior plinth. Fractures and losses to the pointing in this area are likely to be resulting in moisture ingress.

The stonework to the west elevation, see figure 6, generally looks in good condition, apart from around the doorway and to the cornice. The doorway reveals have back weathered considerably with extensive losses, holes, scaling, flaking and powdering of the stone surface, see figure 7. This damage appears to be ongoing but has seemingly developed over a long period of time, as there is evidence that gaps have been filled in the past. There are loosened mortar repairs, which are cementitious and also causing further deterioration to the stone.

In addition, the right (south) side of the moulded arch shows extensive stone deterioration which is associated with water damage, see figure 8. There is a downpipe with a lead hopper in the adjacent corner where the chapel joins the main body of the church. The gutter appears to drop towards the end and it is fitted with a gutter brush which is intended to prevent leaves from settling in the gutter. We were informed by the vicar that this brush was put in at some point over the summer after the gutters had been cleaned out. Leaves are clearly trapped in the bristles.


Figure 7 & Figure 8: Details of damages around the doorway.

The lead hopper has been moulded to form a drip channel facing away from the building, which is presumably a precaution in case the hopper over fills and the downpipe does not dispose of the water fast enough. There is an area of lead flashing on the wall that leads down into the hopper and this has mildew at the bottom of it, suggesting issues with moisture. There are also areas of mildew growth in the corner which may be related to water over shooting the guttering and blowing back onto the wall. On the day of the site visit the sky was over cast but there was no rain, so it was not possible to see how the water was disposed, however, the corner does not appear to be particularly wet and does not show extensive algae or moss growth. There may have been issues with poor rainwater disposal in the recent past, but this appears to be remedied at present in this area.

Figure 9: Overview of the north elevation

Erosion of the stone surface is evident in the east corner of the north wall suggesting that water has been over-flowing in the past, or is currently over-flowing. There is also an area of very damp looking stone to the north-west corner which may relate to water over-shooting the gutter and running down the wall, as some water run-off staining is evident, see figure 11.

Figure 10 & Figure 11: Detail of debris in gutter and gutter brush (left), overview of water damage below string course (right).

There is erosion to the stone surface in several areas notably behind the down pipe in the centre of the elevation, see figure 12. This could possibly be due to the wind channelling in that area, or could be related to a leak in the down pipe or hopper in the past. As the stone in this area is presently dry, and there is little or no biological growth, if the deterioration was due to moisture penetration, this issue appears to have been resolved. There is an area of eroded stonework below the string course, which is situated directly beneath the junction of two sections of guttering.

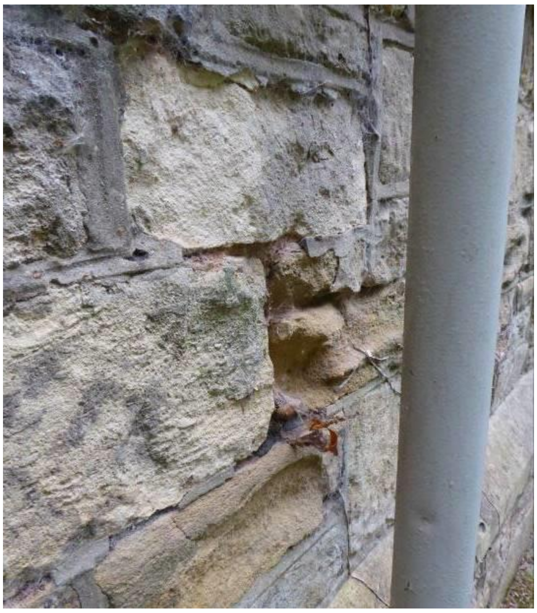


Figure 12 & Figure 13: Detail of area of deep erosion behind downpipe (left), overview of new lime pointing above string course (right).

The pointing has been replaced in many areas, especially to the upper wall above the string course, and looks generally sound, see figure 13. Below the string course the pointing is more modern and appears to be lime based. However, the older pointing below this is the thick moulded type, which appears to be cementitious, with small patches of later re-pointing. The stone has eroded in places, especially in this area, possibly due to the inadequate pointing mortars. There are also some failing and open joints to the lower part of the stonework, especially in the north east corner where moisture will be able to penetrate.

Figure 14 & Figure 15: Overview of east elevation (right), detail of lead hopper and flashing (right).

The stonework and pointing to the east elevation generally appears to be in good condition with predominantly moulded historic cement pointing present, see figure 14. However, small patches of repair above the window and in the north east corner were noted and some deterioration below the moulded string course is evident, where it is apparent that water damage has caused deterioration of the pointing and the stone, see figures 16 and 17.

Figure 16 & Figure 17: Details of damaged and eroded stonework below string course in close proximity to the downpipe.

The stone in this area has suffered from prolonged moisture ingress and is showing scaling, flaking and mould growth. This is most likely associated with the rain water disposal system in the south east corner, where mildew is clearly evident on the walls and to the drainage channel on the floor. Water drip marks are evident behind the lead hopper, which is quite shallow. There is an area of lead lining fitted into the joint between the gable head stone, however, if the water is over shooting from the gutter or from the main roof, this may not be adequate.

3.2 Wall and ceiling paintings

Finely detailed wall paintings are present above the dado on all four elevations of the Chantry Chapel, see figure 18, with polychrome stencil decoration and applied gilded stars found to the roof timbers.

Figure 18: Detail of the north wall painting

3.2.1 Roof timbers

The style of the decoration to the roof timbers is typical of high Victorian designs, and the condition is generally good. There are heavy dust and dirt deposits and extensive areas of cobwebs, particularly towards the apex of the roof, see figures 19 and 20. The applied gilded stars are likely to be a copper alloy as green corrosion product was evident to numerous areas, see figure 21. Some dark spots were also noted to the timbers, which appeared to be either staining from previous condensation or mould spots, suggesting high humidity levels/condensation events. This is generally to be expected, due to warm air within the chapel rising and forming condensation as it comes into contact with the colder roof timbers.


Figure 19 & Figure 20: Overview of painted roof timbers showing extent of cobwebs and dirt deposits (left) and detail of north-west panels

There are localised areas of flaking and paint loss which appear to be related to previous moisture ingress as well as differential movement of materials. For example, there are areas of paint loss along the lower edge of the south face of the roof timbers, where there have been historic issues with moisture ingress from the valley between the Chapel and the Sanctuary. The timbers are currently dry and there appeared to be no indication of recent moisture ingress. In addition, differential rates of expansion and contraction of the timber substrate and the paint layers following fluctuations in temperature and humidity appear to have resulted in numerous small areas of cleavage/micro flaking and paint loss, see figure 22.


Figure 21 & Figure 22: Detail of applied star, with green corrosion product evident suggesting the use of copper alloy (left) and detail of beam decoration (right), with micro flaking and loss to the paint layer, as well as 'shadows' of a possible earlier scheme beneath the currently gilded flowers.

During the inspection, evidence of a previous decorative scheme beneath the three flowers in the chevron design to the lower timber beams was noted, see figure 22. The 'shadows' of earlier flowers could be seen, which are similar in shape to the extant scheme but are slightly off set. A sample of paint was taken for analysis and the findings are discussed in the following chapter.

3.2.2 Plaster substrate

The plaster to the walls above the dado is in very poor condition in numerous areas, but it is particularly perilous on the east wall at high level and to the left side of the window, see photographs in Appendix 4 and condition maps in Appendix 5. Just below the apex there is a void of approximately 3cm behind the plaster, where material has fallen out from behind the upper coats of plaster and paint. The stone substrate can be seen in this area. At the right side edge of the wall where it abuts the ceiling timbers, it can clearly be seen that there are deep losses in the plaster as the unpainted ends of the timber boards have been exposed. Below this is a large area of cementitious repair mortar which tapers off at the base of the void and loss. This mortar repair is likely to have been a previous attempt to stabilise the edges of the loss, with the additional losses happening subsequently. This inappropriate mortar repair is likely to be contributing to the ongoing deterioration of the surrounding plaster and paint. Some bulging of the original plaster around the repair mortar is also evident.

The poor condition of the plaster continues on to the east end of the north wall, with high moisture readings and salt deposits in this area. In the corresponding area of exterior stonework there are some patch lime pointing repairs, cementitious mortar repairs and numerous losses and gaps in the pointing where moisture could be penetrating. The stone is also eroded in this area. There also numerous areas of unstable and lost plaster on the west wall, most notably to the right side of the door and at high level. These also correspond to areas of erosion and loss to the exterior stonework and pointing.

There are fractures springing from the apexes of all four window arches on the north wall, the most severe of which is to the westernmost window, where there is a detached and loose section. There are no opened joints to the corresponding exterior wall, but this may be due to them being filled during the recent programs of re-pointing.

As well as the large area of repair to the east wall, additional cementitious mortar repairs were noted to the lower east corner of the south wall (above dado); around the edge of the moulded arches of the south arcade, notably on the right edge of the western arch; around the door on the west wall, particularly to the left side of the stone arch; as well as a small area to the left side of the westernmost window on the north wall.

3.2.3 Paint and ground layers

The paintings to the upper walls are extremely detailed and well executed, and are thus of great significance. They have been executed in zinc oil paints on a white zinc oil primer/undercoat, whilst the gold has been laid on a thin coat of an ochre pigmented oil size. Although the paintings on the north wall are still in relatively good condition and are largely intact, the extent of damage and loss to the remaining three walls has resulted in extensive passages of painting becoming largely illegible, see photographs in Appendix 4 and condition maps in Appendix 5.

As well as the large areas of paint lost as a result of the failed and failing plaster substrate discussed above, there are many additional losses to the paint and ground layers. These appear to be predominantly as a result of moisture ingress, subsequent drying out of fabric and movement of soluble salts, and are largely concentrated on the east and west walls, and the eastern and western spandrels of the south wall.

Salt efflorescence and areas of micro-flaking are also evident to many passages of the paintings, and have been highlighted on the condition maps in Appendix 5.

On the east and west walls it is clear that the wall paintings extend beneath the band of modern cream paint found directly above the dado moulding. Small areas of uncovering were undertaken using a scalpel and acetone swabs which revealed part of a circular floral motif found to the lower area of the west wall.

3.3 Dado

Although the walls at dado height are currently plain painted, an initial inspection was undertaken to determine whether more decorative painting may exist beneath the extant scheme, and also whether the existing finishes are impacting on the condition of the significant paintings above.

It appears that all the plaster up to dado height on the north, east and west walls has been replaced with cementitious mortar. This is delaminating and bulging severely, particularly to the left side of the heater on the north wall, and there are extensive areas of salt efflorescence present to all areas.

3.4 Painted stonework

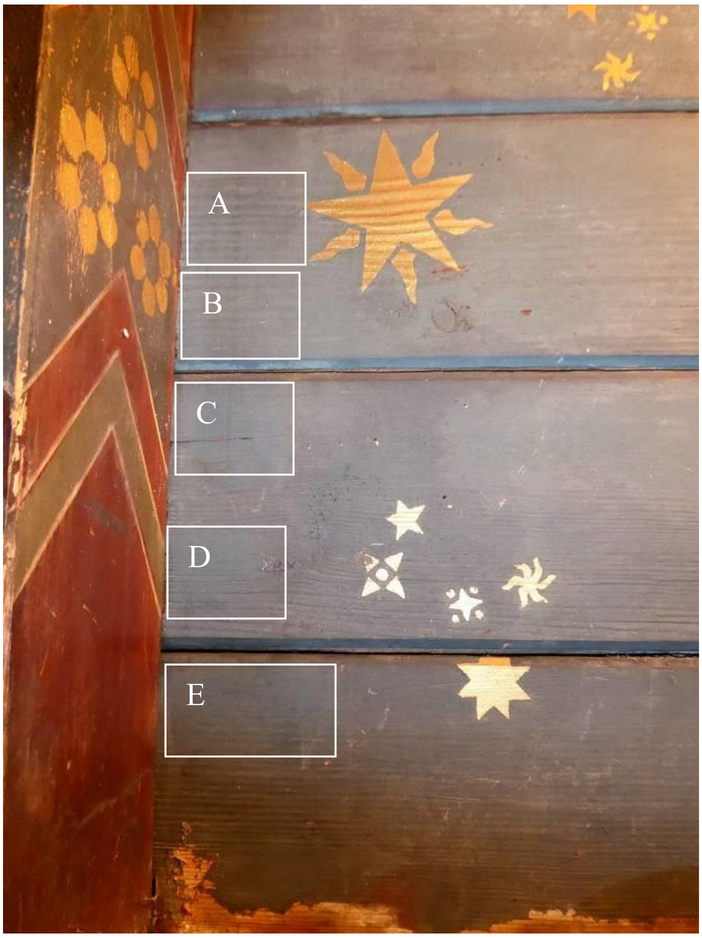
The stonework within the Chapel is currently plain painted. The paint is flaking off in many areas, particularly to the East window and north wall easternmost window, where thick salt encrustations and efflorescence can be seen. According to the Vicar, these areas are decorated fairly regularly, maybe as much as once a year, in what the decorator described as a breathable emulsion. However, the paint layers do not appear to be particularly permeable as salt deposits are building up behind the paint layers causing the stonework to spall and blowing off the paint films. Several paint samples were taken to determine the stratigraphy and paint media in these areas.

3.5 Summary of cleaning tests

Small, localised cleaning tests were undertaken to the wall painting on the central spandrel of the south arcade, as well as to painted roof timbers in the south west corner.

The results are recorded fully below, but in summary, the most effective method of removing surface dirt from the wall paintings was found to be dry cleaning with a soft brush and vacuum to remove loose dust and dirt, followed by further cleaning using dilute ammonia on cotton swabs. This provided a significant tonal lift without affecting the paint or gilding.

With regards to the painted timber ceiling panels, the most effective method was found to be the art gum eraser. On the timber beams, water on cotton wool swabs was found to be the most effective method.



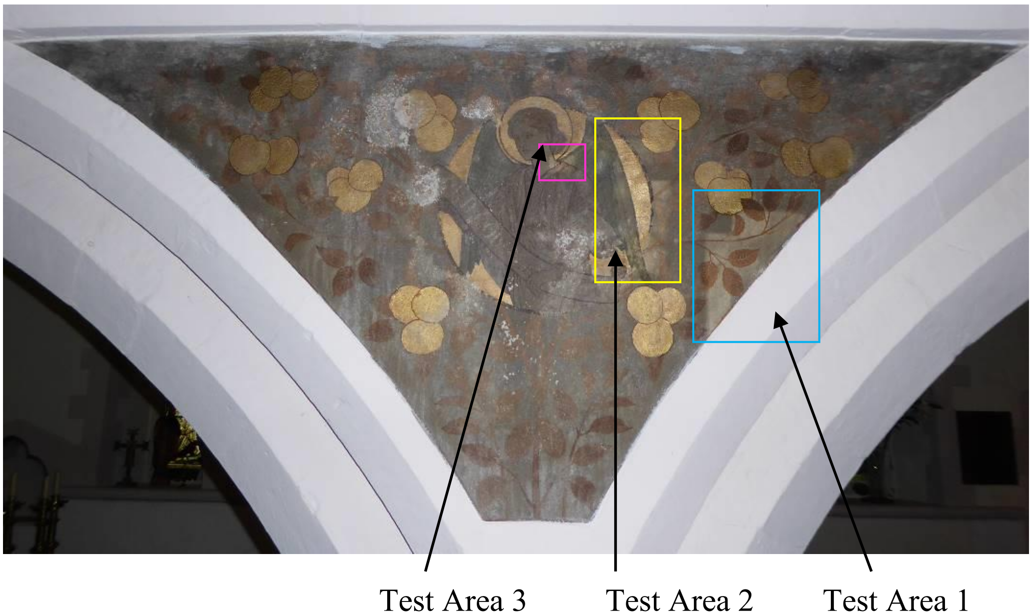
A = white spirit applied with cotton wool

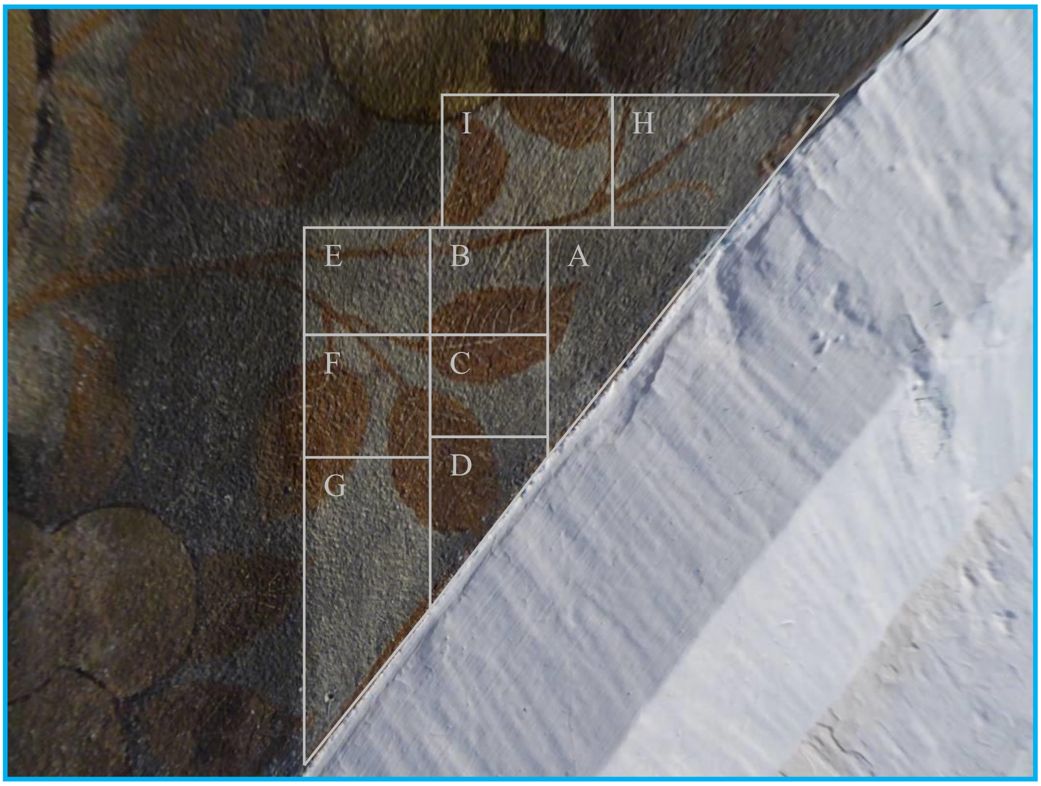
B = soft latex sponge (wishab)

C = Artgum eraser

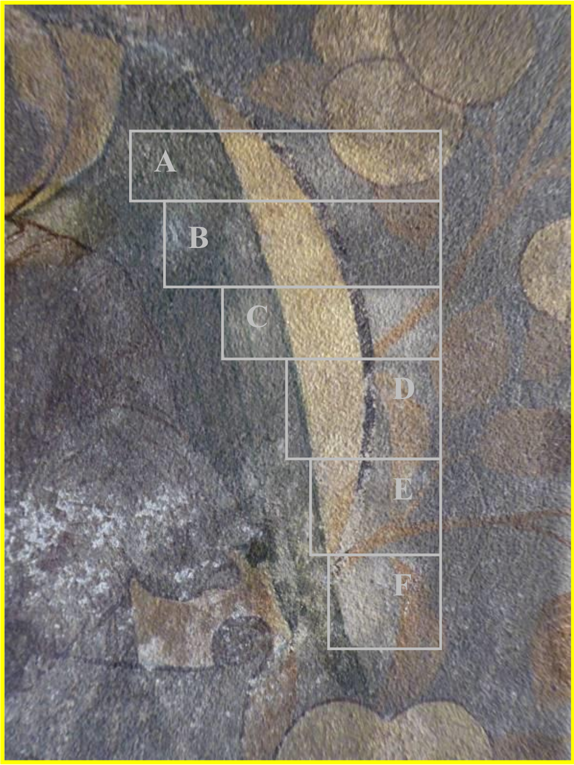
D = deionised water applied with cotton wool swab

E = deionised water applied with sponge





A = soft latex sponge
B = deionised water applied with cotton wool swab
C = deionised water and sponge
D = IMS applied with cotton wool swab
E = white spirit applied with cotton wool swab
F = weak solution of non ionic detergent in deionised water applied with cotton wool swab, cleared with deionised water
G = 3% tri-ammonium citrate solution applied with cotton wool swab, cleared with deionised water
H = V&A mix applied with cotton wool swab, cleared with deionised water and white spirit
I = weak solution of ammonium hydroxide applied with cotton wool swab



A = soft latex sponge
B = deionised water applied with cotton wool swab
C = deionised water applied with sponge
D = IMS applied with cotton wool swab
E = white spirit applied with cotton wool swab
F = weak solution of non-ionic detergent in deionised water applied with cotton wool swab, cleared with deionised water

Note: water and salt damage to lower part of test area proved difficult without further tests and prior consolidation

I = weak solution of ammonium hydroxide applied with cotton wool swab

4 Technical Examination

4.1 Paint analysis

4.1.1 Rationale & methodology

In order to evaluate the basic stratigraphy and media type of paint layers and to inform specifications for conservation, a limited number of paint samples were taken from selected locations on the wall paintings, overpainted dado and roof timbers.

Samples were carefully collected using a number of hand-held tools, labelled and stored in clean plastic bags. Samples were usually between 1-5mm^2. All sample locations were recorded and are detailed in Appendix 6.

Cross Section Analysis

Samples were mounted in clear casting resin and assessed under magnification (usually 100x) to identify the layer structure and perform basic media identification. Employment of fluorescence microscopy indicated in more detail layer structure and the nature of films. This is a particularly effective tool for the identification of later additions, such as waxes and resins. Photomicrographs of cross sections were taken and are used in cross-reference with other available information to identify the relationship between the specific paint layers.

Microchemical Analysis

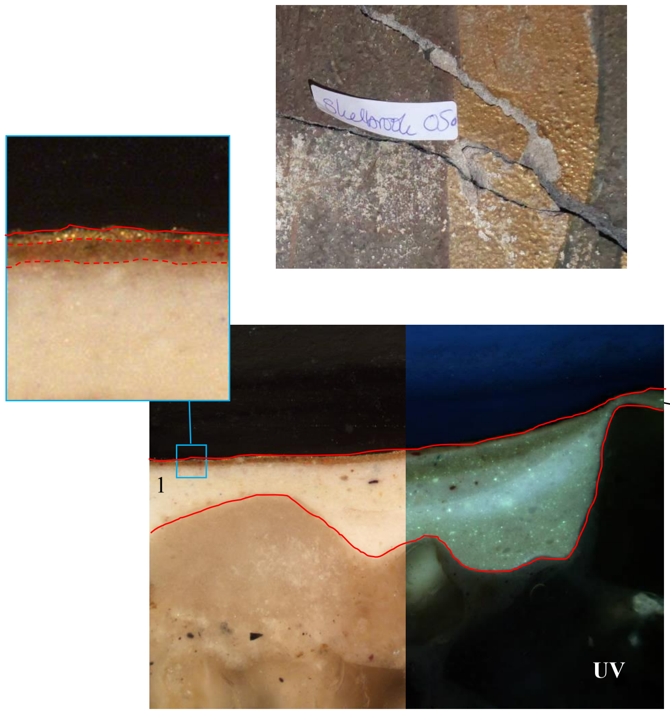
Stain tests and simple chemical tests were undertaken following techniques recorded by Joyce Plesters[4] to identify the basic composition of the paint films. It is important to identify the paint media, as it may have implications on treatment and redecoration recommendations.

4.1.2 Results

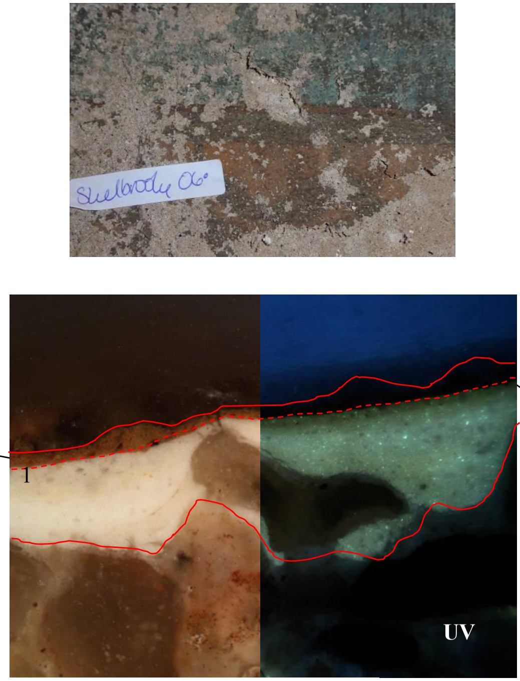
The following section outlines the results of this preliminary paint analysis based on interpretation through limited research of currently available archive documentation and investigation of paint archaeology. The results of the current investigation may be superseded if further evidence becomes available.

[4] Joyce Plesters, *Cross-sections and chemical analysis of paint samples Studies in Conservation*, Volume 02, pp. 110-157, 1956

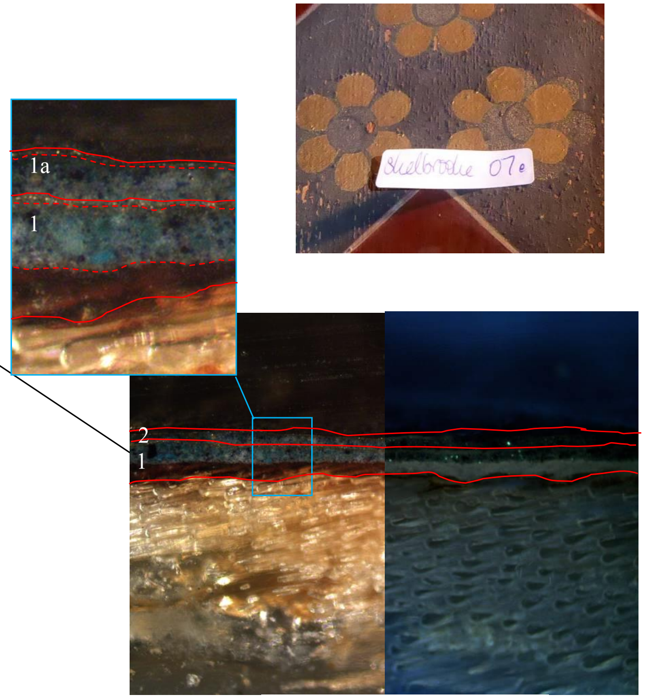
Photomicrographs:



Sample 5 – North wall (same stratigraphy as sample 3)



Sample 6 – West wall

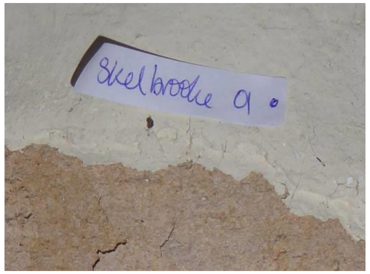


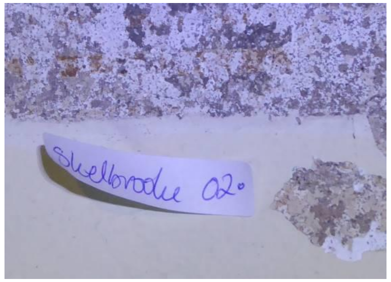
Sample 7 – Roof timber

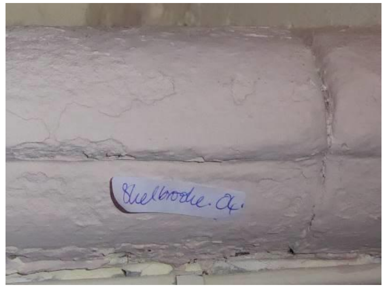
Comments:

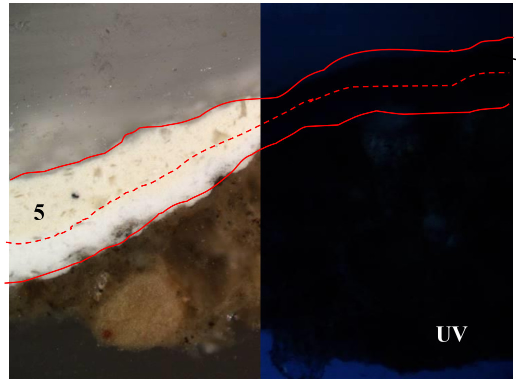
Samples 3, 5 and 6 contain only the original decorative scheme. Samples 3 and 5, taken from areas of gilding on the east and north walls consist of the same stratigraphy, namely white zinc oil primer/undercoats, followed by an ochre coloured oil size and a layer of gold leaf. Zinc paint is indicated by the characteristic 'sparkles' visible in uv light, and was confirmed with a positive stain test using dithizone. The presence of oil is indicated by fluorescence in uv light and confirmed with a stain test using Rhodamine B. Sample 6, taken from the west wall painting, also contains the same zinc oil primer/undercoats followed by an ochre/sienna top coat.

Sample 7, taken from a painted roof timber, consists of two schemes of gold leaf on a blue zinc oil paint, on top of an oil stain to the timber. The two schemes can clearly be seen in the photograph above, with the upper gilded flowers being slightly off-set to the earlier scheme. The paint characteristics appear to be the same or very similar, and no dirt layer is evident between the schemes so they may have been painted within a short space of time. Further investigations and sampling would need to be undertaken to confirm whether the two schemes are present throughout the ceiling, or whether this is just a localised issue, possibly to adjust the layout slightly.

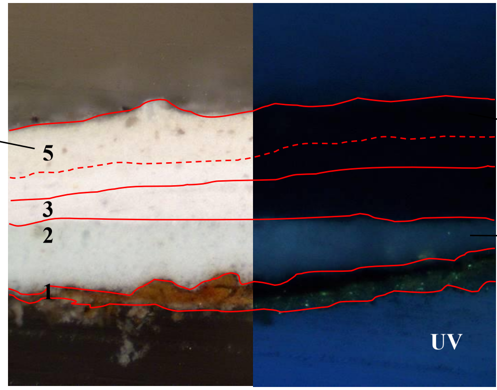




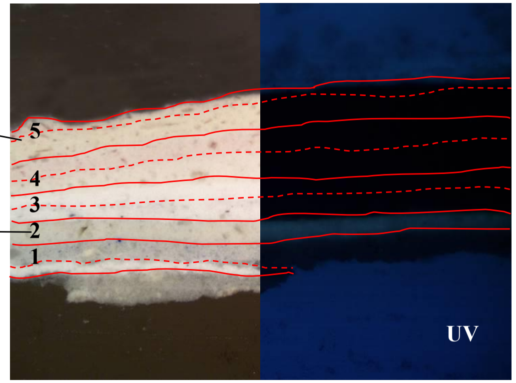




Sample 1 – East wall window surround



Sample 2 – East wall above string course



Sample 4 – North wall string course/cill

Comments:
Sample 1, taken from the painted window surround on the east wall, contains only the most recent scheme of a cream emulsion on a white undercoat. The lack of auto fluorescence in uv and the paint's solubility in acetone indicate a modern resin paint. The presence of only one scheme of decoration in the sample suggests that the failure seen at present is not just a recent issue.

Sample 2, taken from an area of overpaint on the east wall above the dado, clearly shows the presence of the original scheme of wall paintings which consists of a white zinc oil primer/undercoat and an ochre/sienna top coat. Above this are three plain painted more modern schemes. Fluorescence characteristics and solubility tests indicate the most recent two off-white schemes are in modern resin paint, whereas the second pale blue scheme appears to be an oil alkyd.

Sample 4 taken from the currently pink painted cill/string course contains five schemes. The earliest is a pale blue probable distemper; the layer effervesced in dilute hydrochloric acid indicating the presence of carbonates. Schemes 2 and 3 correspond with the second and third schemes in sample 2, namely a pale blue oil alkyd followed by an off white modern resin paint. Schemes 4 and 5 are both a pale pink modern resin paint on a cream undercoat.

4.2 Mortar analysis

4.2.1 Rationale and methodology

Mortar analysis can be an essential part of the restoration of historic buildings. Any replacement, replication, or repair mortars generally need to be as similar to the original as possible (as long as these have served the building well), or at least look the same and perform in the same way. Analysis of a mortar can tell us the source of its constituent materials, their suitability in the first place, as well as the possible causes of any failure. What is most often required from the analysis of a mortar is its mix ratio by volume (Aggregate:Binder) and the characteristics of its binder and aggregate.

A variety of specific volumetric, titrimetric, gravimetric and microchemical techniques were used, in addition to polarised light microscopy, in order to determine the components and characteristics of the mortar samples. The samples were carefully collected by hand from discrete but representative areas and put into sealed and clearly labelled sample bags. All sample locations are indicated on the photographs in Appendix 6.

4.2.2 Results

Full results of the analysis can be found in Appendix 8, but are summarised below:

Sample MO1 Top Coat

Observation and analysis show the sample to be a 2mm thick, fine grained, grey-buff coloured, non-hydraulic dolomitic lime mortar, with a mix ratio by volume of 1:1 (aggregate : binder).

The aggregate is a fine grained, sharp, light grey-buff coloured silica sand containing mainly quartz grains 0.14mm diameter down to <0.09mm. The binder is a Dolomitic (Magnesian) non-hydraulic lime containing about 10% magnesium carbonate.

Sample MO1 Base Coat

Observation and analysis show the sample to be a 12mm thick, fine grained, grey-buff coloured, non-hydraulic dolomitic lime mortar, with flecks of carbonated, white dolomitic lime from the binder, and with a mix ratio by volume of 1.5:1 (aggregate : binder)

The aggregate is a fine grained, sharp, light grey-buff coloured silica sand containing mainly quartz grains 0.14mm diameter down to <0.09mm, like that found in the top coat. The binder is a Dolomitic (Magnesian) non-hydraulic lime containing about 16% magnesium carbonate.

While the mode and grading of the aggregate is appropriate for a thin top coat, it is arguably too fine for a base coat, allowing potential cracking and shrinking.

Sample MO2

Observation and analysis show the sample to be a 1 – 2mm thick, fine grained, grey-buff coloured, non-hydraulic dolomitic lime mortar with a mix ratio by volume of 1.5:1 (aggregate : binder), like the top coat in sample M01.

The aggregate is a fine grained, sharp, light grey-buff coloured silica sand containing mainly quartz grains 0.14mm diameter down to <0.09mm, like that found in the top coat. The binder is a Dolomitic (Magnesian) non-hydraulic lime containing about 10% magnesium carbonate.

Sample M03 Base Coat (East wall, North Side).

Observation and analysis show this sample to be a 5mm thick, fine grained, grey-buff coloured, non-hydraulic dolomitic lime mortar with a mix ratio by volume of 2.3:1 (aggregate : binder), like the base coat in sample M01.

The aggregate is a fine grained, sharp, light grey-buff coloured silica sand containing mainly quartz grains 0.14mm diameter down to <0.09mm, like that found in M01 base coat. The binder is a Dolomitic (Magnesian) non-hydraulic lime containing about 30% magnesium carbonate.

4.2.3 Conclusions

In general Magnesian lime mortars are harder and generally less soluble in water than calcium carbonate. However, when converted to their respective sulphates in damp sulphurous gas polluted atmospheric conditions, the magnesium sulphate in dolomitic lime mortars is 145 times more solubility than calcium sulphate, such that it is readily disrupted and unstable compared with calcitic lime mortars.

With this in mind any replacement mortars should be physically similar to the original but contain non-hydraulic calcium lime, not Magnesian lime. In addition, the base coats used for any future replication and repair would best contain a grey-buff coloured silica sand with quartz grains gradin from fine – medium, perhaps including some coarse fraction. This would reduce any likelihood of shrinking and/or cracking.

The mix ratio by volume for the base coat should be 1.5–2.5 : 1 (aggregate : lime binder).
For the thinner top coats 1–1.5 – 1 (fine grained aggregate : lime binder) would be appropriate.

5 Deterioration assessment

Moisture movement and salt migration/crystallisation cycles can have a severe impact on the condition of historic fabric. In order to define and interpret the risks to the wall paintings, a limited survey of the moisture content and salt types and levels in the walls was undertaken. Preliminary tests were carried out to investigate the environmental conditions within the church, with a view to identifying factors that may have an impact on the condition of the wall paintings. The results will enable recommendations to be made for any future conservation and remedial work.

5.1 Relative humidity and temperature readings

5.1.1 Methodology

Relative Humidity (RH) and Temperature values were recorded inside and outside the church using an electronic hygrometer. It is acknowledged that such readings have limited value. However, an awareness of the RH and temperature values at the time of the survey will help put the results for wall moisture readings and salt analysis, on this day, in context.

5.1.2 Results

Date: 27th October 2016
Conditions: Overcast but dry

Location	Relative humidity (R.H) %	Temp. °C	Dew point °C	Vapour Pressure (VP mb)	Absolute Humidity/ Moisture Density AH/Md (g/m^3)
Internal	64.2	18.6	11.8	13.8	10.7
External	66.5	16.1	9.9	12.2	9.4

5.1.3 Interpretation

The readings show that the air inside the church contains significantly more moisture than the air outside (internal Md > external Md), which suggests that the building fabric may be damp or the building has not yet equilibrated with the current drier weather system.

The depression of the internal dew point is 6.8°C (18.6 – 11.8 = 6.8°C), so wall surface condensation is unlikely unless temperatures inside fall to around 11.8°C, perhaps towards early morning (all else being equal).

5.2 Moisture profiling and salts testing

5.2.1 Methodology for moisture profiling

Measurements of relative moisture concentrations in the fabric of the walls of the Chantry Chapel were made using an electronic Protimeter[5] in capacitance mode. A

[5] A Protimeter is a resistance meter. Resistance techniques measure the resistance of a material to an electric current. Since liquid water is a good conductor the higher the moisture content of the material the lower the electrical resistance. This hand-held resistance meter measures resistance between a pair

protimetre in conductance mode was also used to provide an indication as to whether the walls are damp or affected by salts. Measurements were taken at regularly spaced points on the walls within the Chapel in a grid pattern and the results can be found in Appendix 7.

5.2.2 Results of moisture profiling

Both the capacitance and Protimeter, but particularly the Protimeter, can give anomalously high readings if hygroscopic soluble salts are present on/in the wall. The Protimeter, relying on surface conductance properties, is perhaps a better salt meter than moisture meter, its readings increase with increasing salt and moisture concentrations. Therefore, the two readings taken together and confirmed by soluble salt testing give a more comprehensive result and better understanding regarding moisture concentrations and possible locations of high soluble salt concentrations.

The results of the capacitance meter and Protimeter readings can be found in Appendix 7 and may be interpreted using the following tables:

Marble **Porosity ~ 0.5 – 1%**	**Protimeter** (1cm) **Capacitance mode**	**Protimeter** (surface) Measure mode **(%WME)**
Dry – <0.3% moisture Wet (>0.3% at Saturation)	130 – 146 >197 (alarm!)	5 – 10%WME >20%WME (alarm!)

Limestone **Porosity ~ 24%**	**Protimeter** (1cm) **Capacitance mode**
Dry Wet (11% at Saturation)	105 – 140 140 – 280

Lime plaster (and most gypsum plasters) generally:

Protimeter (1cm) **Capacitance mode**	**% Moisture Content**	**Comments**
0 – 105	0	Very dry
105 – 140	0 – 3.0	Dry
140 – 175	3.0 – 6.0	Dry – Damp
175 – 210	6.0 – 8.0	Damp
210 – 315	8.0 – 14.0	Damp – Very damp
>315	>14.0	Very wet and/or high salt content

of pins which are pushed onto the surface of the fabric. Resistance meter is very sensitive to most types of wood since the measurements are reproducible as the material is consistent (unlike masonry where salt and moisture content are not easily distinguishable). This is why the Protimeter more readily gives anomalously high readings with high salt content, even if the actual moisture content is low.

Protimeter % WME	Implication
0 – 12	Dry
12 – 17	Damp
> 17	Damp/wet

Note: %WME = Wood Moisture Equivalent. If wood is 'dry' the %WME = 8–10%, if it is damp–wet %WME is >17%. Therefore, if a material is 'dry' it will show 8–10% WME too (i.e. equivalent to the % of moisture in wood when dry), even if normally a similar moisture content in this material would indicate it is wet. Therefore, if marble is 'dry' it too will show 8 to <17%WME (i.e. equivalent to the % of moisture in wood when dry, (normally 8 to <17% moisture in marble or lime plaster, would indicate they are wet). When each different material in the wall is tested, the moisture content will be different. If each reading is within the dry range then the materials are in equilibrium; if they are not it indicates a problem.

5.2.3 Summary of moisture readings by elevation

East Wall

The base of the wall up to string course height, below the window on gypsum plaster, gives capacitance readings of 240 – 552 (dry – very damp) and Protimeter readings of 21.4 – 24.0%WME, indicating damp gypsum plaster.

On the lime plaster walls from window sill height to wall apex height, the readings essentially decrease to capacitance 144 – 236, Protimeter 9.5 – 18.5%WME, suggesting dry – damp lime plaster with some salts.

West Wall

The base of the wall up to string course/dado height on gypsum plaster, gives capacitance readings of 223 – 255 (dry - damp) and Protimeter readings of 21.6 – 30.4%WME, indicating significantly damp gypsum plaster.

On the lime plaster walls around and above the top of the door up to wall apex height, the readings are capacitance 148 – 287, Protimeter 9.2 – 16.0%WME, suggesting dry lime plaster with few salts.

North Wall

The base of the wall up to string course height below the alcoves, on gypsum plaster, gives capacitance readings of 240 – 270 (dry - damp) and Protimeter readings of 16.3 – 29.5%WME, indicating significantly damp gypsum plaster.

On the stone around the alcoves the readings are capacitance 157 – 231 (dry), Protimeter 9.2 – 16.0%WME, suggesting dry stone with few salts.

Above the alcoves on lime plaster, the capacitance readings are 133 – 156 (dry) and Protimeter 11.9 – 12.8%WME (dry with few salts).

South Wall

The base of the stone columns of the arches give capacitance readings of 184 – 900 (dry – very wet) with moisture increasing markedly towards the easternmost column base. The Protimeter readings are 26.2 – 42.9%WME, indicating damp – wet stone with significant salts, increasing to very wet stone with a high salt content towards the easternmost column base.

On the stone at the top of the columns the capacitance readings are 162 – 404 (dry - damp) and Protimeter 17.2 – 31%WME, suggesting dry – damp stone with a high salt content.

These readings are consistent with rising damp in the stone columns, which may be acting as 'wicks' for ground moisture, with more active rising damp towards the easternmost column.

On the lime plaster above and around the arches, the readings are capacitance 139 – 146 (dry) and Protimeter 10 – 14.4 (dry with very few salt).

5.2.4 Methodology for salt testing
Relative concentrations of soluble salts present on the surface of the walls were determined using Merckoquant® test strips which detect the levels of sulphates, chlorides and nitrates present. Sample locations can be seen in Appendix 6.

5.2.5 Results of salt testing

Sample	pH	% 'Active' lime	% Sulphates	% Nitrates	% Chlorides
S01	10	0.003	17.2	0.014	0
S02	10	0.008	19	0.02	0

Note: Since the solubility of gypsum (calcium sulphate) is no more than 0.24 grams per 100ml water (0.24%) the sulphate anions determined in the above samples (17.2%) must mostly be magnesium sulphate given its high solubility of 35.1% in water and its prevalence in the stonework and substrates (Magnesian limestone), together with calcium and perhaps potassium and sodium sulphates (found in bricks and cements).

5.2.6 Interpretation of salt testing
There is a very small percentage of nitrates and negligible chlorides present on the wall surfaces, but the high percentage of magnesium and calcium sulphates found in the salt efflorescence and crusts indicates much dissolution, migration of these salts from the core of the walls and their precipitation at the surfaces. This clearly testifies to protracted and repeated periods of high moisture content and RH within the fabric and ambient air inside the church, due to moisture or rain ingress.

6. Conclusions and recommendations

6.1 Conclusions and summary of causes of deterioration

The investigations and analysis have shown that the majority of the historic and ongoing deterioration evident to the wall paintings within the Chantry Chapel has been caused by moisture ingress and subsequent movement of soluble salts.

The environmental readings taken on the day of the survey show that the air inside the church contains significantly more moisture than the air outside, which suggests that the building fabric may be damp or the building has not yet equilibrated with the current drier weather system. In addition, the high percentage of magnesium and calcium sulphates found in the salt efflorescence and crusts indicates much dissolution, migration of these salts from the core of the walls and their precipitation at the surfaces. This clearly testifies to protracted and repeated periods of high moisture content and RH within the fabric and ambient air inside the church, due to moisture or rain ingress.

The locations of the damage and the preliminary moisture and salt profiling indicate this is due to a number of factors:

- Rising damp – Moisture readings indicate damp to very damp gypsum plaster at dado height to the north, east and west walls, as well as high levels of damp to the stone columns in the south arcade, which may be acting as 'wicks' for ground moisture.
- Blocked guttering/failing rainwater disposal systems – Higher moisture readings in the south east and south west corners of the chapel correspond to the locations of downpipes. In addition, the patterns of deterioration to the wall paintings and exterior pointing and stonework indicate historic failure of the rainwater disposal system; although the majority of the moisture readings above dado height indicate the fabric is generally dry.
- Failing/inappropriate pointing – Many areas of failing pointing were noted to the exterior of the chapel, particularly below the string course (see figures 12, 16 and 17). These will be allowing moisture through the walls to the significant wall paintings, and are clearly contributing to the high moisture readings taken.
- Damage to gable stones, flaunching and flashing – The cracks evident in the stone slabs to the gable ends, as well as damaged flaunching and flashing is likely to be allowing moisture to ingress at high level, as well as causing water to run down the exterior walls, resulting in erosion of stonework and damage to pointing mortar.

6.2 Recommendations

It is imperative that before an extensive programme of conservation work is undertaken on the wall paintings, the appropriate repairs to the building envelope and fabric are completed to ensure ongoing and further moisture ingress is prevented. Following these works and initial emergency stabilisation to the most vulnerable areas of plaster and paint, it is recommended that the fabric be left to dry out fully for a period of up to a year, before the more extensive program of conservation of the paintings is started. The works have therefore been broken down into two phases:

6.2.1 Phase 1

Essential Works

Secure the building envelope:

- Inspection of the valley gutter between the chapel and chancel should be undertaken by a specialist to determine whether there are any issues/blockages that need to be remedied. In general, the rainwater disposal goods and roof should be regularly inspected and cleared as part of general maintenance regime. It is understood that this has already been put in place.
- Where cementitious and other pointing is failing, this should be carefully removed and re-pointed using lime based mortars. As a program of re-pointing in lime mortar has recently been undertaken, the same mortar recipe should be used for the purposes of consistency/continuity. These works could be undertaken by Hirst Conservation or alternatively by an experienced contractor.
- Repairs to stone slabs and flaunchings at the gable ends should be undertaken using suitable lime based mortars to ensure moisture can't ingress and is directed away from the building. These works could be undertaken by an experienced contractor.
- Flashing repairs to the Chantry Chapel roof should be undertaken by a specialist.
- Mortar repairs should be undertaken to secure edges of damaged stone around the west door. Armatures are likely to be required for large areas and small capping/filleting repairs to other areas. The intention of the repair is to protect from moisture ingress and to shed water away from the door, rather than to recreate original profiles. It was noted during the survey that timber batons/fillets have been fitted to the edges of the door to mediate the gaps between it and the stonework. This could perhaps be looked at by a joiner to improve the design and make the door more watertight.

Emergency stabilisation of plaster/paintings:

- Emergency consolidation of the most vulnerable areas of flaking paint should be undertaken to prevent any further losses during grouting repairs and the subsequent drying out period. Analysis indicated that the paint media is a zinc oil paint, so a heat activated acrylic dispersion such as Plextol B500 or Lascaux 498 would be a suitable consolidant, although further testing should be carried out on site.
- Grouting repairs should be undertaken to secure the most vulnerable areas of delaminating lime plaster on the east and west walls. The voids behind the delaminating plaster should firstly be cleaned of any loose material. Capping and filleting repairs are likely to be required to stabilise the plaster edges and enable the grouting to take place. The exact method required will need to be assessed further once the voids have been cleared out and the 'flexibility of the plaster determined for securing to the substrate. Other methods of support such as tissue may be required during stabilisation.

Highly Recommended Works

In addition to the essential works outlined above, the following works are strongly recommended and are considered important in improving the condition of the fabric and thus the stability of the paintings.

- Removal of cementitious repair mortar to east wall, where failure has occurred, should be undertaken. The remaining areas of cement repair should then be assessed to see if they can be safely removed and a more appropriate repair in lime mortar conducted in these areas. As the large repair to the east wall is not at a level consistent with the original lime plaster, it would not be appropriate to apply a skim coat of lime plaster to build up the plaster surface, as this would result in failure. Therefore, every attempt will be made to remove the inappropriate repair where safe to do so. Where cement mortar repairs are stable and aren't inflicting damage to surrounding areas, they should be left in situ.
- The gypsum plaster at dado height is in poor condition, damp and salt laden, and there is extensive delamination from the stone substrate. In addition, the more impervious gypsum plaster is likely to be 'forcing' moisture and salts from rising damp higher up the walls to the significant lime plaster and wall paintings. For this reason, it is strongly recommended that the plaster is removed and re-plastered using a more appropriate lime-based mortar. All areas will need to be carefully examined during removal to ensure no significant plaster and paintwork remains beneath the gypsum plaster.
- Initial analysis, in conjunction with solubility tests and the condition of the paint to the stonework suggests there are impermeable paint films present. These area clearly trapping salts behind them resulting in disintegration of the stone substrate as well as continual losses to the paintwork. Therefore removal of these impermeable paints would be preferable, followed by redecoration in a limewash or distemper. As this is not a small job, and breathable paints are likely to discolour when damp, further assessment and discussion to determine the feasibility and extent of paint removal should take place. As a minimum, the paints should be removed from the areas with most resultant damage, namely the east window and easternmost north wall window, as well as to the right of the west door.
- Following paint removal, consolidation of friable stonework using suitable materials such as nano-lime for limestone and ethyl silicates for sandstone should be undertaken as required. However, further testing of types and concentrations of soluble salts should be undertaken after paint removal, to inform suitable consolidation methods for the stone – ethyl silicates should not be used where concentrations are high.
- A full assessment of the drainage system to the exterior could be undertaken by a specialist contractor and repairs to the drainage channel around the base of the chapel completed.

6.2.2 Phase 2

Following a period of a year, the conditions of the Chapel and wall paintings should be briefly re-assessed to ensure it is appropriate to carry out the more extensive program of conservation work outlined below.

Recommended Works

- Areas of plaster loss should be replaced using a suitable lime-based mortar.
- Fractures on the north wall and smaller losses should be surface filled using an appropriate filler such as Mowiol 4-98, which is a polyvinyl alcohol (15%) dissolved in demineralised water. Mixed with chalk or whiting it produces a flexible, stable and fully reversible (in water) filling material.
- All surfaces should initially be dry cleaned using a soft brush and vacuum extraction to prevent re-deposition. Great care should be taken in areas of friable paint, and cleaning may need to be undertaken in conjunction with consolidation.
- Further cleaning of the wall paintings should then be undertaken using a solution of dilute ammonia (<pH 9) applied with cotton swabs. With regards to the painted timber ceiling panels, the most effective method of further cleaning during on-site testing was found to be the art gum eraser. On the timber beams, water on cotton wool swabs was found to be the most effective method.
- Consolidation of any remaining areas of flaking paint should be undertaken using a suitable heat-activated acrylic dispersion such as Plextol B500 or Lascaux 498. The adhesive will be applied behind the flakes by syringe or brush and the flakes laid flat by pressing with a heated spatula separated from the wall paintings by a sheet of silicone release paper. Prior to the application of the consolidant, the surface will be pre-wetted using Industrial Methylated Spirit (IMS) to improve the flow and penetration.
- Small areas of loss and/or fill, where the layout/design of the painting is known, will be retouched to integrate with the surrounding. A reversible paint such as Paraloid B72 in xylene and dry pigments or artists acrylics could be used. Where there are losses in gilding, 23.5 carat gold leaf on an oil size could be used.
- For the more extensive areas of loss and large areas of repair, a neutral background colour should be selected for repainting to minimise the impact of the loss. Without knowledge of the lost areas of painting, it would not be appropriate to attempt to repaint these areas.

Optional Works

Consideration could be given to the following works should budgets allow:

- The installation of more suitable drainage around the Chapel may improve the situation with rising damp.
- It was noted that the current hoppers are relatively shallow and may overspill more often than is desirable. The size of these hoppers could perhaps be increased.

Appendix 1: Historic England List Entry Summary

This building is listed under the Planning (Listed Buildings and Conservation Areas) Act 1990 as amended for its special architectural or historic interest.

Name: CHURCH OF ST MICHAEL AND ALL ANGELS
List entry Number: 1314783

Location
CHURCH OF ST MICHAEL AND ALL ANGELS, STRAIGHT LANE
The building may lie within the boundary of more than one authority.
County:
District: Doncaster
District Type: Metropolitan Authority
Parish: Hampole
National Park: Not applicable to this List entry.
Grade: II
Date first listed: 05-Jun-1968
Date of most recent amendment: Not applicable to this List entry.

Legacy System Information
The contents of this record have been generated from a legacy data system.
Legacy System: LBS
UID: 334475

Asset Groupings
This list entry does not comprise part of an Asset Grouping. Asset Groupings are not part of the official record but are added later for information.

List entry Description
Summary of Building
Legacy Record - This information may be included in the List Entry Details.
Reasons for Designation
Legacy Record - This information may be included in the List Entry Details.
History
Legacy Record - This information may be included in the List Entry Details.
Details

SE51SW HAMPOLE STRAIGHT LANE (north end), Skelbrooke

2/54 Church of St. Michael and 5.6.58 All Angels

GV II

Church. Medieval but extensively rebuilt by Joseph Goddard following a major fire in 1872. Rubble limestone, red tile roofs. West tower, 3-bay nave with south porch, 2-bay chancel with separate north chapel and door in gabled projection to south. Tower: chamfered plinth, large quoins. C19 west door with shouldered lintel, 3-light window above has Decorated-style tracery and hood mould with head-stops. Offset beneath C19, pointed, 2-light belfry openings. Band with carved bosses beneath embattled parapet with renewed pinnacles. Nave: chamfered plinth. Gabled south porch has hooded arch and old carving of angel with shield; single-light window on left, two C19 2-light windows on right have Decorated-style tracery. Buttress projection on right houses stair turret. North nave windows as south, buttresses between. Gable copings with cylindrical stack to north, gable cross. Chancel: C19 lancets to south have foiled heads. 3-light east window with geometrical tracery. 4 quatrefoil windows to north chapel. Gable crosses.

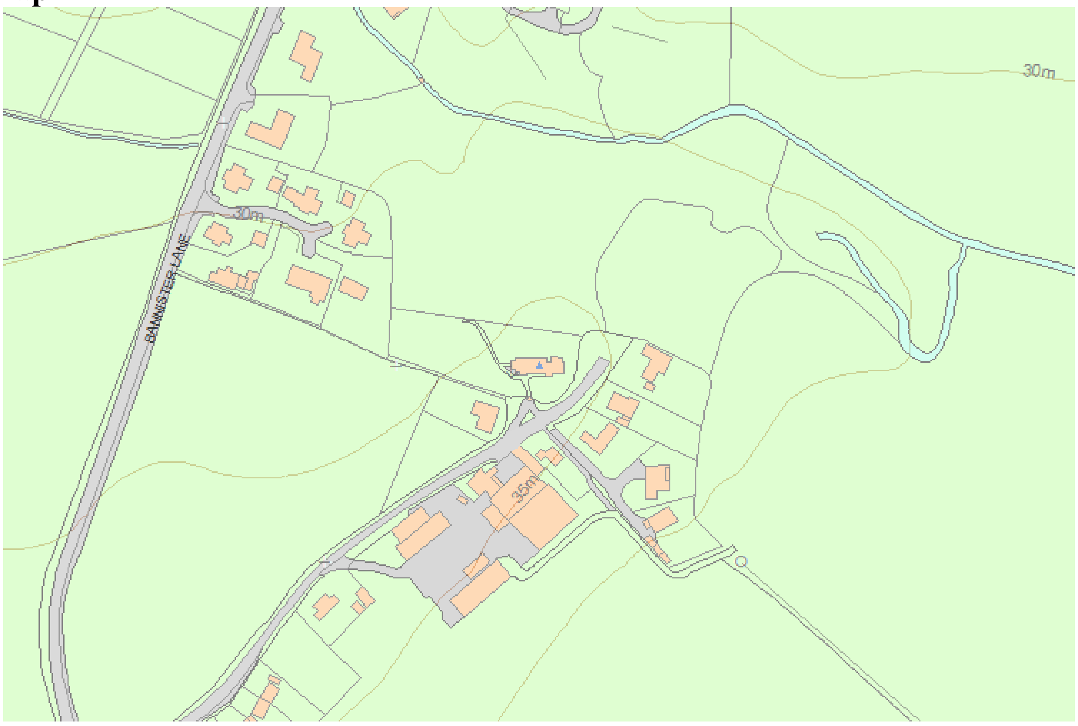
Interior: nave has segmentally-pointed tower arch. Truncated stone newel stair built into south buttress projection. C19 chancel arch with trefoil shafts to moulded arch, C14 piscina. C15, double-chamfered arcade into chancel chapel has broach-stopped base to octagonal pier. C19 roofs. Stained glass west window of 1885; window to north of nave by Heaton, Butler and Bayne.

Listing NGR: SE5111812088

Selected Sources
Legacy Record - This information may be included in the List Entry Details

National Grid Reference: SE 51118 12088

Map



Appendix 2: Research summary report by Archangel Heritage

Client: Amanda White, Hirst Conservation
Site: St Michael and All Angels Church, Skelbrooke nr Doncaster
Research brief: to consult the relevant CARE file for any information pertaining to the northeast chantry chapel
Place of research: Church of England Record Centre (CERC), Bermondsey, London
Archives consulted: CARE 35/181 Skelbrooke St Michael and All Angels
Date consulted: 1 November 2016

Research summary
The file contains a small folder relating specifically to painted surfaces in the church. Its contents date back to September 1991 when Ronald G. Sims, Chartered Architect of York, wrote to Andrew Argyrakis, Council for the Care of Churches, to supply Mr. Argyrakis with his August 1991 Report on the Conservation of Wall and Roof Paintings to the North East Chapel, prepared on behalf of the P.C.C. (a full copy of Sims' report which includes colour images has been supplied separately).

The following July two estimates for conservation were submitted to the parish and were then forwarded Mr. Argyrakis. They were as follows [the stages in Hesp and Jones quote refers to Sims report]:

Quote 1: Hesp and Jones
Stage One work to include cleaning down roof timbers, consolidating plaster on the East wall and cleaning wall paints. £3,480
Poulticing to remove salts. £300
Stage two for re-plastering the West wall and repainting areas of the paintwork in the West section and Eastern section which have been lost. £2,960
Total: £6,740

Quote 2: Francis W. Downing
To clean the dirt from the roof and the wall paintings following restoration of the plaster by other craftsmen, for re-touching the paintings as necessary.
£4,440; plaster work, £1,500; total £5,940

The parish made an application to the Council for the Care of Churches for grant aid to carry out the work. Mr. Argyrakis forwarded the Sims report and quotes to the council's Paintings Committee. David Park of the Conservation of Wall Painting Dept, Courtauld Institute of Art replied to Mr. Argyrakis on 3 August 1992 raising concerns regarding all aspects of the proposed conservation work.

The next item in the file is an extract from a 1997 quinquennial inspection report that commented on the condition of the wall paintings as follows:

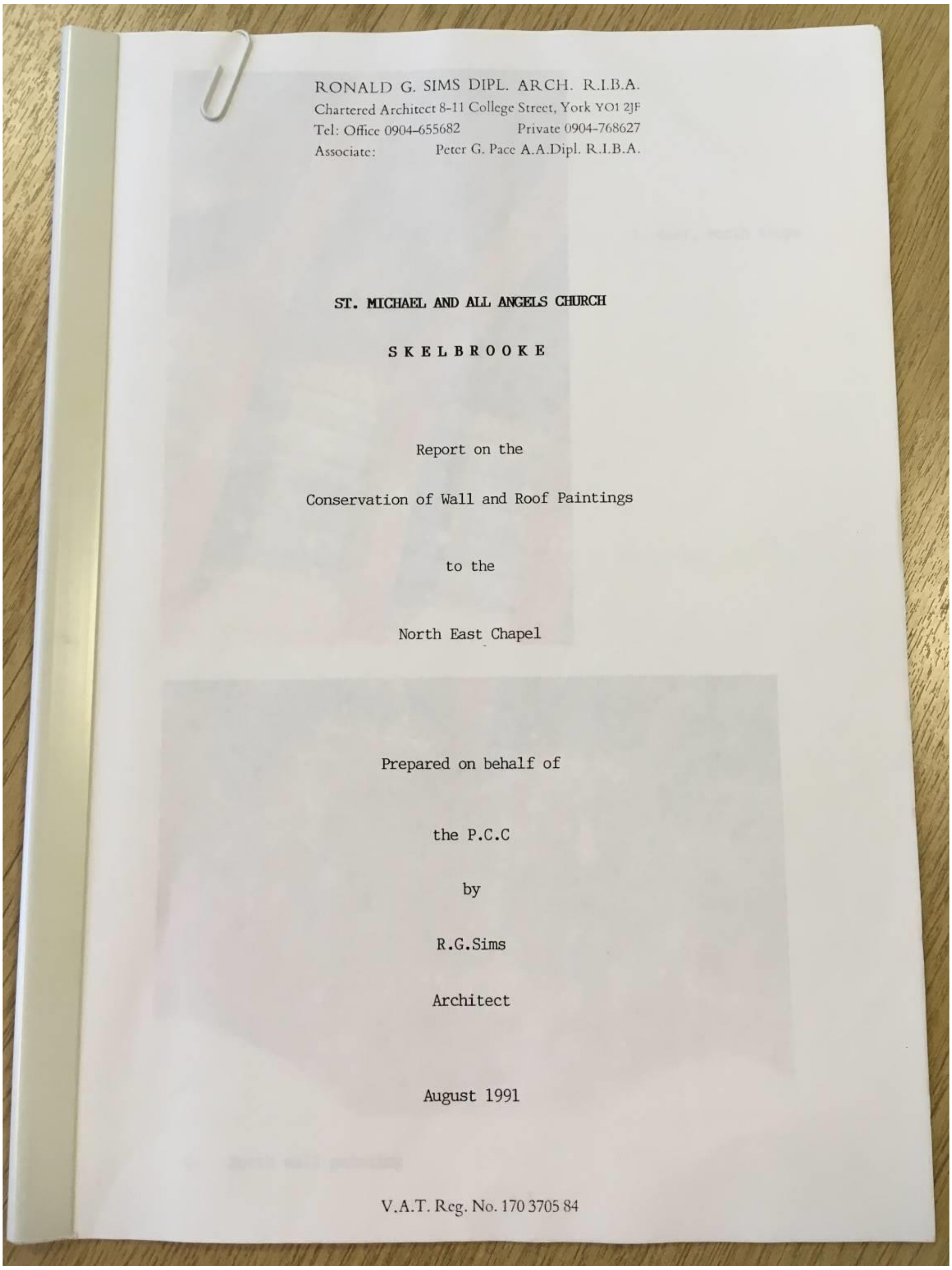
25. North-East Chapel Murals
The decorative murals in the North-East Chapel together with the polychromatic decoration of the ceiling joists and panels is of the highest quality. Unfortunately, it has suffered due to damp penetration from the defective lead-lined inner gutter which has since been repaired. Whilst the plater itself is still eroding, extensive salting has

mostly disappeared indicating that the walls are now relatively dry. It is of the greatest importance that the gutter is kept well cleaned out as any back-up will cause the problem to reoccur.

It is now time to consider the restoration of what is by far the most important item in this Church. It is advised that a grant is available for such work through English Heritage but it needs to be applied for. The Architect would advise the PC that it should consider such action as early as possible before the friezes are unrecognisable and unable to be repainted. If the work could be tackled within the next two years all the detail is still identifiable and could be restored.

The firm of Hesp and Jones was invited to resubmit a revised estimate, which the vicar of Adwick-le-Street with Skelbrooke forwarded to Mr Argyrakis on 2 September 1998 along with another copy of Sims' 1991 report and the 1997 report extract above. The last item in the file is a reply from Mr. Argyrakis dated 4 September 1997, in which he recommends the parish commission a detailed technical survey and condition report from conservators who have extensive experience of this type of work and his letter includes a list of possible candidates

Appendix 3: Copy of 1991 report by Ronald G Sims



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ST. MICHAEL AND ALL ANGELS CHURCH

S K E L B R O O K E

Report on the

Conservation of Wall and Roof Paintings

to the

North East Chapel

Prepared on behalf of

the P.C.C

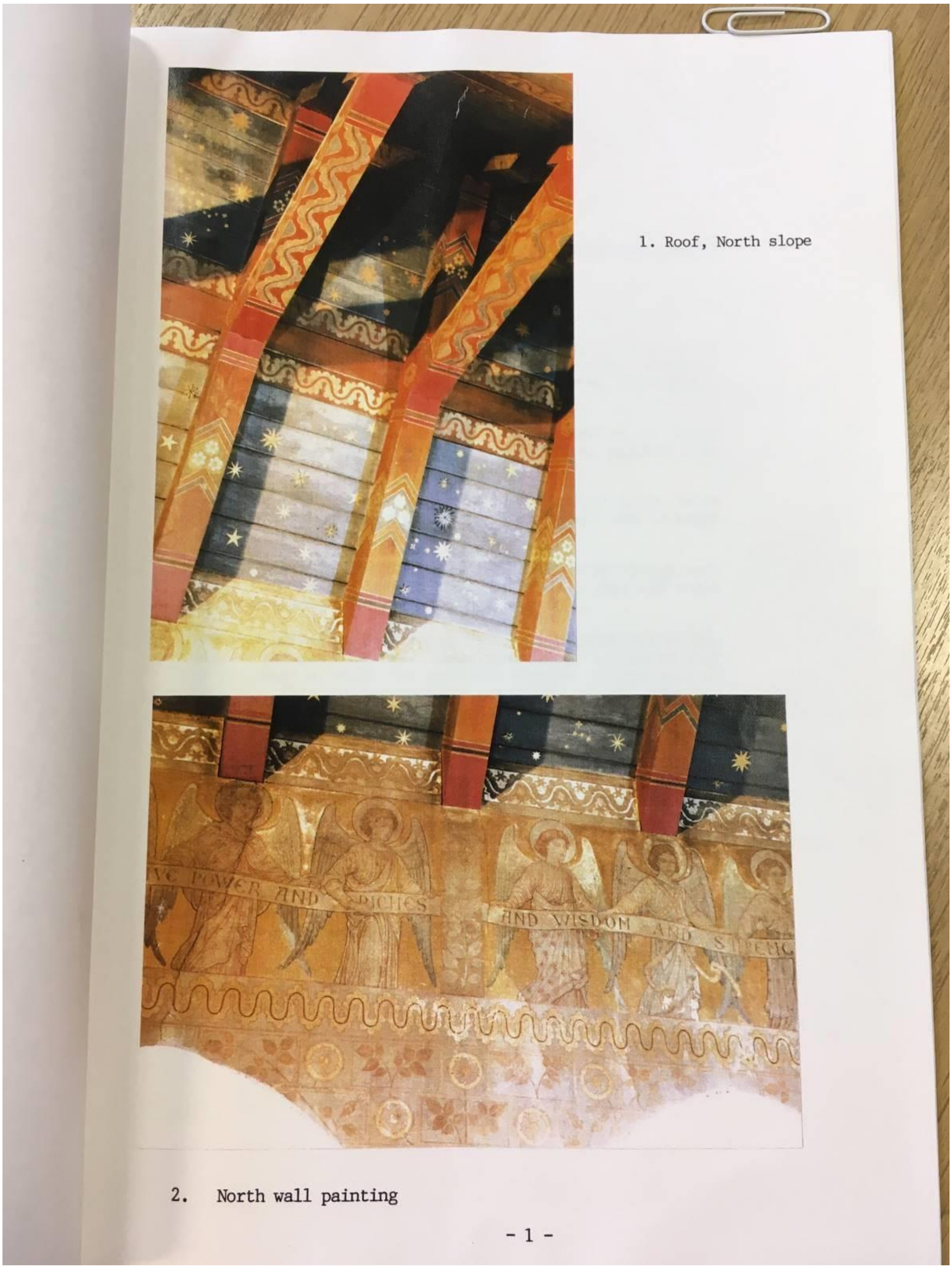
by

R.G.Sims

Architect

August 1991

V.A.T. Reg. No. 170 3705 84


1. Roof, North slope

2. North wall painting

- 1 -

ST. MICHAEL AND ALL ANGELS CHURCH

S K E L B R O O K E

CONSERVATION OF WALL AND ROOF PAINTINGS TO NORTH-EAST CHAPEL

GENERAL

The Victorian paintings on plaster and timber are typical of High Victorian work which may be seen in other Yorkshire churches such as Garton-on-the-Wolds, Knapton, Thixendale, Kirby Underdale and Bugthorpe.

Much gilding has been used as a background on to which figures are set which are mostly drawn or painted with lines, using very little block infilling.

Decoration on the roof timbers is in flat oil paint, with some raised lead stars gilded, to form relief (see attached photographs).

The paintwork on the timbers is relatively sound though very dirty. It is proposed to clean these areas only and touch up those areas where the paint has been lost.

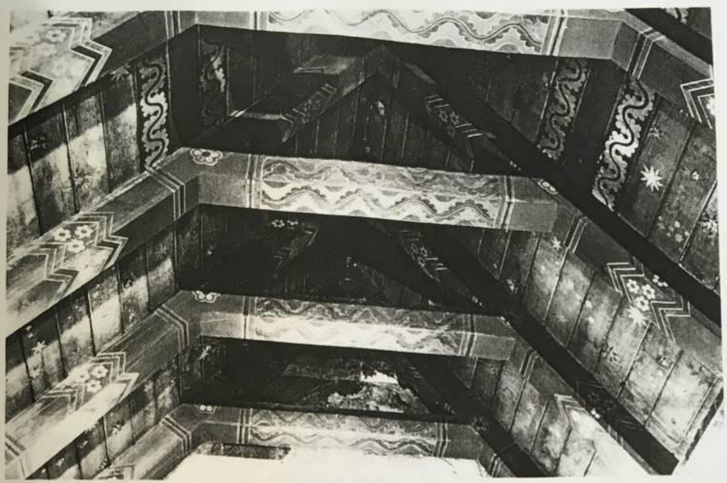
The wall paintings pose a more difficult problem in that the plaster has deteriorated. Water penetration has caused much of the base on which the paintwork depends to come away or loosen. This is particularly noticeable on the East and West walls and above the valley gutter running between the Chapel and the Chancel.

Roof repairs have been carried out in the recent past and precautions taken to ensure the water in the valley gutter can be discharged through overflow chutes in the event of a blockage. The walls have had some two years in which to dry out. Salting has virtually ceased.

Conservation work to the plaster where it has lost its key, will be required; together with new areas to be replastered which have been made up in the past using unsympathetic materials and causing loss of the original detail.

The work is to be split into two stages and the contractor is asked to price each stage separately:-

- 2 -



3. Roof looking East

4. Roof and wall looking North East

- 3 -

STAGE ONE

Carefully clean down the whole of the roof timbers which include rafters, collars and roof boarding to two slopes with one decorated wall plate on the South wall.

The dirt to be removed without removing any of the paint surface.

It is anticipated the gilding will also survive without additional gilding other than to the lead/copper stars which have suffered badly.

Allow for carefully removing the stars, cleaning and re-gilding.

Note the stars extend well up the roof slopes on both slopes.

A number of stars are missing and allowance for remaking 20 stars and gilding them and refixing should be made.

In isolated places, paint has either been chipped or peeled from the boarding or truss and allowance for touching up these in the original colours should be made.

The paint on the South wall plate is due to later decorating of the adjacent stonework and requires carefully removing.

The plasterwork to the walls requires consolidating and renewing where it is missing.

On the Eastern wall, the delicate section on the lower Northern area requires careful infilling of the voids behind the plaster to regain the key and making up in traditional lime plaster where sections are lost. See attached specification for lime plaster.

The section over the head of the window on the East wall has been made up in a modern cement render and this requires carefully removing and new lime plaster inserting.

At the Western end the plaster is pitted but remains of painting on the surface is such that renewal of this plaster will cause loss of original features. Only if reinstatement of the paintings is undertaken will replastering of this wall be possible and that is included in Stage Two.

In Stage One, the plaster is merely to be brushed down and any loosened parts to be consolidated.

The wall paintings to be carefully cleaned to remove all traces of dirt.

The fractures in the plaster on the North wall to be carefully filled and painted to obscure the repair.

Where salts have caused damage to the plaster, it may be necessary to apply a poultice to draw these out and the exact method and extent of this work will be agreed with the contracdtor and a Provisional Sum for this should be entered.

- 4 -

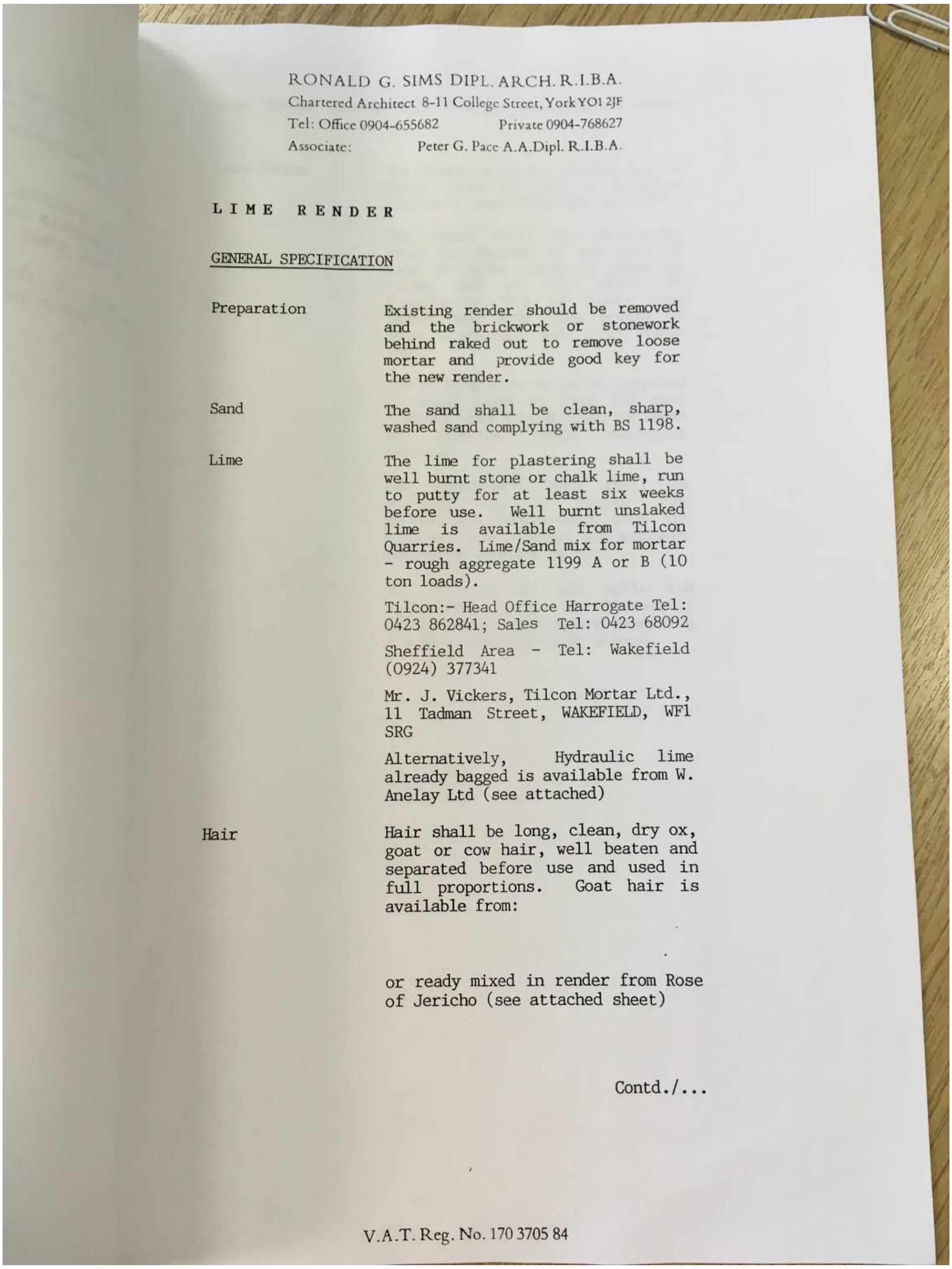
STAGE TWO

Following completion of Stage One, the wall paintings are to be repainted to retrieve all lost detail but not to the extent of overpainting any work which may be read satisfactorily.

The missing portions on the East and West walls together with the spandrels on the South wall are to be repainted to match the best areas remaining on the North wall.

Reinstatement of the plaster on the West wall will be required to form a suitable suface.

- 6 -



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Associate: Peter G. Pace A.A.Dipl. R.I.B.A.

L I M E R E N D E R

GENERAL SPECIFICATION

Preparation	Existing render should be removed and the brickwork or stonework behind raked out to remove loose mortar and provide good key for the new render.
Sand	The sand shall be clean, sharp, washed sand complying with BS 1198.
Lime	The lime for plastering shall be well burnt stone or chalk lime, run to putty for at least six weeks before use. Well burnt unslaked lime is available from Tilcon Quarries. Lime/Sand mix for mortar - rough aggregate 1199 A or B (10 ton loads). Tilcon:- Head Office Harrogate Tel: 0423 862841; Sales Tel: 0423 68092 Sheffield Area - Tel: Wakefield (0924) 377341 Mr. J. Vickers, Tilcon Mortar Ltd., 11 Tadman Street, WAKEFIELD, WF1 SRG Alternatively, Hydraulic lime already bagged is available from W. Anelay Ltd (see attached)
Hair	Hair shall be long, clean, dry ox, goat or cow hair, well beaten and separated before use and used in full proportions. Goat hair is available from: or ready mixed in render from Rose of Jericho (see attached sheet)

Contd./...

V.A.T. Reg. No. 170 3705 84

Lime Render general specification continuation sheet 2

Lime Render

The render is to be carried out in three coats to give a finished thickness (excluding key) of 7/8".

The coarse stuff for plastering shall be composed of one part of lime to three parts of sand by volume and in this shall be incorporated 9lb of clean long beaten hair free from grease or other impurities, with every cubic yard.

The setting coat is to be composed of equal parts of lime and sand finished with a wood float to leave an approved rough sandpaper texture.

The plasterer's work shall be executed in a proper and workmanlike manner with true and even surfaces, angles and arrises. Angles and arrises by eye.

The surfaces of all walls and partitions shall be thoroughly wetted immediately before rendering and all rendering to be scored.

2.

French Hydraulic Lime 'XHN'

We have now established an agency to sell this material in 50 kilo bags in Scotand, Cumbria, ancashire, Merseyside, Cheshire, Northumberland, Tyne and Wear, Durham, all of Yorkshire, Humberside and North Wales.

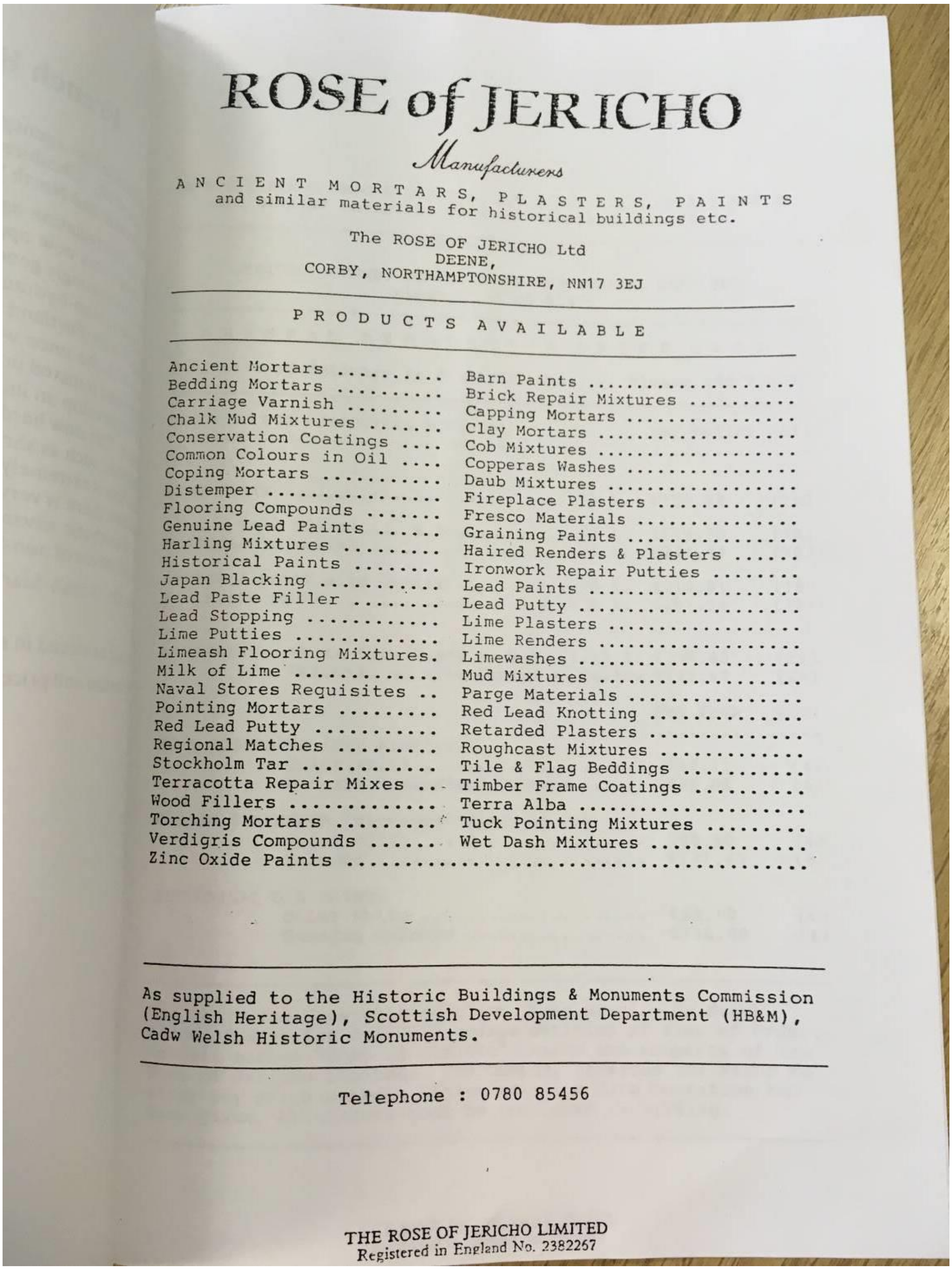
There is a growing appreciation again of lime as the major binder material in mortars and enderings. Although this new appreciation stems mainly from work in conservation, the rowing interest is increasingly general. In the UK, no true hydraulic lime has been marketed or some twelve years. Non-hydraulic limes are still available but, for normal building works, re usually gauged with Portland cement to produce a set. The French natural hydraulic compares closely with the once well known British hydraulic limes such as the Blue Lias, Holywell or Rugby and is mixed in similar proportions for renders and mortars, eg. 1:2½, 1:3 nd 1:4. 'XHN' will develop an initial set in a few hours, but will harden progressively over a ong period of time. This slow hardening process avoids many of the problems associated with quick setting cements, such as shrinkage cracking and poor bonding. A mortar or rendering nix based on this lime is extremely workable and adheres well; no plasticiser or bonding agent gent is required and there is very little risk of alkali salt staining of masonry. This lime also requently has an aesthetic advantage over other binder, because its pale, off-white colour voids the dead whiteness of non-hydraulic lime and the greyness of Portland.

t is featured in the British Standard 6270 Part 1 1982 "Cleaning and Surface repairs of uildings".

The material should be stored in dry conditions.

For further information and prices write or telephone:-

William Anelay Limited
Murton Way,
Osbaldwick,
York,
YO1 3UW.
Telephone: York (0904) 412624



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		Per Pack	(of)
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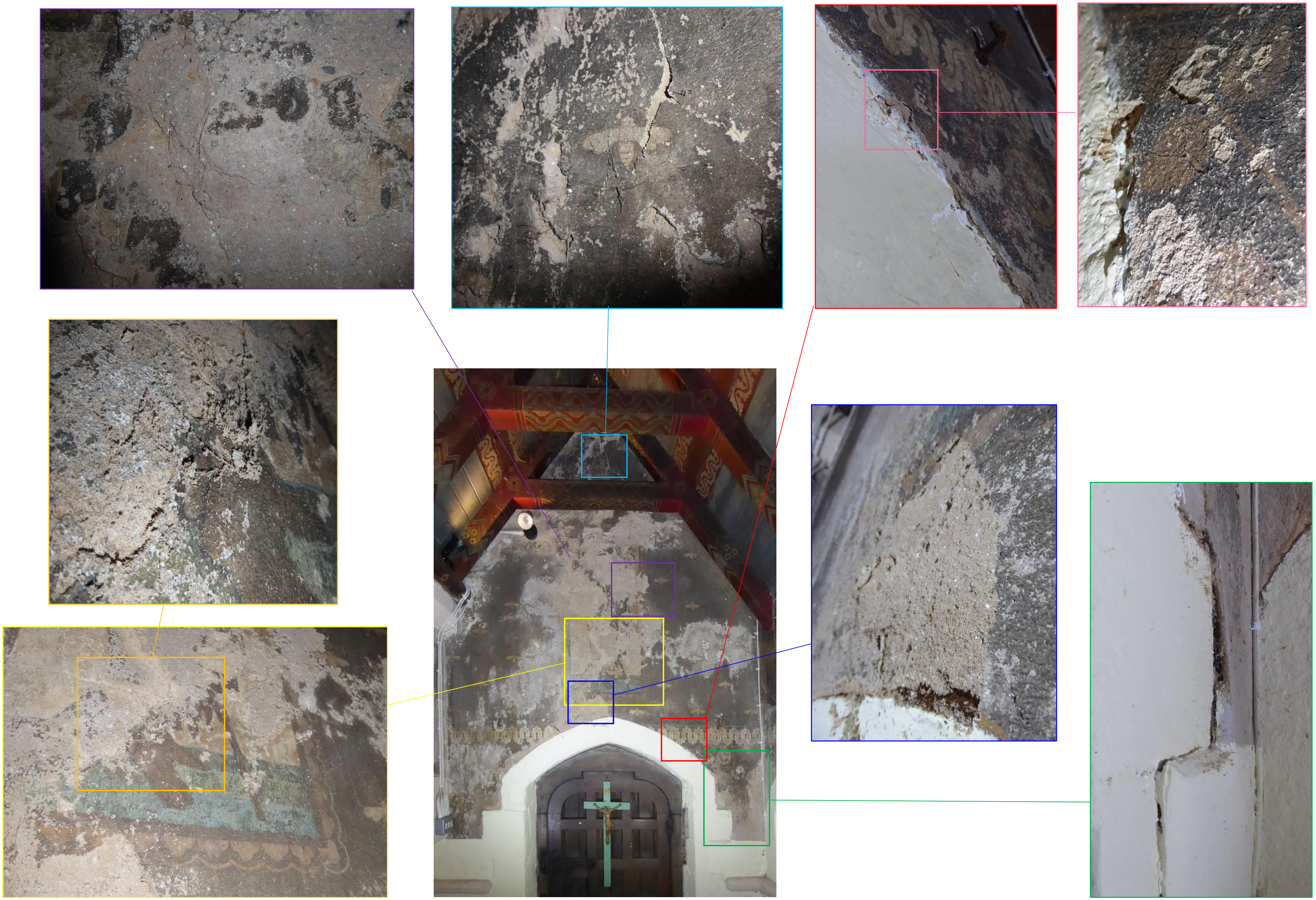
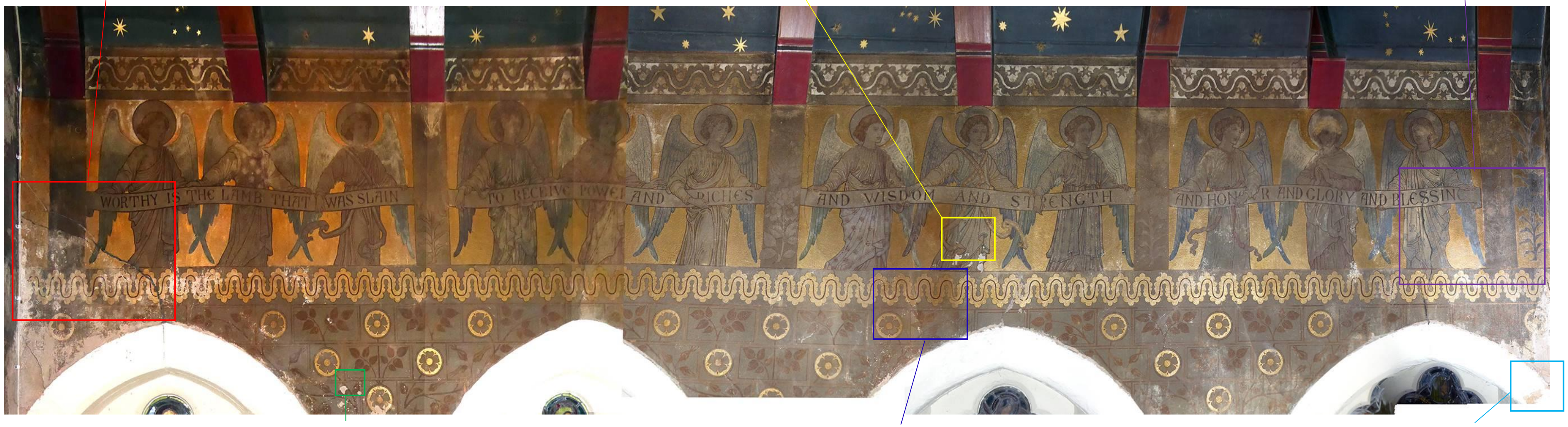
Appendix 4: Photographic record of condition

East Wall:

West Wall:



North Wall:


WORTHY IS THE LAMB THAT WAS SLAIN
TO RECEIVE POWER AND RICHES
AND WISDOM AND STRENGTH
AND HONO R AND GLORY AND BLESSING

South Wall:

Appendix 5: Condition maps

East & west walls:

East Wall

Delaminating/unstable plaster

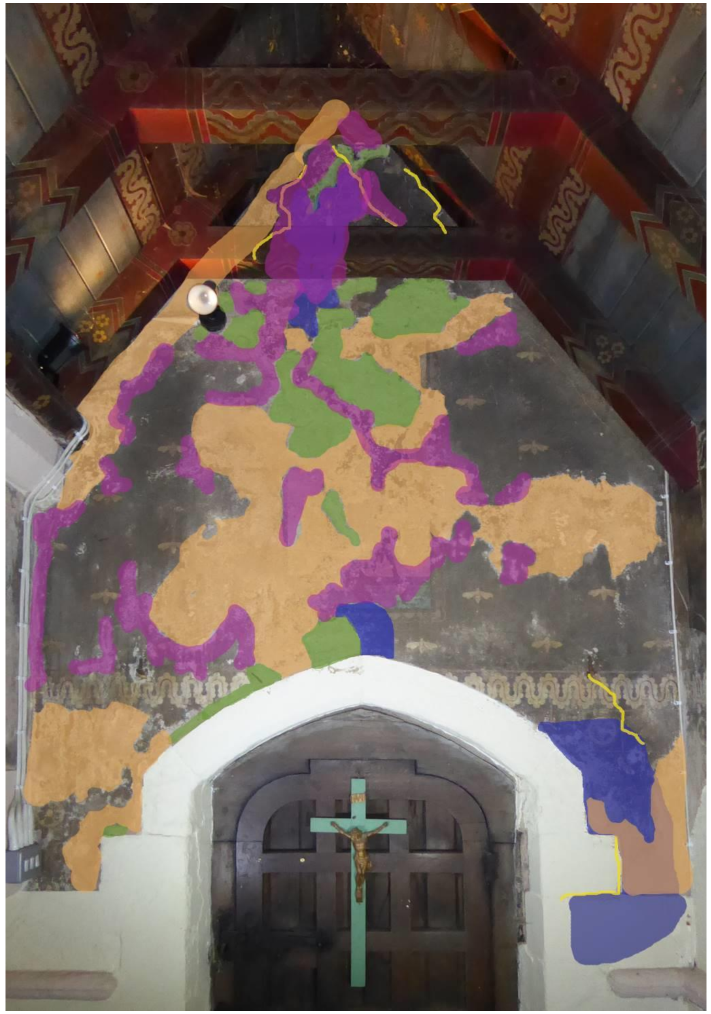
Cementitious repair mortar

Areas where majority of paint layer has been lost

Plaster losses

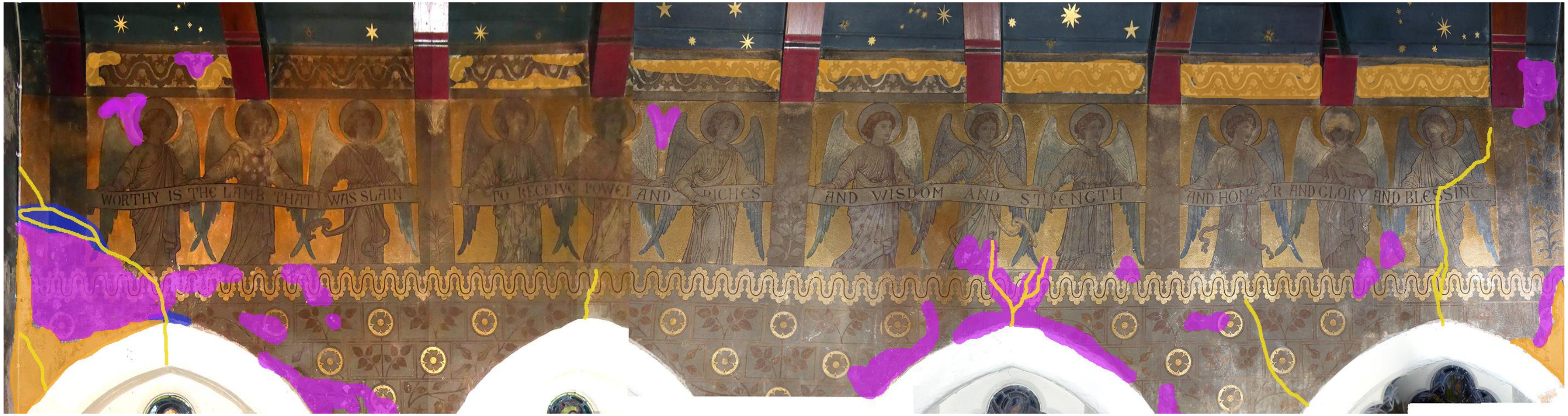
Unstable/flaking paint

Fractures



West Wall

North wall:



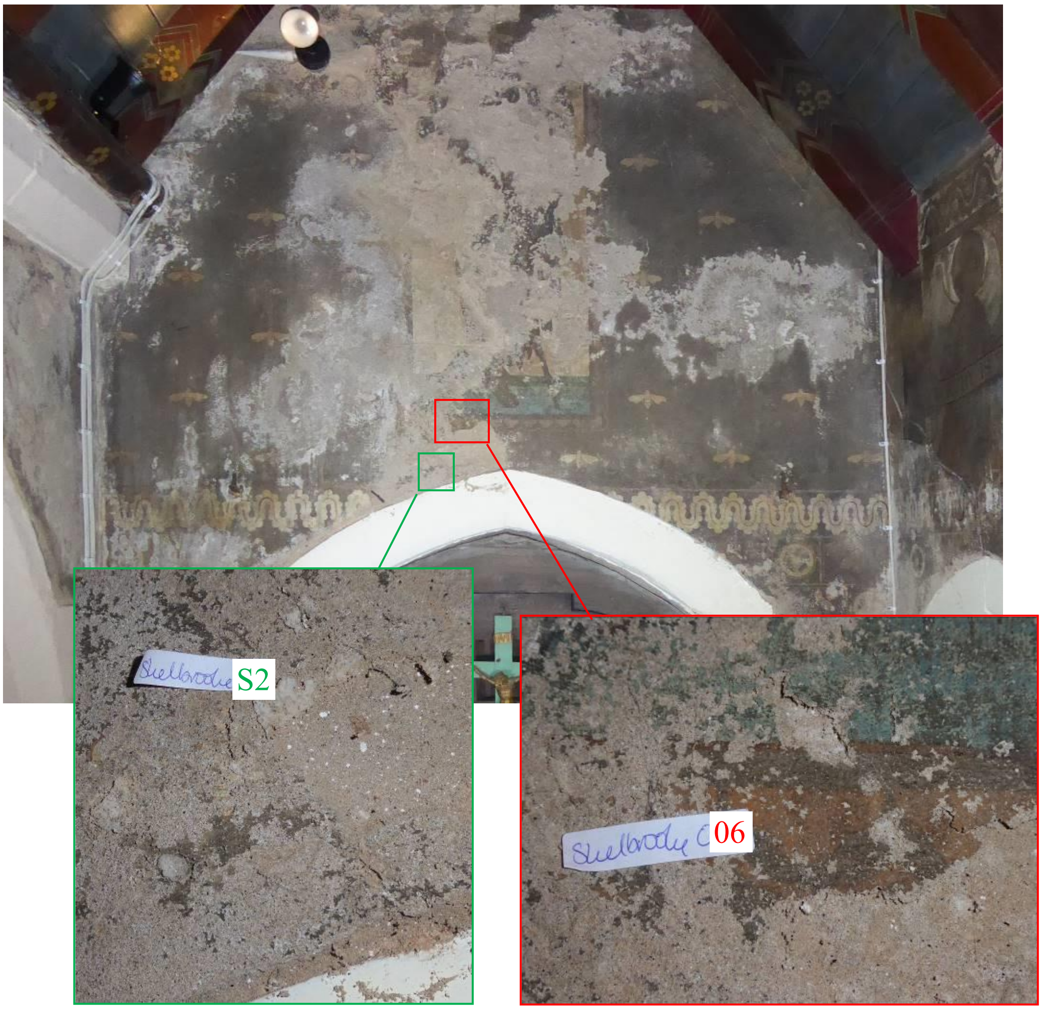
South wall:

Appendix 6: Paint, mortar and salt sample locations

East Wall:

Paint samples: 01, 02 and 03, Mortar sample: M03

West wall:

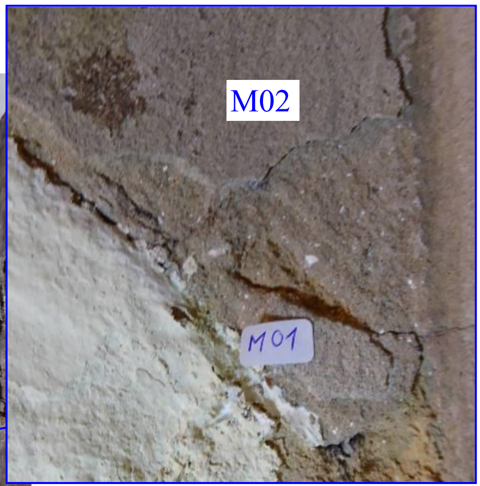


Paint sample: 06, Salt sample: S2

Roof timbers:

Paint sample: 07

North wall:



Paint samples: 04 & 05
Mortar samples: M01 & M02
Salt sample: S1

Appendix 7: Moisture readings

East Wall

Protimetre readings XX.X

Protimetre in capacitance mode readings XXX

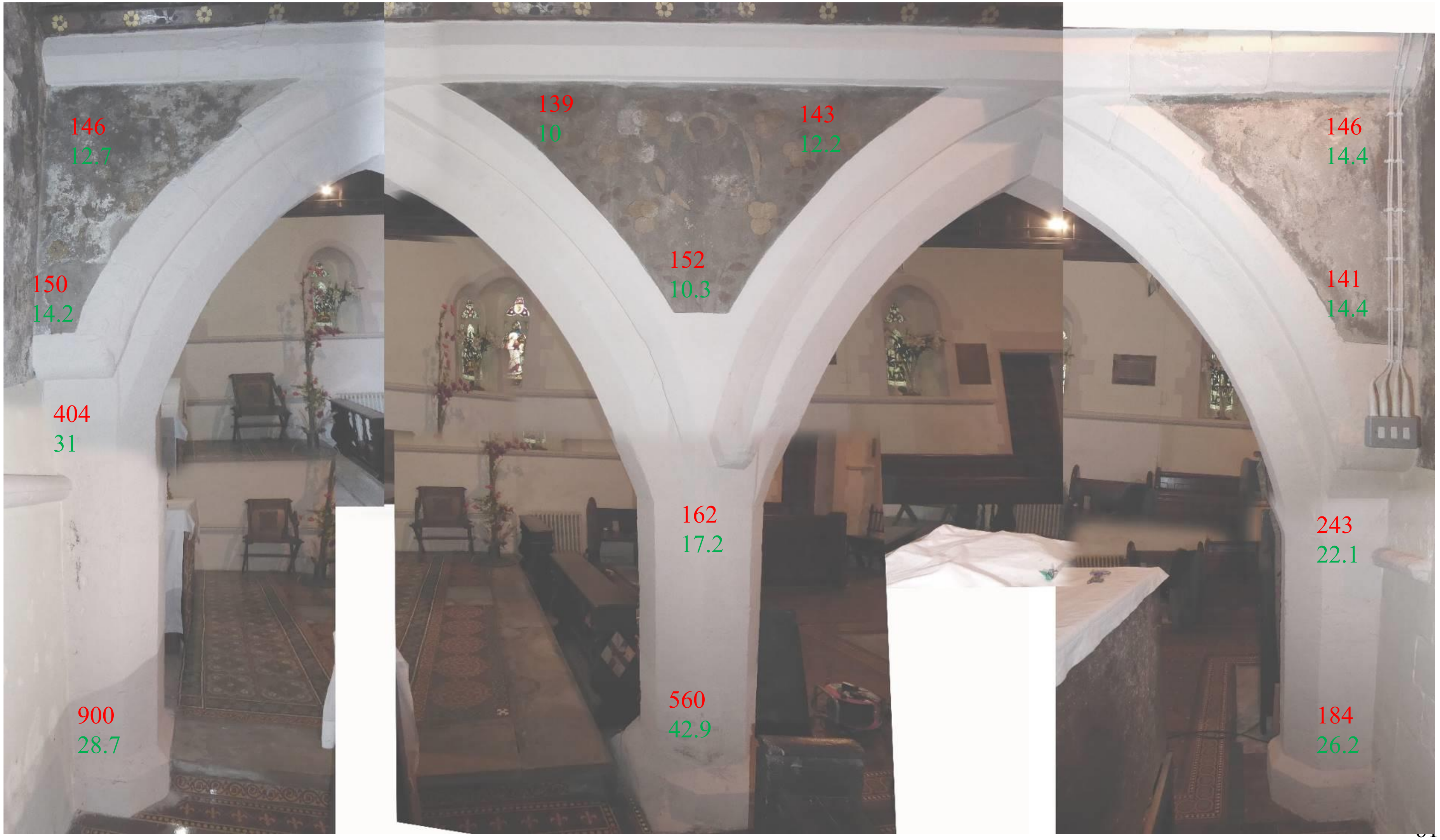
West Wall:


209
20.2
150
9.8
164
11
152
10.1
287
16.9
150
9.2
187
12.8
152
11.5
284
9.7
148
10.4
237
22.9
223
21.6
255
30.4
236
25.8
231
23

North Wall:

156
12.6
133
139
12.8
143
12.6
139
11.9
153
12.7
153
11.8
152
12.3
231
21.3
202
14.4
23.6
157
13.1
162
12.3
225
21.5
262
19.8
251
22.3
241
19.1
239
16.3
220
16.6
240
18.3
243
20.3
270
26.2
258
22.6
240
25
240
23.8
439
29.5
254
26.3

South Wall:


146
12.7
139
10
143
12.2
146
14.4
150
14.2
152
10.3
141
14.4
404
31
162
17.2
243
22.1
900
28.7
560
42.9
184
26.2

Appendix 8: Mortar analysis results

Mortar Analysis

Date Analysed: 30/11/16
Sample: MO1 Base Coat, Skelbrooke
Observations: A light grey-buff coloured, fine grained mortar, 12mm thick, with small flecks of white lime.

RESULTS

Components of Mortar	Method	Results % by mass	
Calcium Carbonate %C	Calcimetry - CO_2 emission	13.8	
Dolomite %D	Calcimetry and titrimetric (EDTA)	15.3	
Aggregate	Gravimetric	67.1	
Gypsum	Barium Chloride	0.4	
Nitrates	Titrimetric/test strips.	0.04	
Chlorides	Titrimetric/test strips.	0.38	
Iron Oxides (Fe_2O_3)	Test strips/Titrimetric (potassium dichromate)	0.6	
pH of mortar sample	Indicator Strips/pH meter	10	
Mix Ratio	**Parts By Mass Aggregate : Binder (A : B)**	2.1	
Mix Ratio if binder was lime putty	**Parts By Volume Aggregate : lime putty**	1.2	
Mix Ratio if binder was HL/cement	**Parts By Volume Aggregate : Hydraulic Lime or cement**	1.5	
Active lime [$Ca(OH)_2$]	Titrimetric (Extracted in 10% sugar solution)	0.003	
Carbonated lime in binder (degree of Carbonation)	From %$Ca(OH)_2$ in binder	99.96	
Cementitious Compounds	%S x 2.5	2.21	
Soluble Silica %S	Volumetric/Titrimetric - (Conversion to silicomolybdic acid)	0.88	
Soluble Silica in Original Binder	From %S x $(\frac{A}{B} + 1)$	3.62	
CaO in Original Binder	From CaO in mortar	35.45	
CaO in Mortar	Titrimetric (EDTA) Gravimetric (ammonium oxalate)	8.67	
Aluminium Oxide in Binder	Gravimetric (using Oxine)	-	
Cementation Index for Binder (CI)	$CI \approx \frac{\%S \times 2.5}{(\%C \times 0.56) + (\%D \times 1.5)}$	0.07	
Type of Binder or equivalent strength	Dependent on the % Soluble Silica in Binder	Dolomitic lime non - NHL1	

A lime putty with 50% moisture by mass is considered in the calculations above.A greater percentage of moisture in the lime putty, gives a higher Aggregate : Binder ratio (by mass and/or volume)

ACID INSOLUBLES AGGREGATE MODE				
SIEVE SIZE	**RETAINED MASS (gms)**	**% RETAINED**	**% PASSING**	**AGGREGATE CHARACTERISTICS**
5.45		0	100	
2.465		0	100	
0.915		0	100	
0.567		0.25	99.74	Angular clear/yellow/brown quartz + grey-black iron compounds (some magnetic)
0.411		4.62	95.11	As above
0.14		64.78	30.33	As above
0.09		17.99	12.33	As above
<0.09		12.33	0	As above

Methodology: A variety of specific volumetric, titrimetric, gravimetric and microchemical techniques, in addition to polarised light microscopy, are used to determine the components and characteristics of the mortar sample, as shown in the results table.

<table>
<tr>
<td>Summary of Results and Comments:</td>
<td>
The aggregate: is a fine-grained grey-buff coloured sharp silica sand, similar to that found in the top coat:


Aggregate Base coat, mag.x 10

The Binder: is a non or slightly hydraulic (very feebly hydraulic – NHL1) dolomitic lime.

The Mortar: has a mix ratio by volume of 1.5 : 1 Aggregate : Binder
</td>
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</table>

Mortar Analysis

Date Analysed: 30/11/16
Sample: MO1 Top Coat, Skelbrooke
Observations: A 2mm thick, soft, fine-grained, light grey-buff coloured mortar

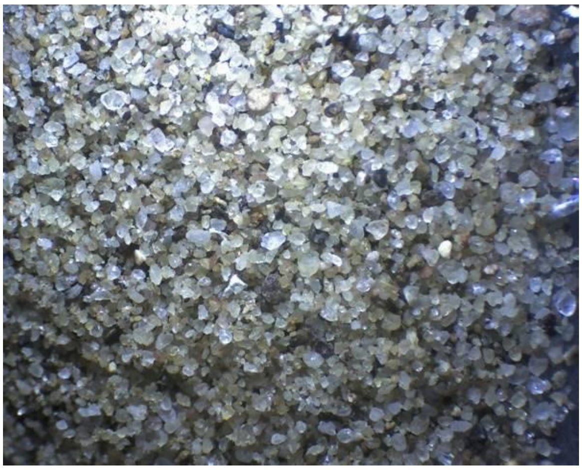
RESULTS

Components of Mortar	Method	Results % by mass	
Calcium Carbonate %C	Calcimetry - CO_2 emission	18.72	
Dolomite %D	Calcimetry and titrimetric (EDTA)	18.66	
Aggregate	Gravimetric	60.13	
Gypsum	Barium Chloride	0.49	
Nitrates	Titrimetric/test strips.	0.02	
Chlorides	Titrimetric/test strips.	0	
Iron Oxides (Fe_2O_3)	Test strips/Titrimetric (potassium dichromate)	0.4	
pH of mortar sample	Indicator Strips/pH meter	10	
Mix Ratio	Parts By Mass Aggregate : Binder (A : B)	1.5	
Mix Ratio if binder was lime putty	Parts By Volume Aggregate : lime putty	0.9	
Mix Ratio if binder was HL/cement	Parts By Volume Aggregate : Hydraulic Lime or cement	1	
Active lime [$Ca(OH)_2$]	Titrimetric (Extracted in 10% sugar solution)	0.009	
Carbonated lime in binder (degree of Carbonation)	From $\%Ca(OH)_2$ in binder	99.93	
Cementitious Compounds	%S x 2.5	1.54	
Soluble Silica %S	Volumetric/Titrimetric - (Conversion to silicomolybdic acid)	0.61	
Soluble Silica in Original Binder	From $\%S \times (\frac{A}{B} + 1)$	2.059	
CaO in Original Binder	From CaO in mortar	37.50	
CaO in Mortar	Titrimetric (EDTA) Gravimetric (ammonium oxalate)	11.24	
Aluminium Oxide in Binder	Gravimetric (using Oxine)	-	
Cementation Index for Binder (CI)	$CI \approx \frac{\%S \times 2.5}{(\%C \times 0.56) + (\%D \times 1.5)}$	0.039	
Type of Binder or equivalent strength	Dependent on the % Soluble Silica in Binder	Non Hydraulic Dolomitic lime	

A lime putty with 50% moisture by mass is considered in the calculations above.A greater percentage of moisture in the lime putty, gives a higher Aggregate : Binder ratio (by mass and/or volume)

ACID INSOLUBLES AGGREGATE MODE				
SIEVE SIZE	**RETAINED MASS (gms)**	**% RETAINED**	**% PASSING**	**AGGREGATE CHARACTERISTICS**
5.45		0	100	
2.465		0	100	
0.915		0	100	
0.567		0.53	99.46	Angular clear/yellow/brown quartz grains
0.411		6.41	93.04	As above
0.14		71.65	21.39	As above
0.09		9.62	11.76	As above
<0.09		11.76	0	As above

Methodology: A variety of specific volumetric, titrimetric, gravimetric and microchemical techniques, in addition to polarised light microscopy, are used to determine the components and characteristics of the mortar sample, as shown in the results table.

Summary of Results and Comments:	**The aggregate**: is a fine grained, grey-buff coloured sharp silica sand, similar to that found in the base coat:  Aggregate mag.x 10 **The Binder:** is a non-hydraulic dolomitic lime. **The Mortar**: has a mix ratio by volume of 0.9 – 1 : 1 Aggregate : Binder.

Mortar Analysis

Date Analysed: 1/11/16
Sample: MO2 Skelbrooke
Observations: A soft, fine grained, thin (1 - 2mm), light grey-buff coloured mortar.

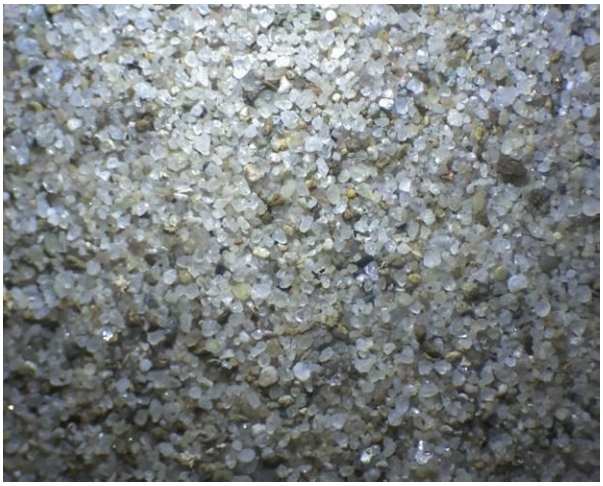
RESULTS

Components of Mortar	Method	Results % by mass	
Calcium Carbonate %C	Calcimetry - CO_2 emission	22.94	
Dolomite %D	Calcimetry and titrimetric (EDTA)	13.87	
Aggregate	Gravimetric	60.15	
Gypsum	Barium Chloride	0.58	
Nitrates	Titrimetric/test strips.	0	
Chlorides	Titrimetric/test strips.	0	
Iron Oxides (Fe_2O_3)	Test strips/Titrimetric (potassium dichromate)	0.7	
pH of mortar sample	Indicator Strips/pH meter	9.5	
Mix Ratio	**Parts By Mass** **Aggregate : Binder (A : B)**	1.5	
Mix Ratio if binder was lime putty	**Parts By Volume** **Aggregate : lime putty**	0.9	
Mix Ratio if binder was HL/cement	**Parts By Volume** **Aggregate : Hydraulic Lime or cement**	1.1	
Active lime [$Ca(OH)_2$]	Titrimetric (Extracted in 10% sugar solution)	0.002	
Carbonated lime in binder (degree of Carbonation)	From %$Ca(OH)_2$ in binder	99.98	
Cementitious Compounds	%S x 2.5	1.72	
Soluble Silica %S	Volumetric/Titrimetric - (Conversion to silicomolybdic acid)	0.69	
Soluble Silica in Original Binder	From %S x $\left(\frac{A}{B} + 1\right)$	2.30	
CaO in Original Binder	From CaO in mortar	45.72	
CaO in Mortar	Titrimetric (EDTA) Gravimetric (ammonium oxalate)	13.69	
Aluminium Oxide in Binder	Gravimetric (using Oxine)	-	
Cementation Index for Binder (CI)	$CI \approx \dfrac{\%S \times 2.5}{(\%C \times 0.56) + (\%D \times 1.5)}$	0.05	
Type of Binder or equivalent strength	Dependent on the % Soluble Silica in Binder	Non Hydraulic Dolomitic lime	

A lime putty with 50% moisture by mass is considered in the calculations above.A greater percentage of moisture in the lime putty, gives a higher Aggregate : Binder ratio (by mass and/or volume)

ACID INSOLUBLES AGGREGATE MODE				
SIEVE SIZE	**RETAINED MASS (gms)**	**% RETAINED**	**% PASSING**	**AGGREGATE CHARACTERISTICS**
5.45		0	100	
2.465		0	100	
0.915		0	100	
0.567		0.28	99.71	Angular clear/yellow/brown quartz grains.
0.411		4.05	95.65	As above
0.14		70.14	25.50	As above
0.09		16.81	8.69	As above
<0.09		8.69	0	As above

Methodology: A variety of specific volumetric, titrimetric, gravimetric and microchemical techniques, in addition to polarised light microscopy, are used to determine the components and characteristics of the mortar sample, as shown in the results table.

Summary of Results and Comments:	**The aggregate:** is a grey-buff coloured, fine grained, sharp silca sand similar to that found in samples MO1 base and top coat:  Aggregate mag.x 10 **The Binder:** is a dolomitic lime. **The Mortar:** has a mix ratio by volume of 0.9 : 1 Aggregate : Binder