HOLDEN CONSERVATION LTD

Conservation works on the Triforium windows of the Nave and Choir, St Albans Cathedral 2008

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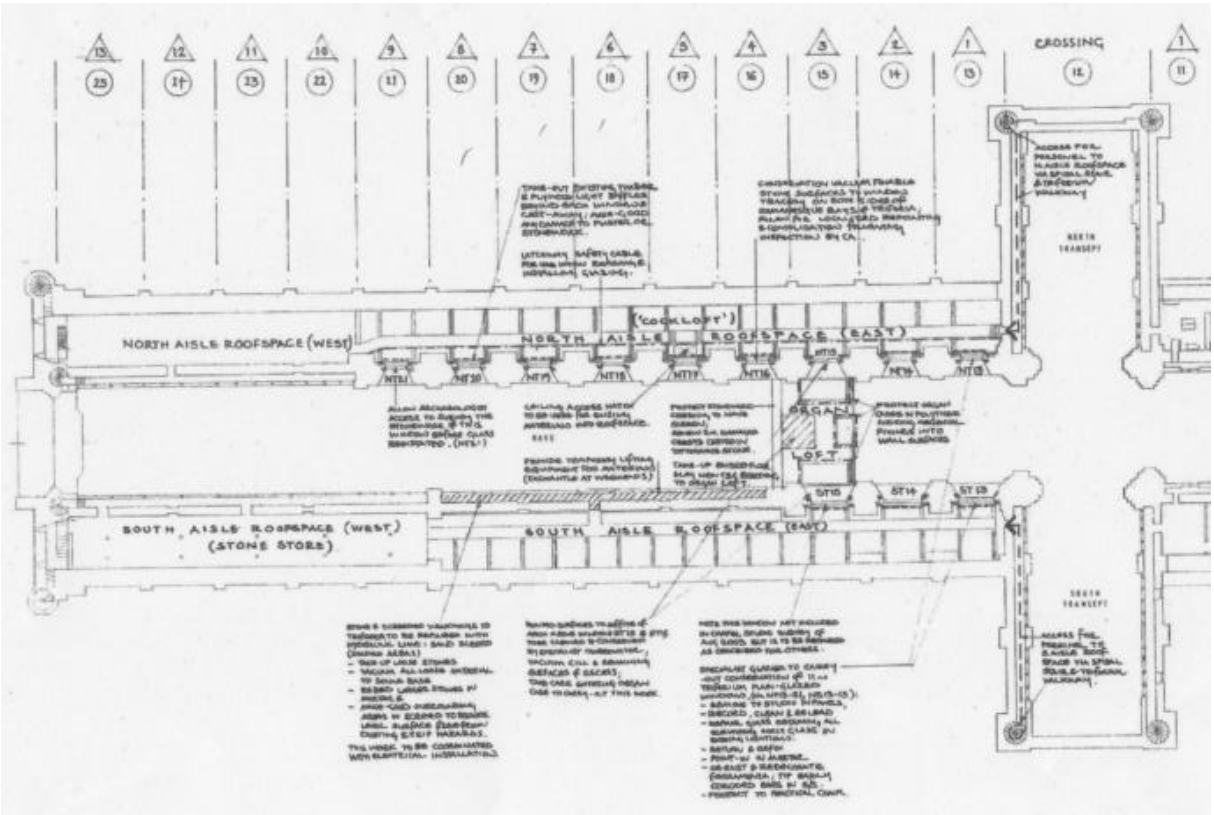
Appendix

38 – 42 Conservation survey

43 – 62 Survey diagrams - annotated

Introduction

The Triforium windows within the Romanesque
Bays of the nave and choir date from the 15th century and were punched through the Norman fabric when the aisle roofs were lowered to lead flats. They provided additional lighting to the interior until the late 19th century when the roofs were raised again to pitch against the walls. Having thus become redundant they were neglected and the condition of the glazing deteriorated to a dangerous condition. Therefore in 2008, as part of the nave project phase 1, the glass was removed for re-leading and conservation work and then reinstated into the existing stonework. At the same time serious structural problems with the stonework of the tracery were addressed. The tracery is constructed in Totternhoe chalk stone, which had suffered fracture from rusting built in metalwork as well as from earlier inappropriate cement and resin based repairs. The “exterior” faces of the tracery (now facing the roof spaces) is badly weathered and soot encrusted, but it was not considered necessary or appropriate to undertake conservation of these surfaces over and above the essential structural repairs. This report itemises the repairs carried out to each of the 11 no. windows. Window NT21 needed no repair having been renewed in the 19th century.



Location diagram for the windows.

Treatment

The stonework was pinned with threaded stainless steel bars and fixed with 'Steinkitt' polyester resin.

A hydraulic lime mortar was used as the backing mortar:
1 part – St Astier hydraulic lime (3.5)
3 parts – fine sharp sand

A hydraulic lime mortar, to match the stonework was used as a general mortar:
1 part – St Astier hydraulic lime (3.5)
3 parts – silver sand

The ferrous bars were painted with 'Hammerite' smooth black paint.

Key

Cement and lead were removed from where the ferrous cross-bars were fixed into the stonework. The sections of cross-bars that had been within the stonework were painted. The stonework around the cross-bars was then filled with backing mortar, to hold the bars in their original positions, and a top coat of mortar applied.

A hydraulic lime mortar repair.

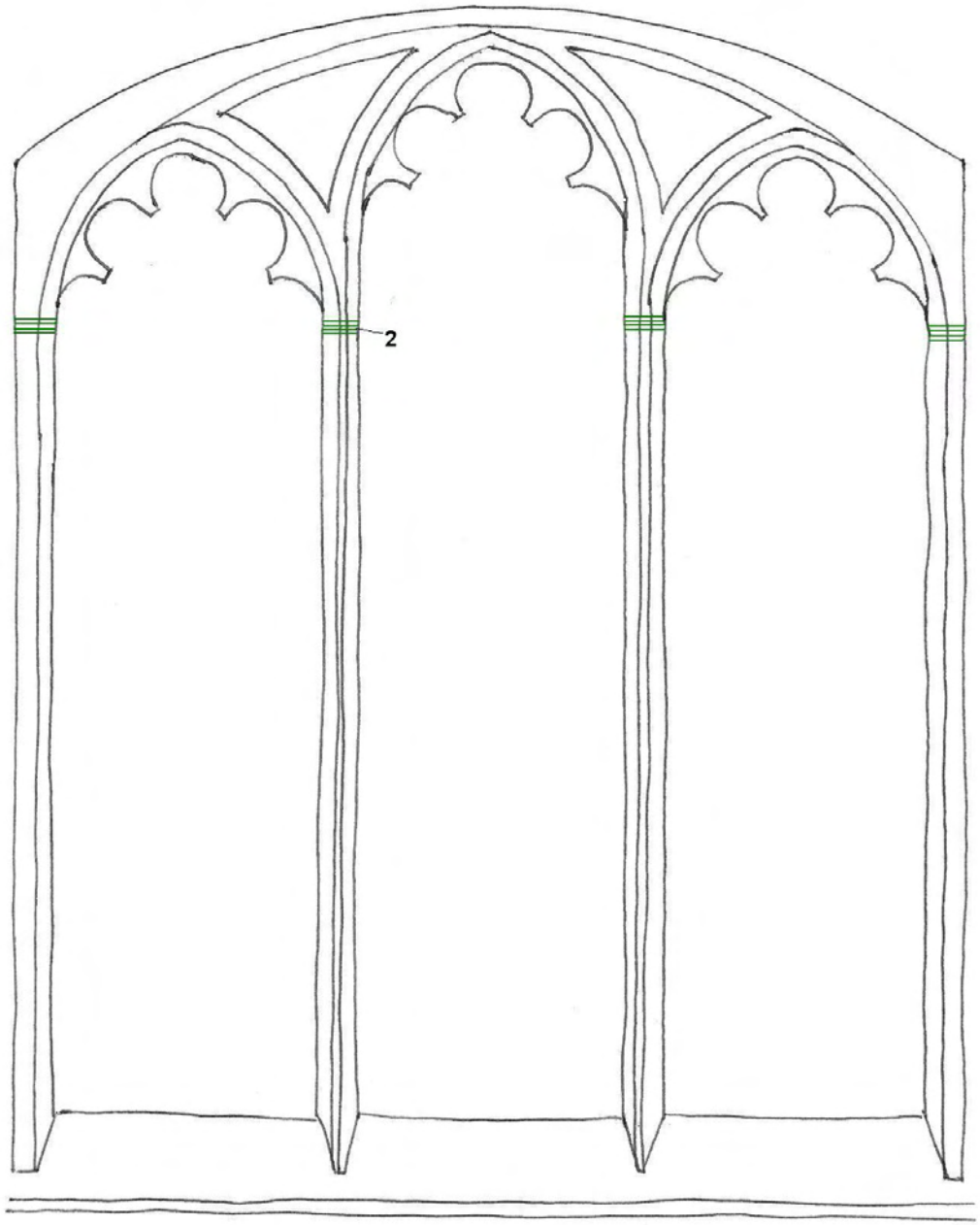
A threaded stainless steel bar fixed with polyester resin.

1 —— The numbers on the diagrams are referring to the similarly numbered photographs relating to the area indicated.

Triforium. North Elevation. NT20 (roof side)



Triforium. North Elevation. NT20 (nave side)





1. Triforium. North Elevation. NT20 (roof side)

6mm threaded stainless steel pin fixing tracery section to re-faced stone, across the joint on the glazing line.



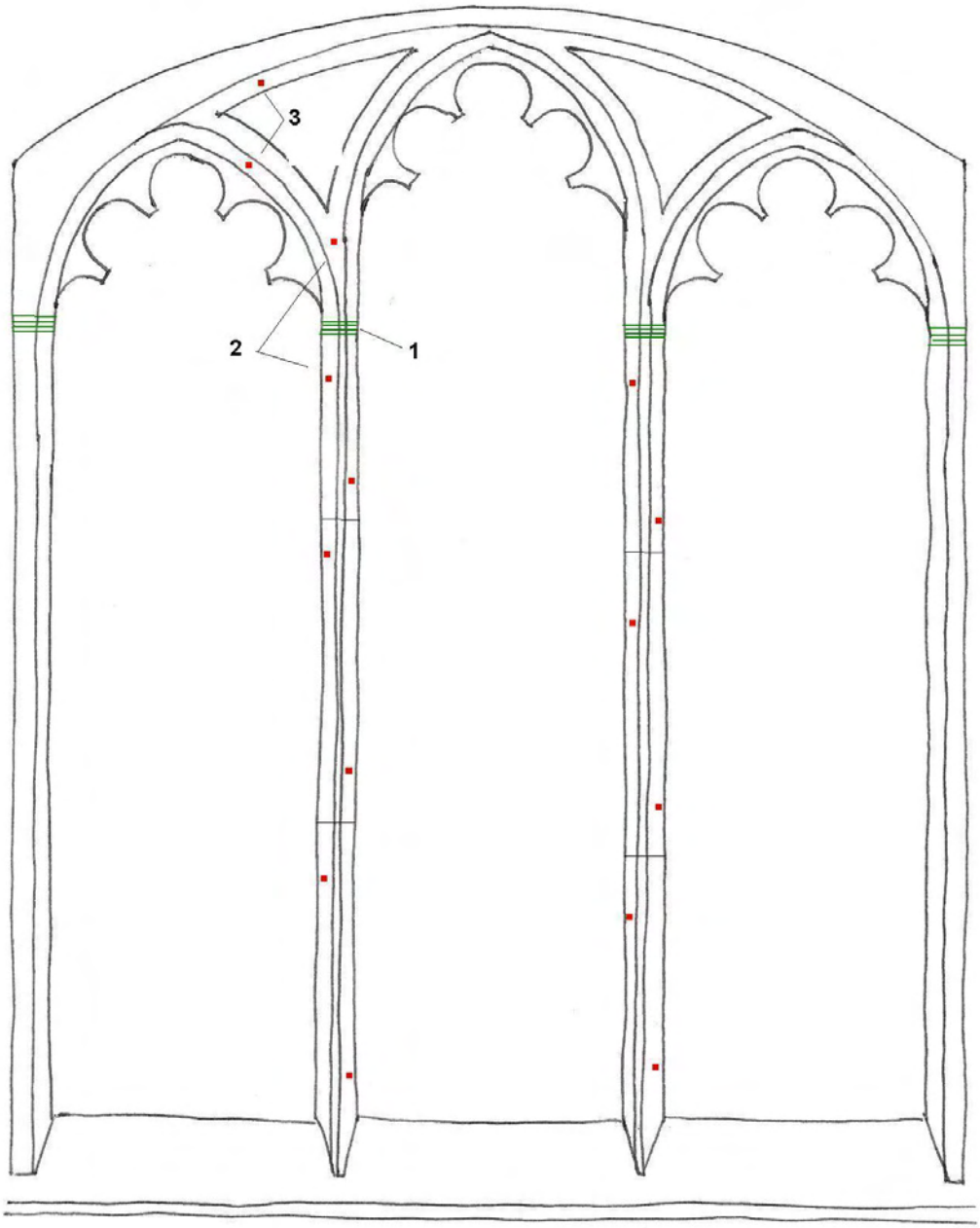
2. Triforium. North Elevation. NT20 (nave side)

Backing mortar visible in hole around ferrous cross-bar, where the cement and lead have been removed.
The cross-bar has been fixed to one side, in its original position, to allow room for the glazing.

Triforium. North Elevation. NT19 (roof side)



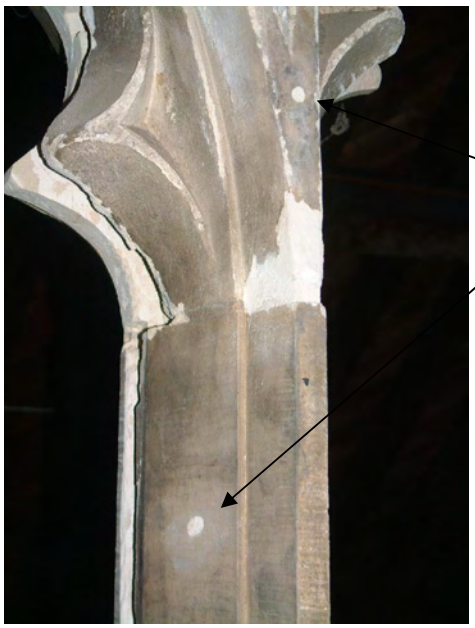
Triforium. North Elevation. NT19 (nave side)





1. Triforium. North Elevation. NT19 (nave side)

Backing mortar visible in hole around ferrous cross-bar, where the cement and lead have been removed.



2. Triforium. North Elevation. NT19 (nave side)

6mm threaded stainless steel pin fixing tracery section to re-faced stone, across the joint on the glazing line.



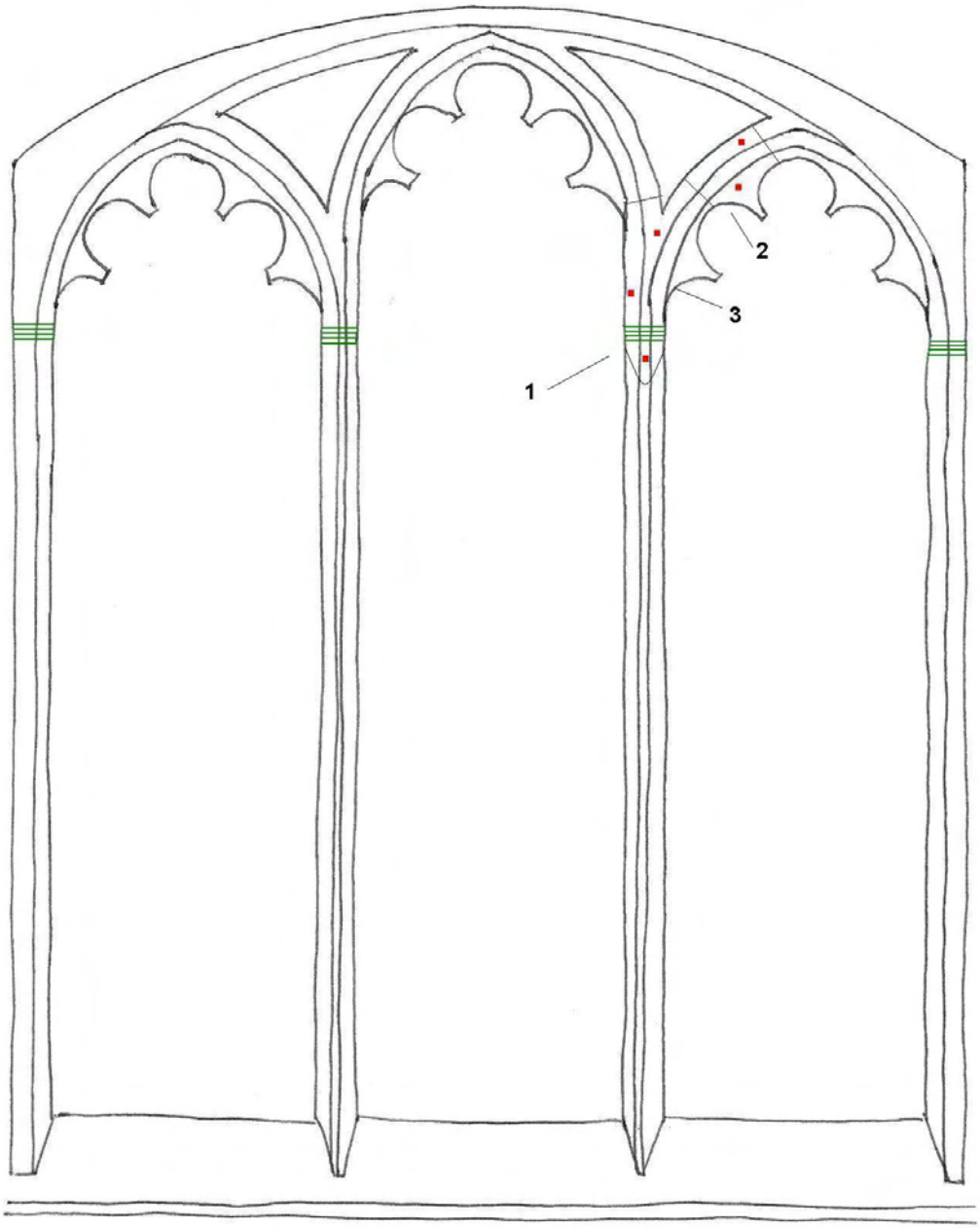
3. Triforium. North Elevation. NT19 (nave side)

6mm threaded stainless steel pin across cracked stonework.

Triforium. North Elevation. NT18 (roof side)



Triforium. North Elevation. NT18 (nave side)





1. Triforium. North Elevation. NT18 (nave side)

Loose stone re-fixed in position with 6mm threaded stainless steel pin and polyester resin.

The joint was filled with hydraulic lime mortar.



2. Triforium. North Elevation. NT18 (nave side)

Two sections of stonework that came loose during glazing removal.

They were pinned back with 6mm threaded stainless steel pins and polyester resin.

The joints were pointed with hydraulic lime mortar.



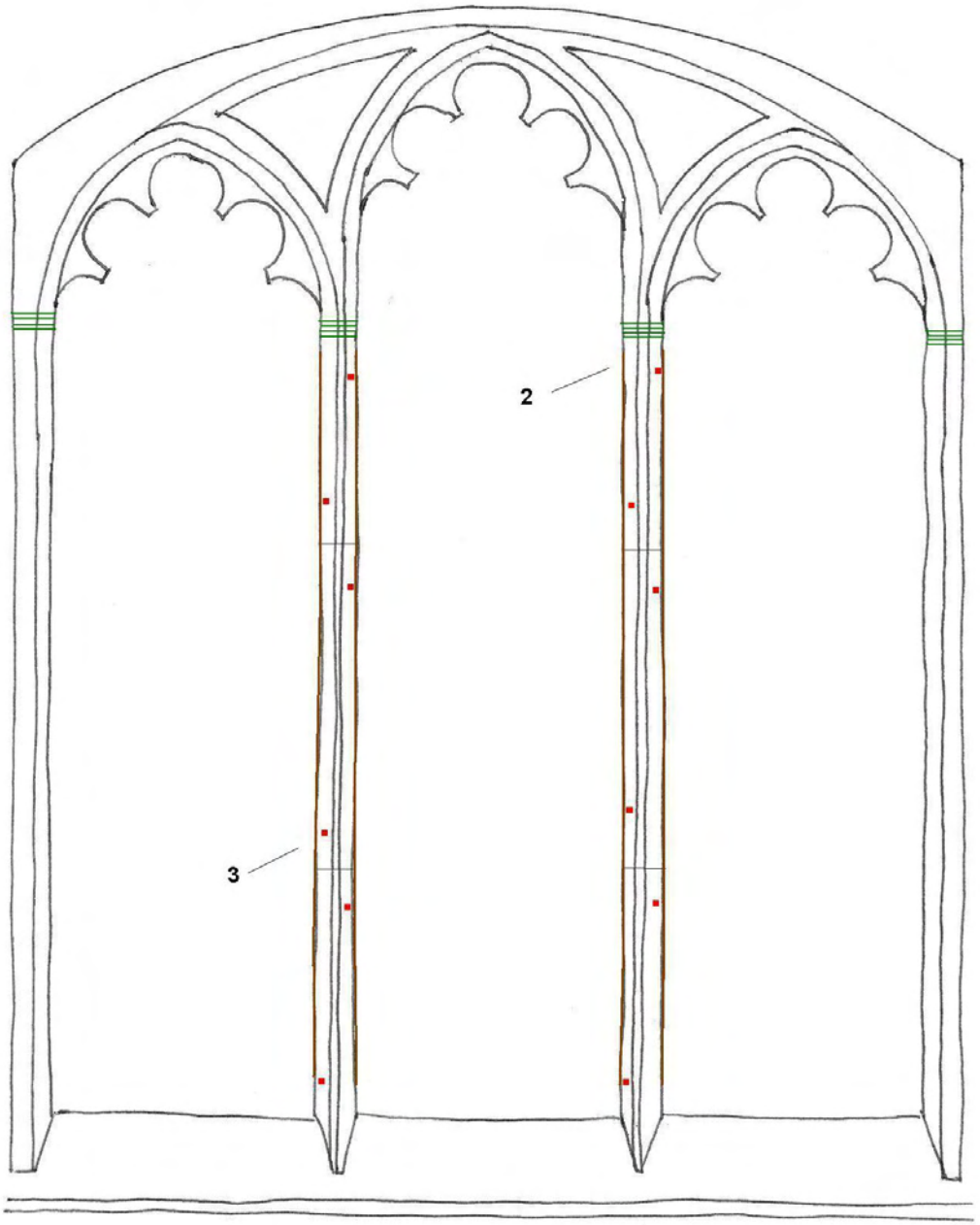
3. Triforium. North Elevation. NT18 (nave side)

The vertical joint along the glazing line was filled with backing mortar, leaving space for the glazing.

Choir. North Elevation. NT14 (roof side)



Choir. North Elevation. NT14 (nave side)





1. Choir. North Elevation. NT14 (roof side)

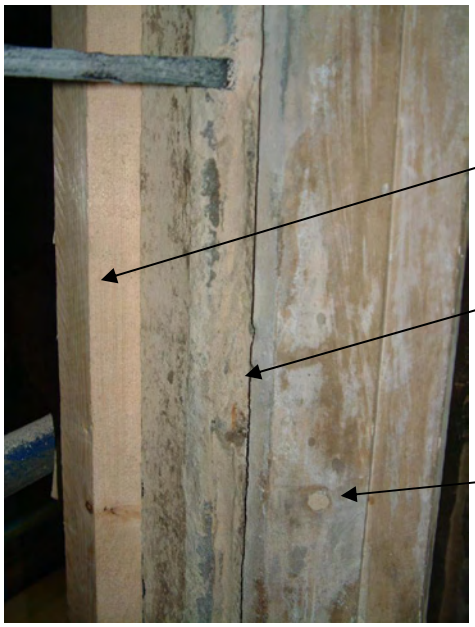
The loose stone re-fixed in position after the roof side of the mullion had been re-aligned and pinned in place with 6mm threaded stainless steel pins and polyester resin.

The vertical joint on the glazing line was filled with backing mortar.



2. Choir. North Elevation. NT14 (nave side)

Cement and lead were removed from around the ferrous cross-bar and the open vertical joint, on the glazing line, cleaned out. They were then filled with backing mortar.



3. Choir. North Elevation. NT14 (nave side)

The wooden brace used to move the loose mullion back into alignment.

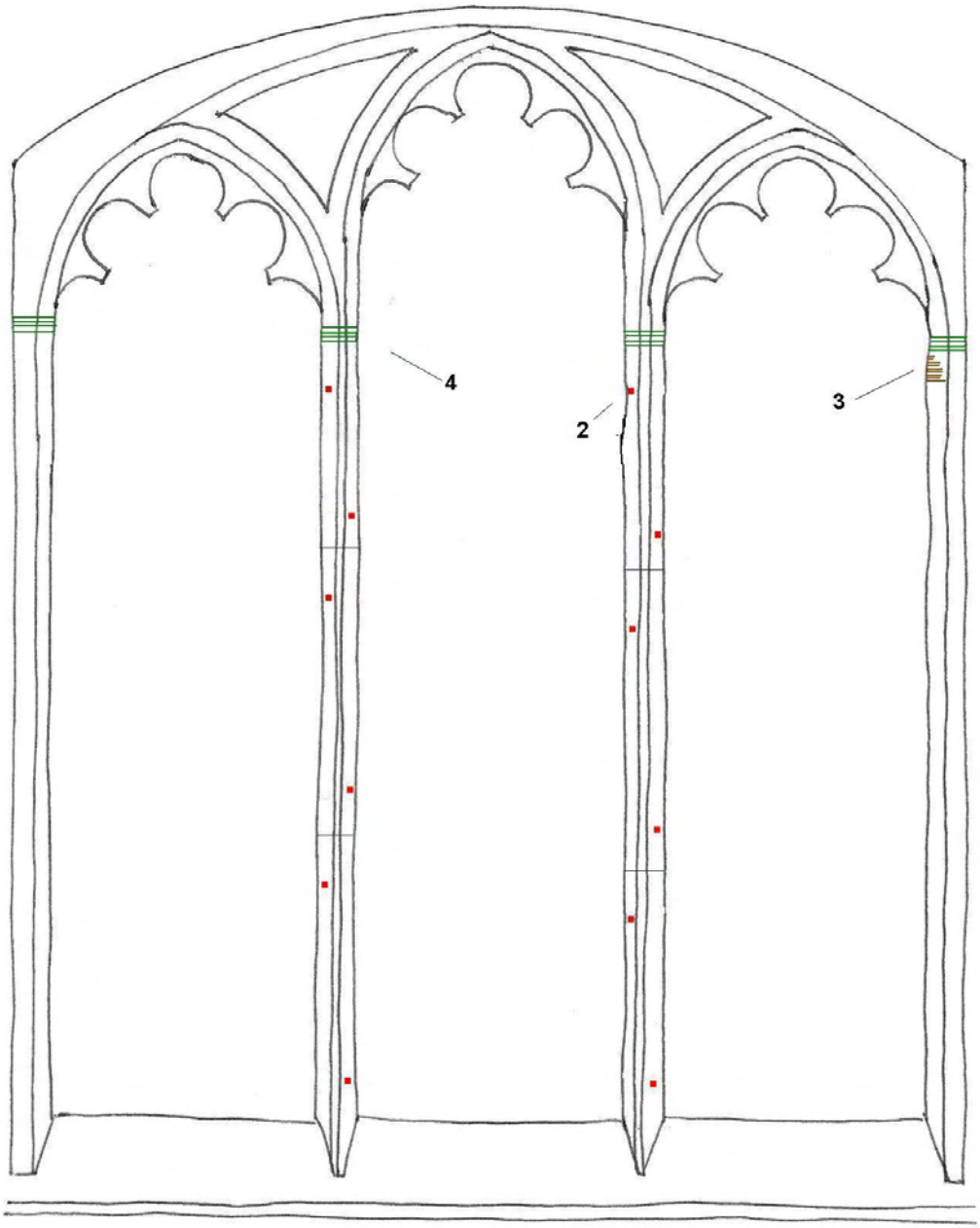
The joint filled with backing mortar.

Detail of a pin-hole, for the stainless steel pins used to cross-pin the mullions together across the vertical joint on the glazing line.

Choir. North Elevation. NT13 (roof side)



Choir. North Elevation. NT13 (nave side)

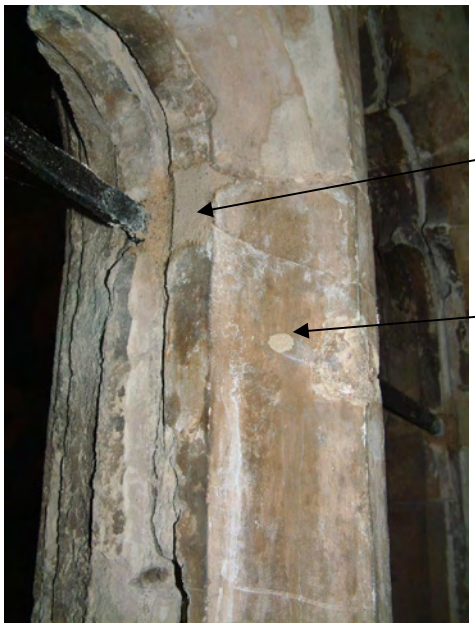




1. Choir. North Elevation. NT13 (roof side)

Loose stone pinned back in position using a stainless steel pin and polyester resin.

The joint was then filled with hydraulic lime mortar.



2. Choir. North Elevation. NT13 (nave side)

Mortar repair to stonework after the removal of the cement and lead around the ferrous cross-bar.

Detail of a pin-hole, for the stainless steel pins used to cross-pin the mullions together across the vertical joint on the glazing line.



3. Choir. North Elevation. NT13 (nave side)

Mortar repair to stonework after the removal of the cement and lead around the ferrous cross-bar.

Loose stone pinned in position. The missing stonework was made up with a hydraulic lime mortar repair.



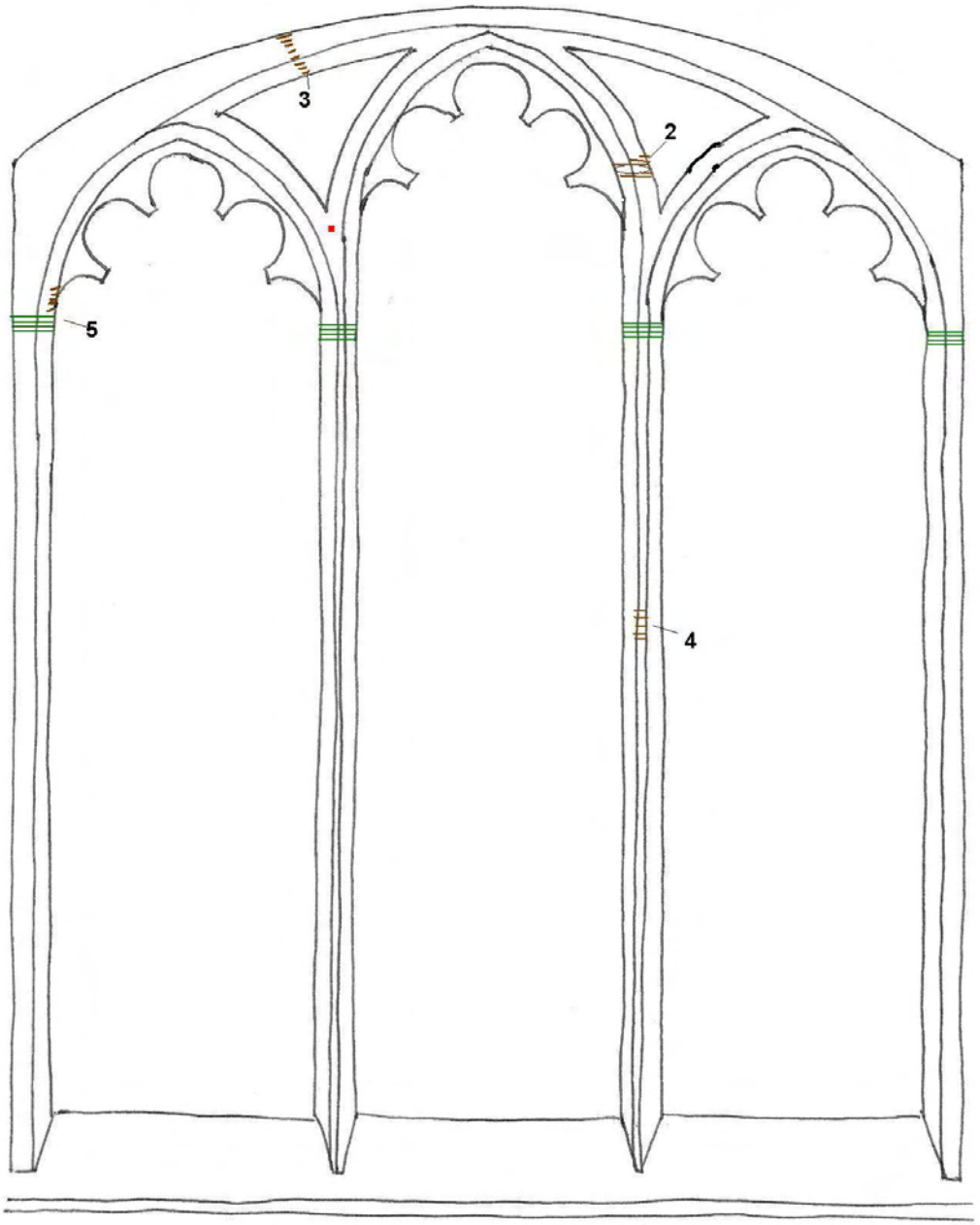
4. Choir. North Elevation. NT13 (nave side)

Mortar repair to stonework after the removal of the cement and lead around the ferrous cross-bar.

Choir. South Elevation. ST13 (roof side)



Choir. South Elevation. ST13 (nave side)





1. Choir. South Elevation. ST13 (roof side)

The rust was removed from the ferrous cross-bar and all the metal painted.

No mortar repair was done.

(The ferrous cramp between the stone sections is visible)



2. Choir. South Elevation. ST13 (nave side)

The broken piece of stone was re-adhered using polyester resin and the missing stone made up with a hydraulic lime mortar.

(The ferrous cramp between the stone sections was visible)
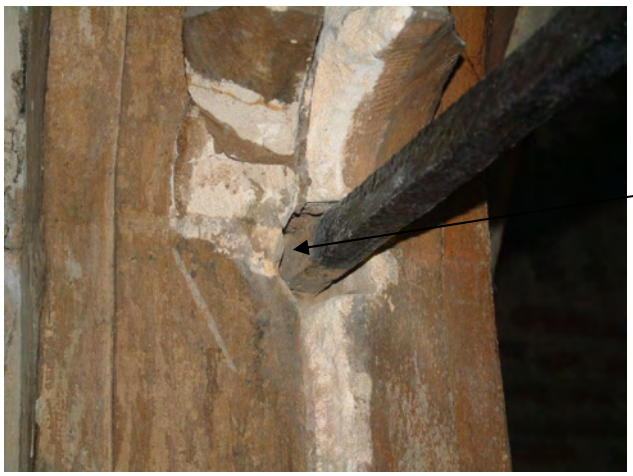


3. Choir. South Elevation. ST13 (nave side)

The cracked cement mortar repair was removed and replaced with a hydraulic lime mortar repair.



4. Choir. South Elevation. ST13 (nave side)

The loose mortar was cleaned out around the old resin repair (the ferrous cramp between the stone sections is visible) and filled with a hydraulic lime mortar.



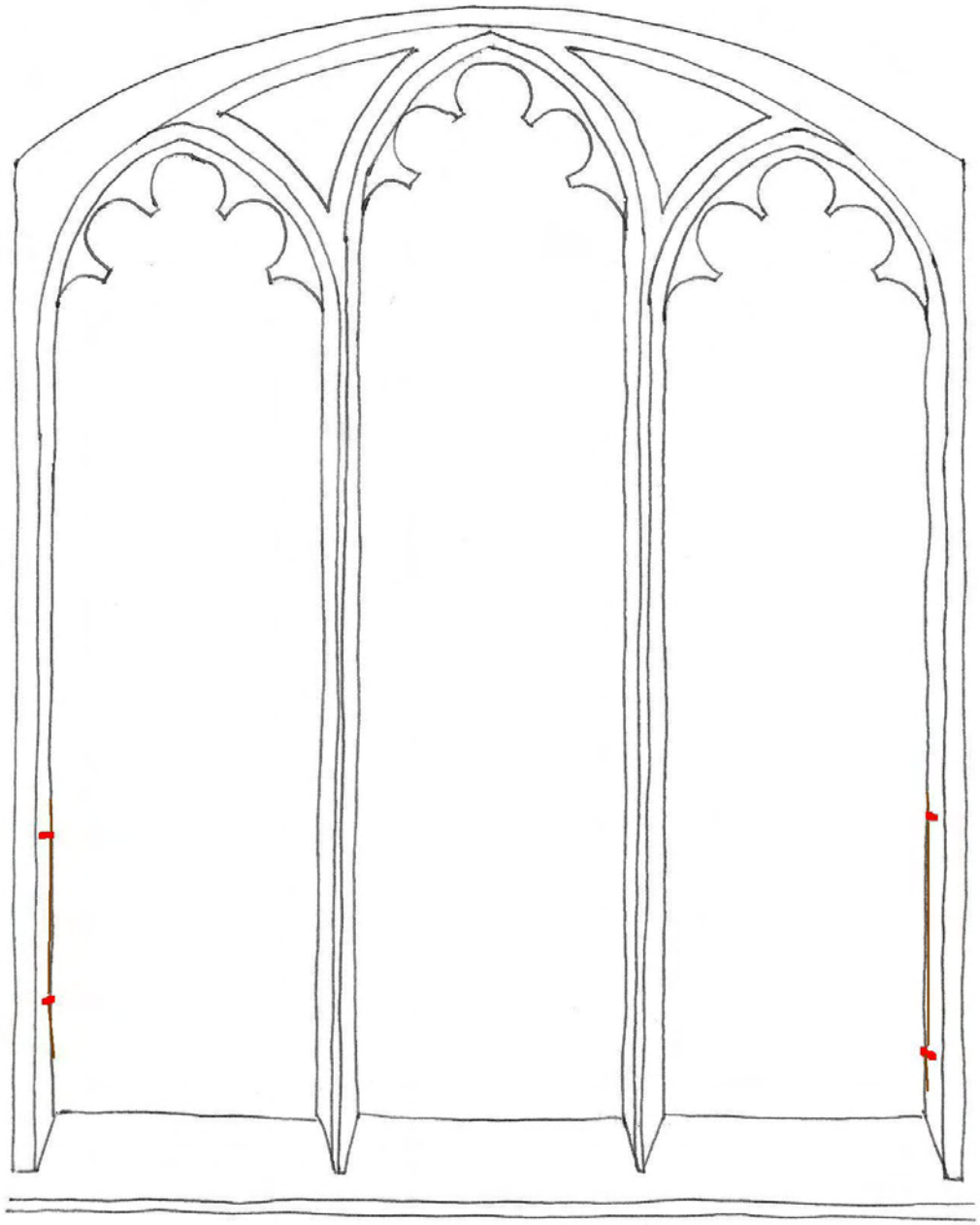
5. Choir. South Elevation. ST13 (nave side)

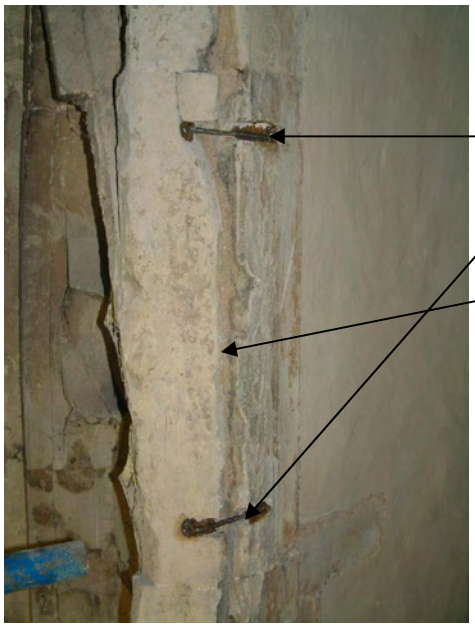
Cement and lead were removed from around the ferrous cross-bar.
The hole was filled with hydraulic lime backing mortar and a hydraulic lime mortar top coat applied.

Choir. South Elevation. ST14 (roof side)



Choir. South Elevation. ST14 (nave side)





1. Choir. South Elevation. ST14 (roof side)

The remains of the two ferrous cramps were removed and replaced with stainless steel cramps.

The joint was filled with hydraulic lime mortar.

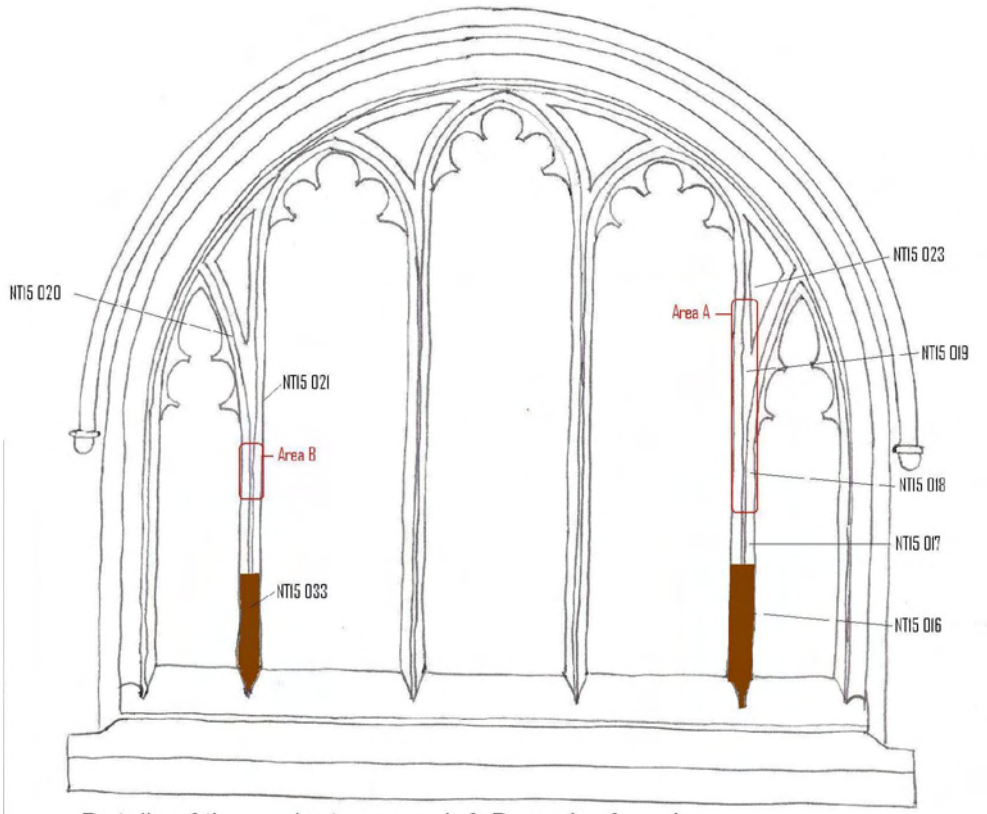


2. Choir. South Elevation. ST14 (roof side)

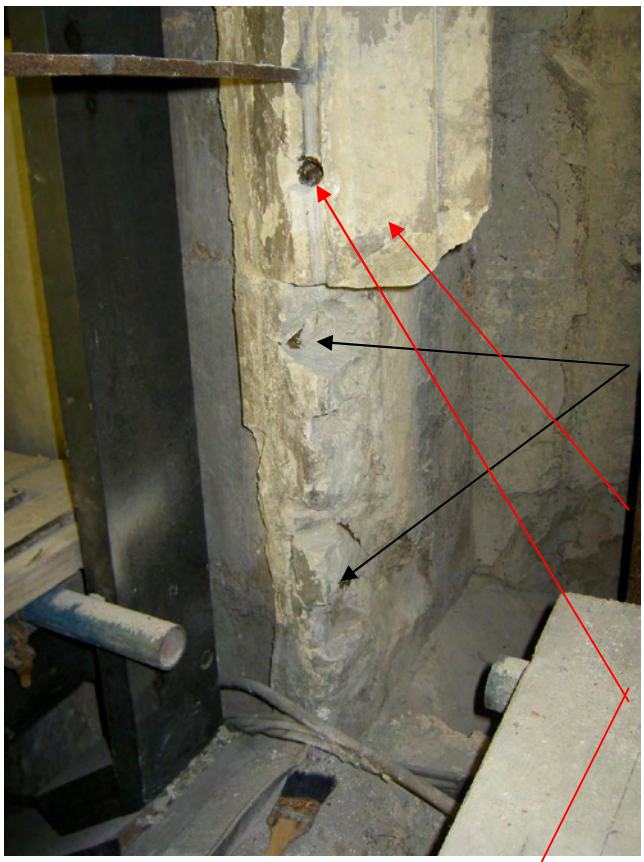
The remains of the two ferrous cramps were removed and replaced with stainless steel cramps.

The joint was filled with hydraulic lime mortar.

Choir south elevation ST15 roof side



Details of the works to areas A & B can be found on the following annotated photographs

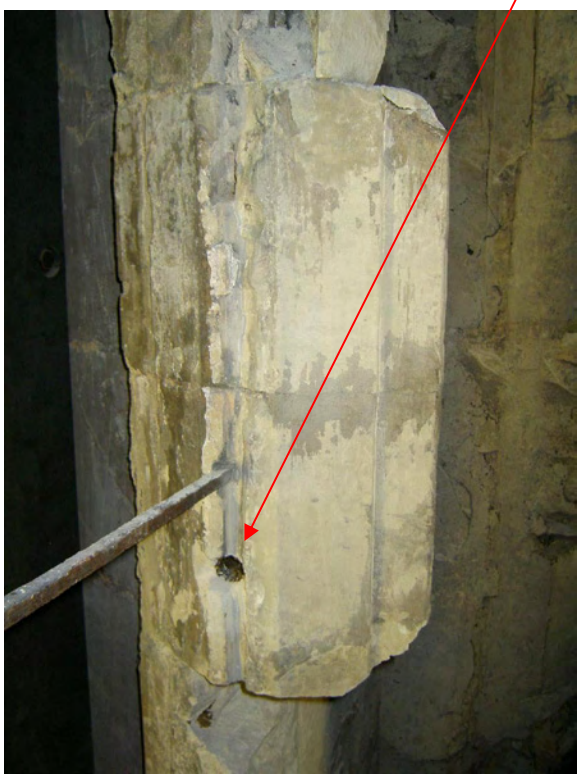


016 Choir. South elevation ST15 roof side

Base area of the east jamb following removal of the previous mortar repair and following re-adhering and pinning to consolidate the damaged pieces revealed beneath the removed mortar.

Two fragments of original stone re-adhered using polyester resin adhesive

Following removal of the previous mortar repair the stone here was left unsupported below and to help carry the load of the stones above a stainless steel dowel was inserted back into the part of the stone built into the blind panel to the east side. This was drilled into the area of the glazing rebate.



017 Choir. South elevation ST15 roof side



018 Choir south elevation ST15 roof side: Mid section of the east jamb following g removal of the previous cement mortar repairs.

The stone was found to have been severely stressed and the remaining fragment was in danger of detaching from the main body of the stone along the glazing rebate line where it appeared to have been previously repaired.

Three stainless steel dowels were used to pin it back to the main body of the stone

It was necessary to reconstruct a glazing rebate in this stone – see later in this report.



019 Choir south elevation ST15 roof side:

The original stone here had a series of horizontal stress fractures apparent within the surface. It is noted that the area above (shown here) had been lost and previously repaired with mortar – it was considered prudent to insert a small pin vertically across the fractures to stabilise the structure.

Pin inserted into drilled hole at this location.



023 Choir south elevation ST15 roof side

General view of the areas covered above in photographs 017, 018 & 019

The resin adhesive visible on the surface of the stone around all the dowel holes was cleaned off during the works.



027 Choir south elevation ST15 roof side

General view of the east jamb showing the installation of stainless steel support in the lower section for the reconstruction of the missing section of stone.



028 Choir south elevation ST15 roof side.

General view following removal of failed previous repairs; the installation of stainless steel pins and the support for the reconstruction of the missing stone at the bottom.

Previously ferrous cramps had been inserted across the glazing rebate in order to secure the north and south sides of the stone together (see condition survey). These had corroded and failed and were replaced by four stainless steel dowels inserted into drilled holes across the fracture line which corresponded with the glazing rebate.

Stainless steel support prepared for rebuilding the missing stone using a lime mortar.



020 Choir south elevation ST15 roof side.

Detail of the two higher dowels.

The resin adhesive was cleaned off and the holes filled with a lime mortar.



021 Choir south elevation ST15 roof side

Details of the two lower dowels inserted across the

It is likely that the ferrous fixings had been inserted during a previous repair when the jambs were refaced. In this instance the two faces are both Totternhoe Stone placing at a date different from the repairs carried out in the oolitic limestone on the choir elevation of both mullions on this same window (see condition survey).

Note the cut slot into which the previous ferrous cramp had been inserted. One of the new dowels was placed within this area.

This adjacent fragment of stone was re-adhered with polyester resin adhesive



029 Choir south elevation roof side.

Base of the east jamb with the reconstructed mortar “stone”.

The repair was carried out using HNL 3.5 hydraulic lime and coarse sharp stone.
In this photograph the mortar is still damp and not fully cured.



031 Choir south elevation ST15 roof side.

The missing glazing rebate was formed using NHL 3.5 hydraulic lime and coarse sharp sand.

(Compare with photograph 018 above).



036 Choir south elevation ST15 roof side.

Lower section of the west jamb following reconstruction of missing sections by use of NHL 3.5 lime and sharp sand mortar.



033 Choir south elevation ST15 roof side.

The base of the west jamb following rebuilding of the missing bottom stone.



034 choir south elevation ST15 roof side.

Detail of mortar repair in the mid section of the west jamb.

NOTE.
On ST15 the choir elevation required no specific intervention.

1.0 On site survey.

1.1 An on site survey was undertaken on 12th March 2008.

1.2 The survey includes the five windows on the north elevation of the Nave numbered NT16 to NT20 inclusive on the Richard Griffiths Architects drawing reference 294S/L07 Revision B Dated Sept 07.

2.0 Brief, scope and limitations of this report.

2.1 The survey was to assess the structural stability of the stonework of the Triforium windows and to make recommendations for any necessary works to conserve and ensure the stability of them.

2.2 Works had already been undertaken by Chapel Studios to remove the glazing from the windows and this had provided evidence of structural failing in the stonework of the windows as a consequence of cracking caused by the corrosion of the ferrous glazing bars and possibly previous repairs and restorations. Namely a section of the window tracery at the springing point of the east mullion on NT 18 had fallen away.

2.3 The overall conservation condition of the stonework, other than structural considerations, is not covered in detail although where such information is considered necessary to the maintenance and conservation management of the window it is noted for further future consideration.

2.4 As far as was possible digital photographs were taken in detail of the nave elevation and will be attached to this report for future reference: these will help to document the details of the general conservation condition.

2.5 Following the onsite survey of 12th March a set of drawings with preliminary comments on the condition together with initial suggestions for treatment has been produced and is attached.

2.6 Discussions with Richard Griffiths Architects confirmed that as far as possible the intention is to conserve both the stonework and the ferrous glazing bars provided that this can be achieved without compromising the structural security of the windows and the stonework in the longer term: This report will set out various options for treatment to achieve this aim.

3.0 Overview of the structural condition.

3.1 The windows in questions no longer have to function in keeping the building weather tight and therefore this offers the opportunity to be more conservative in regard to proposed conservation intervention than would otherwise be required. However it is noted that they are in an extremely sensitive location and the safety of persons using the Cathedral is the major concern. In addition the roof void is well ventilated and as far as reasonable the windows do function to seal the nave environment from the roof environment.

3.2 The windows did formally function as external glazing to the nave and as a consequence the north (roof) elevation exhibits much of the type of deterioration associated with Totternhoe stone exposed to the elements. Similarities between the deterioration on these areas and with the still exposed stones on the north elevation of the Lady Chapel are striking. Furthermore there has been extensive replacement of the north elevation of the mullion stones on windows NT16, NT19 & NT20 as well as repairs to all windows to lesser/greater extents. Most of this work can be attributed to deterioration from this exposure.

3.3 The initial survey suggests that, as with the other extant Totternhoe stonework on the Cathedral, there is likely to have been ongoing maintenance and replacement of stone over a long period from mediaeval times. Where this has been carried out using replacement Totternhoe it is difficult to distinguish exactly the periods of intervention although it appears that the nave elevations are substantially original. With in the north (roof) elevation the distinction of original stone from subsequent repair is harder to ascertain but the very different state of preservation of different areas may indicate periodic maintenance through replacement.

4.0 Details of the condition and areas requiring immediate treatment.

4.1.0 There are structural ferrous glazing bars at the jamb/mullion heads embedded into the stonework; these have corroded and expanded inducing stress within the adjacent stones leading to the formation of cracks and the failure of sections of the surface of the stones. This was the root cause of the failure noted in NT18 as referred to above.

4.1.1 It is intended to try to save the bars and therefore it will be necessary to treat them to inhibit future corrosion which threatens to stress the stone and cause failure. Treatment of the bars will include de-scaling to remove rust, applying an agreed primer, undercoat and finish coat system.

4.1.2 This can most effectively be undertaken if the bars are either removed from the structure or at least fully exposed.

4.1.3 To achieve this, the following options are available.

4.1.4 Remove pieces of stone or complete stones from the mullions and window heads by one of the following where it is deemed possible without damaging the stonework;

- Exploiting and opening sections of stone created by existing hairline cracks in the stones that will in any case require re-adhesion;
- Remove complete stones by opening up the relevant joints to allow extraction of the stone as a unit;

4.1.5 Investigate the possibility of using fine drills to create a hole between the metal bar and the stone in which it is embedded either to allow the bar to be withdrawn allowing it to be treated away from the window structure before being re set or to create sufficient space allowing for the surface of the bar to be de-scaled and a paint system applied in situ;

4.1.6 If none of the above can be executed without unacceptable damage to the stonework it will be necessary to sacrifice the bars by cutting them in order to extract them from the structure and to allow replacing them with an agreed substitute metal bar.

4.1.7 During rebuilding works all cracks and breaks will be pinned, adhered and reconstructed as required. Cracks will be filled by the use of lime mortar or acrylic mortar to be agreed.

4.2.0 The embedded glazing bars at all other points should also be considered a risk in this context although it is assumed these are being dealt with by the works being undertaken by Chapel Studios ongoing at the time of the survey and this report.

4.2.1 We would suggest liaison with Chapel Studios to ascertain why some have been left in situ and to investigate if they can be removed for treatment in accordance with the agreed specification. Also we would request confirmation regarding the proposed treatment to bars that have been removed.

4.2.2 We will allow for the removal of the bars in situ at the time of the survey for this report but not for their treatment or for their replacement.

4.2.4 We estimate that 15 bars remain at the time of this survey.

4.3.0 Areas on the windows have been subject to extensive previous repairs where mullions have been refaced in stone on the north elevation by introducing a vertical joint on the glazing line. It appears that this work has been completed by using only mortars to bond the two sections of stone together thus introducing a point of weakness into the structure. Corrosion jacking and vibration could cause failure in these joints and there would be little warning and no possibility for monitoring at this level.

4.3.1 It is suggested that all mullions and if required the jambs have stainless steel pins inserted to cross stitch the north and south faces together. This should be carried out to each affected stone individually to link the north side and south side together but pins should not generally be inserted across joints between stones. The pins would require holes drilled into the stone and would be fixed using polyester resin adhesive.

4.3.2 The drilled holes would be filled following the insertion of the pins using either lime mortar or acrylic mortar to be agreed.

4.4.0 It appears that during the previous restorations of the windows some areas of the tracery have been rebuilt using original or earlier stone in addition to the works to replace sections of the mullions noted earlier. In some instances this has been carried out using hard cement type mortars within the joints and pointing and it is assumed that similar mortar will have been used as an adhesive buried within the reconstruction joints. There is evidence that subsequent movement has occurred and joints are cracked.

4.4.1 These areas need to be investigated further to confirm the long term stability.

4.4.2 If it is found that these areas contain any kind of ferrous pinning they may need to be opened up and the metal removed and replaced with non-ferrous pins.

4.4.3 If ferrous pins are not extant then no works should be undertaken other than to record the extent of cracking to assist any future inspections.

4.5.0 Windows NT16 and NT19 have areas of cracking within the stones of the tracery. This appears to be stress related rather than from previous breaks and repairs. The cause of these needs to be investigated but it is possible ferrous pins have been introduced in the past and that the corrosion of these is causing the cracking.

4.5.1 If there is evidence of the cracking being caused by internal metal then it will be necessary to partially disassemble the affected areas in order to remove it.

4.6.0 In undertaking any of the above operations in 1 – 5 above it will be necessary to provide temporary propping to the adjacent stonework that will be affected by the work

5.0 Details of the condition relating to non urgent but desirable items of conservation work.

5.1.0 During previous restorations on the windows some areas have been made good using grey cement based mortar repairs. In most cases these are crudely executed. On window NT16 one of these repairs has been dislodged and re adhered using a silicone based adhesive.

5.1.1 It would be desirable to replace these with lime based mortar repairs.

5.2.0 Generally on the windows but particularly on the roof elevations the Totternhoe stone shows a friable surface condition. It has been noted that this is particularly bad on windows NT17 and NT20 and further investigation should be carried out to ascertain if this in any way relates to their proximity to the open roof vents. During the survey it was noted that air currents from the vents directly hit the window surfaces and it is possible that increased humidity and drying is induced as a result.

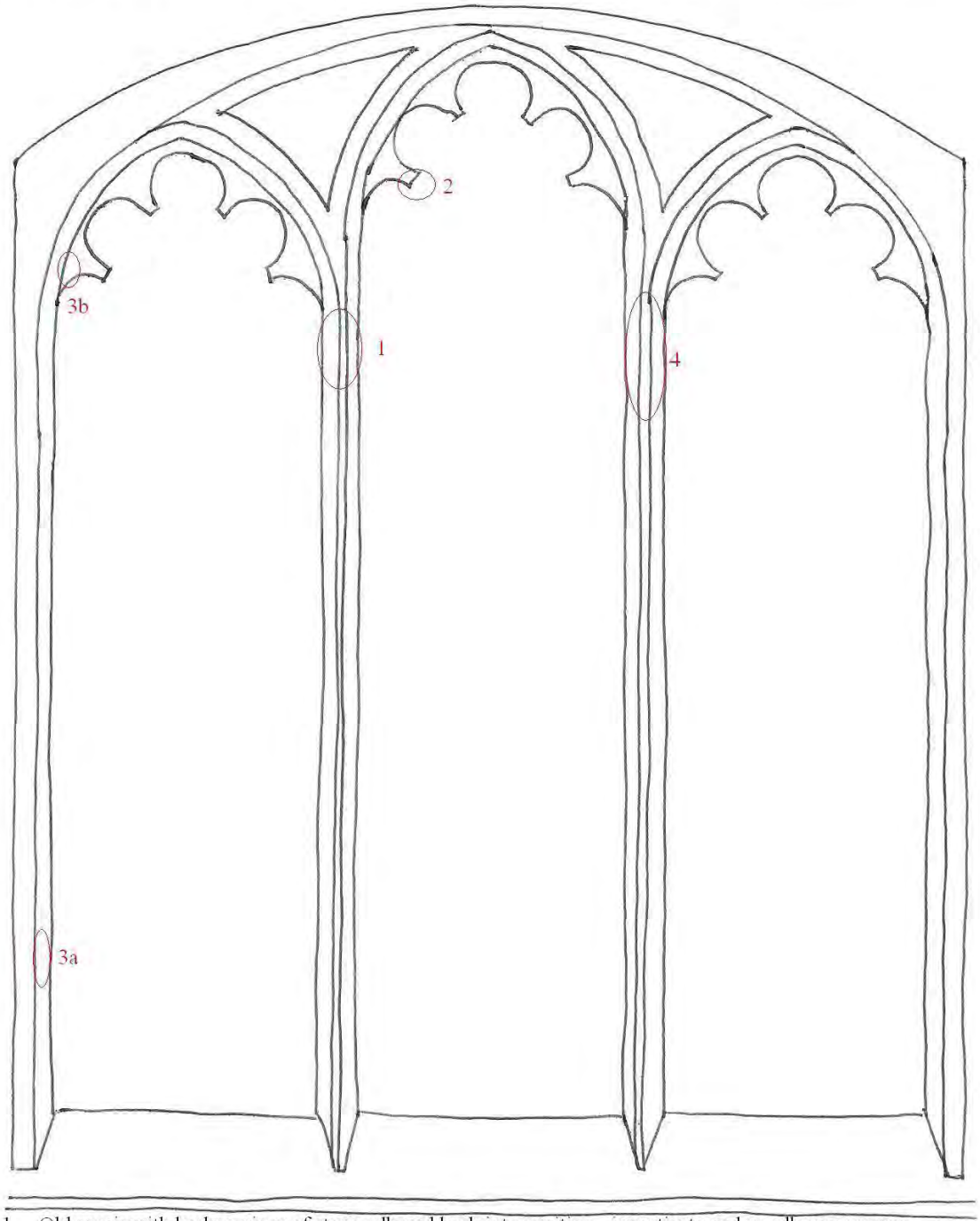
5.2.1 It would be desirable to undertake careful dentistry repairs and general pointing and consolidation of the surfaces.

5.2.2 As these windows are now internal, and as it is presumed they will always remain so, there is an option to undertake this work using acrylic based mortars and emulsions as opposed to using lime based systems. This was not possible in previous external conservation works. Further consideration should be given to this and tests carried out ascertaining if there is benefit in using this approach. The advantage is that the acrylic emulsions offer the possibility of consolidating very friable areas of stone rather than having to brush away the degraded surface in order to provide a sound base for the application of a lime wash/shelter coat.

5.3.0 It appears that the Totternhoe stone on both elevations has some sort of coating resembling a thin lime wash. This is missing in areas where the stone is friable but is still extant across considerable areas of the surface. In some areas it appears to cover over hairline cracks or old repairs that are visible underneath. The exact nature of this coating is not known but it would be desirable to have it looked at by a paint specialist making allowance to have tests carried out for organic materials such as oil or tallow to confirm if it is a form of distemper.

5.3.1 This information would be of interest but not essential to making decisions about treatment as it is not likely that its removal or re-instatement would be recommended.

No. 20 Nave elevation. 24th March 2008

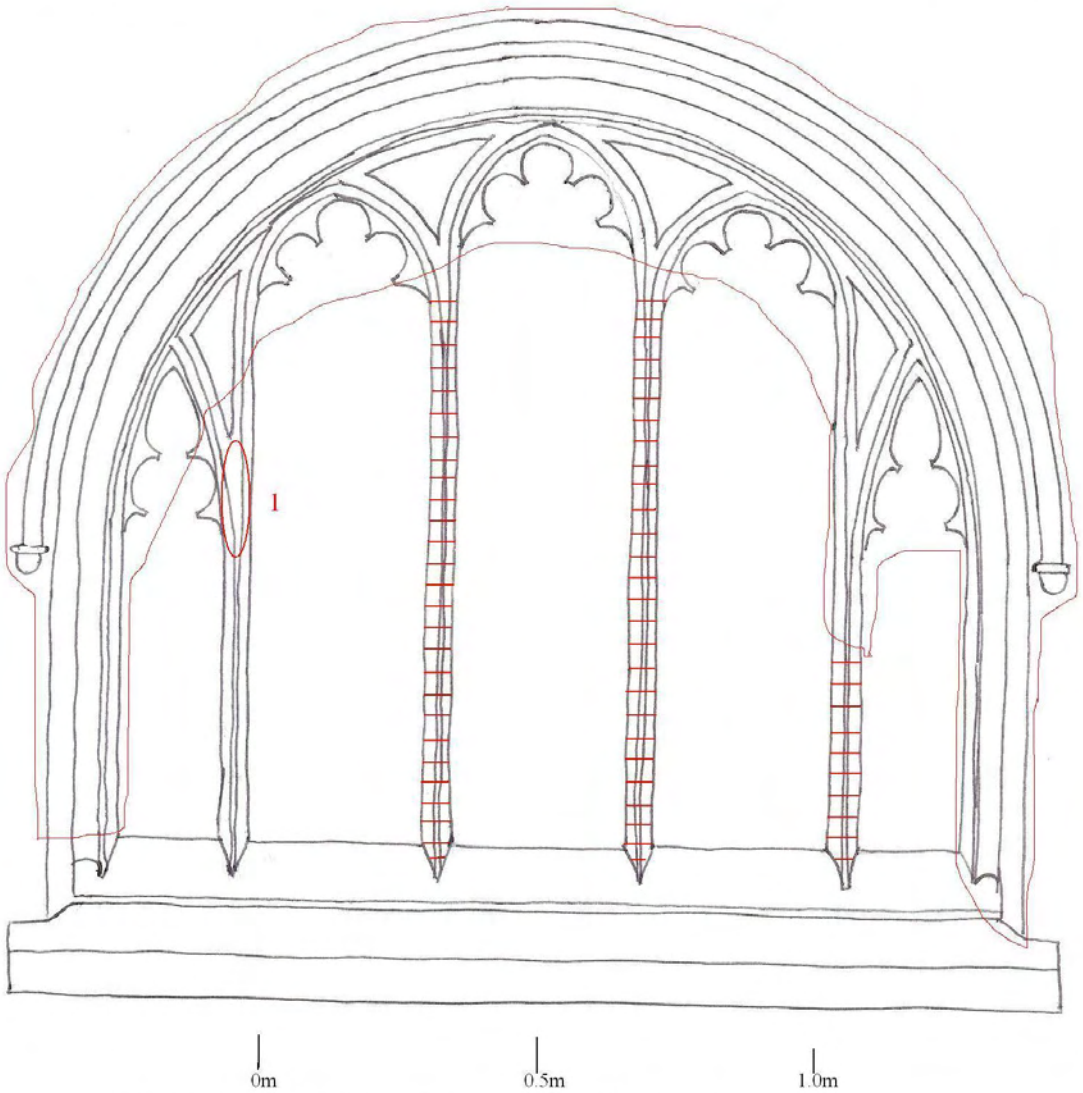


1. Old repair with broken piece of stone adhered back into position - investigate and re-adhere or secure by additional pinning if required.
2. Minor recent chip - no treatment suggested.
3. Noted old holes - possibly from previous glazing bars? No treatment required leave exposed for historical interest.
4. Evidence of stress fracture down the face of the mullion - probably as the result of corrosion jacking in the ferrous glazing bars.
5. If agreed remove ferrous bars and replace with equivalent new bars to specification to be agreed. Allow to pin/cross stitch the heads of two jambs and two mullions if required during these works.
6. Allow to pin/cross stitch mullion stones using stainless steel dowels set in resin adhesive.

0m 0.5m 1.0m

No.20 Roof elevation.

24th March 2008

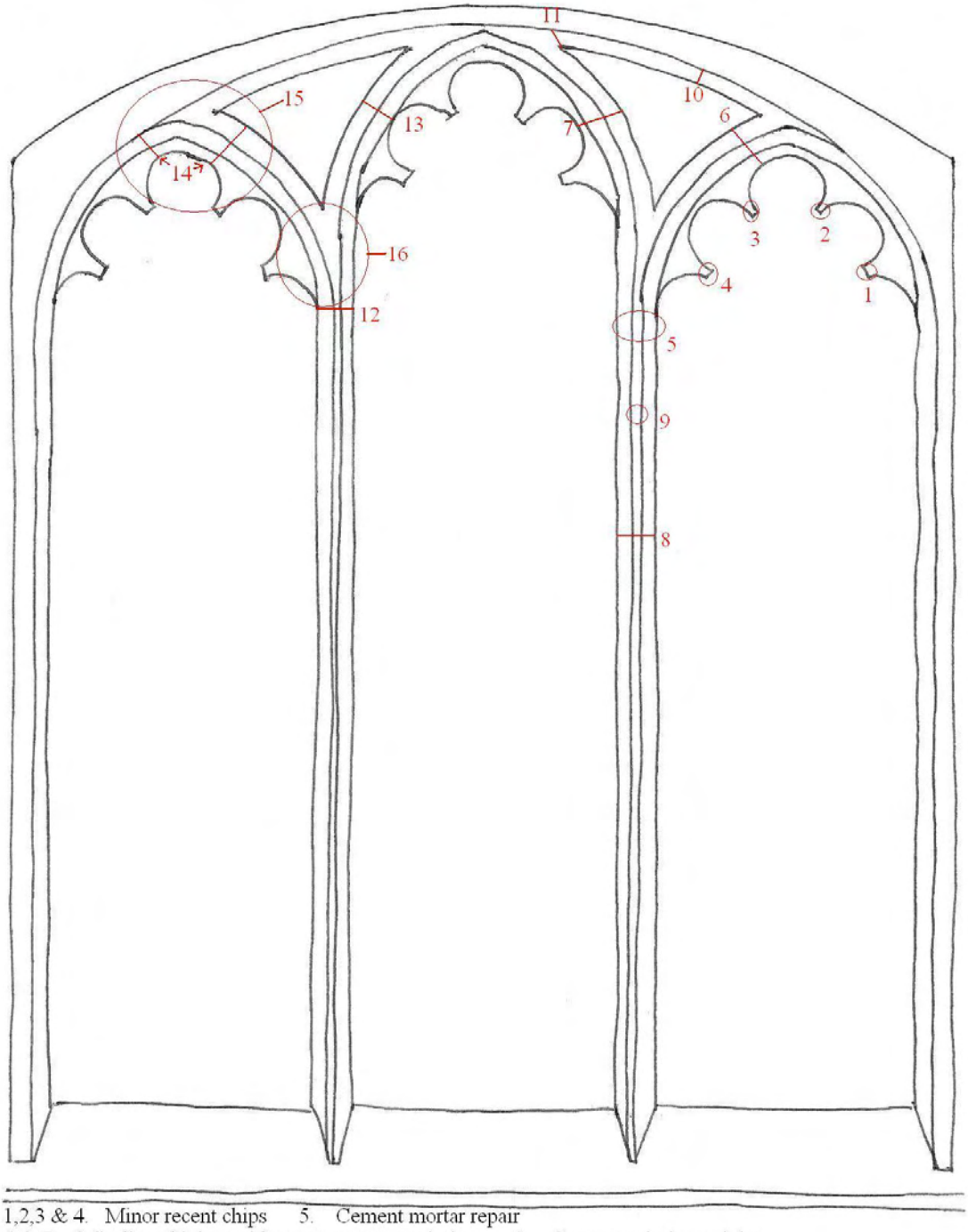


1. Cement mortar repair - it would be desirable to replace this with a lime mortar repair.

The areas hatched in red are replaced mullions.

The area outlined in red broadly indicates the extant areas of medieaval tottenhowe stone that is now extremlly friable and would benefit from dentistry repairs and lime washing. Note that this window is opposite the roof ventilation window and suffers from the same extent of deterioration as window 17.

No. 19 Nave elevation 24th March 2008

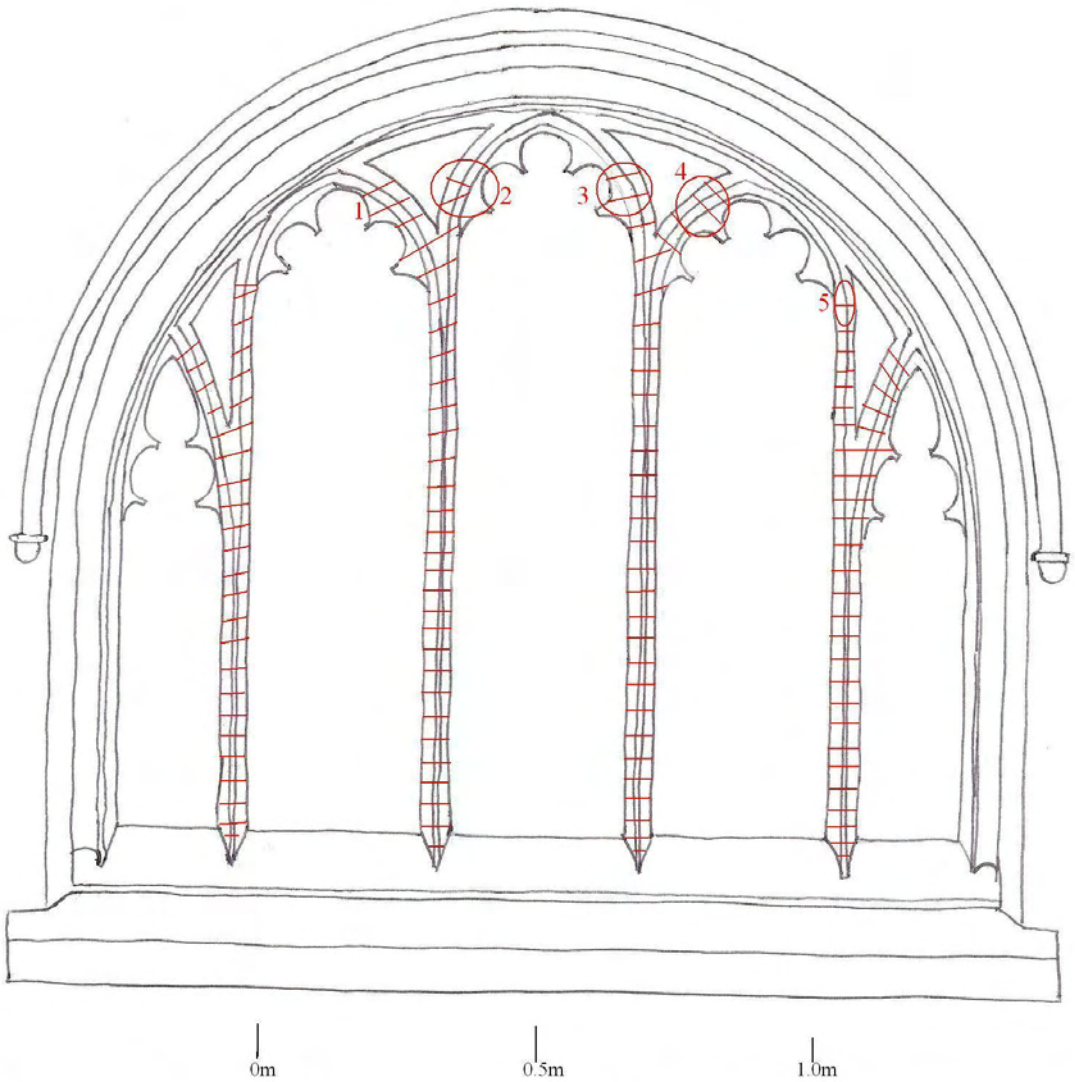


1,2,3 & 4. Minor recent chips 5. Cement mortar repair
6 & 7. Misaligned joints with cement mortar pointing. 8. Cement pointing to joint.
9. Stone marked with a carved "S". 10,11,12,13,14. Cement mortar pointing to joints.
15. This area has considerable cracking at varying locations; possibly the result of stress from internal ferrous pins.
16. The face of the stone has a hairline crack running down the face which appears to be aged in the upper section but fresh and progressing in the lower section; indicating continuing movement.
NOTE: The condition of the stonework on the nave elevation should be noted in context with the extensive replacement that has been undertaken on the roof elevation of this window which indicates both historical and current structural movement within the window. This needs detailed on site investigation and allowance to partially rebuild the nave elevation as required.

0m 0.5m 1.0m

No. 19 Roof elevation.

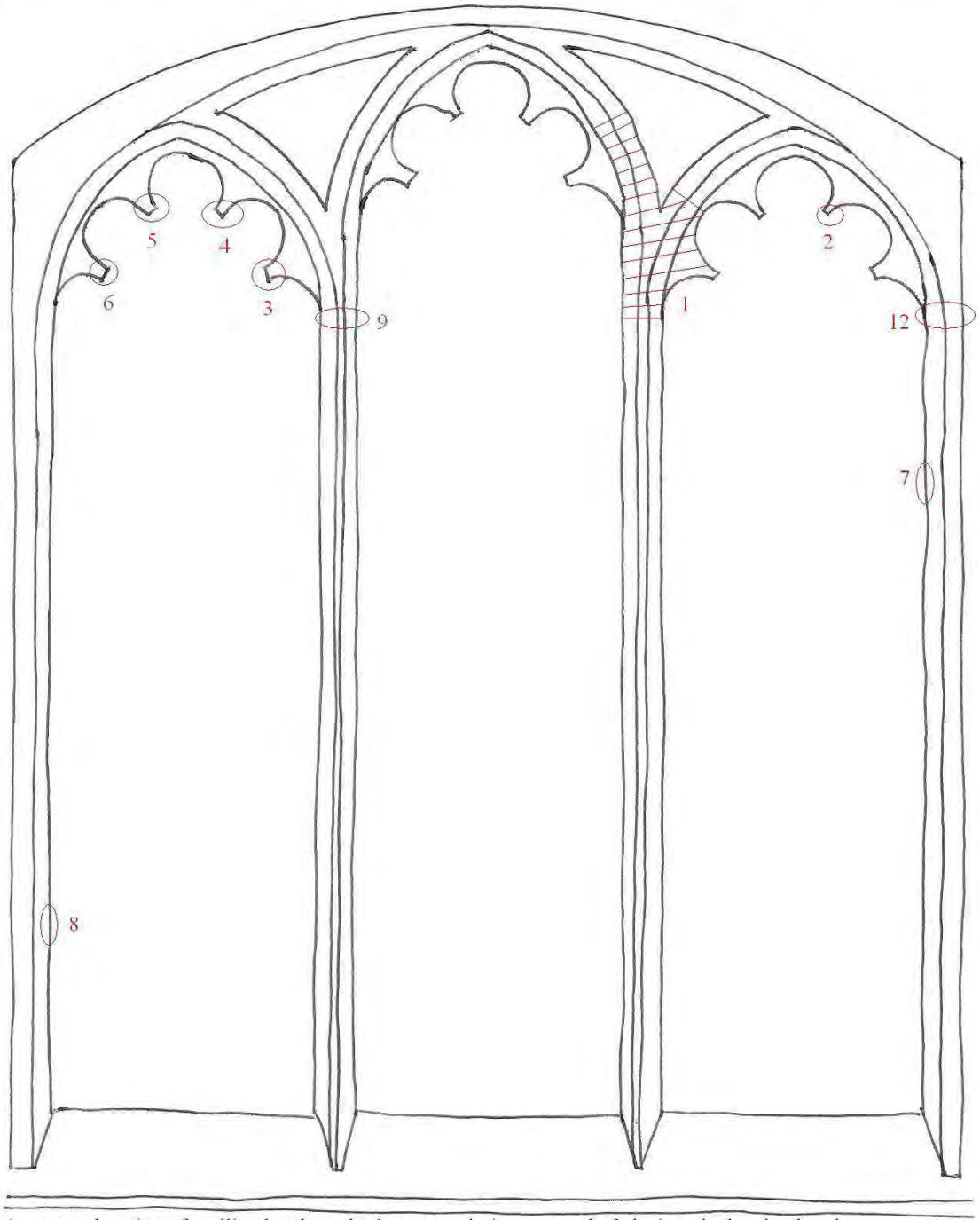
24th March 2008



1. The joint is cracked - compare to the nabve elevation where there is much misalignment in this window.
2, 3,4 & 5. Areas of cement filling/repair - it would be desirable to replace these with lime mortar repairs.

The areas hatched with red lines are replaced mullions.

No. 18 Nave elevation. 24th March 2008



1 nave elevation of mullion head was broken away during removal of glazing; the break edges have evidence of discolouration from soiling consistent with an old hairline crack indicating that there is a history of stress induced cracking from the corrosion jacking of the ferrous glazing support bars.

2,3,4,6,7 & 8 recent chips but no treatment suggested.

9 hairline crack evident in the joint at the head of the mullion. Indictes stress movement within the structure at this point.

10 If agreed remove ferrous bars and replace with equivalent new bars to specification to be agreed. Allow to pin/cross stitch the heads of two mullions and two jambs if required during these works.

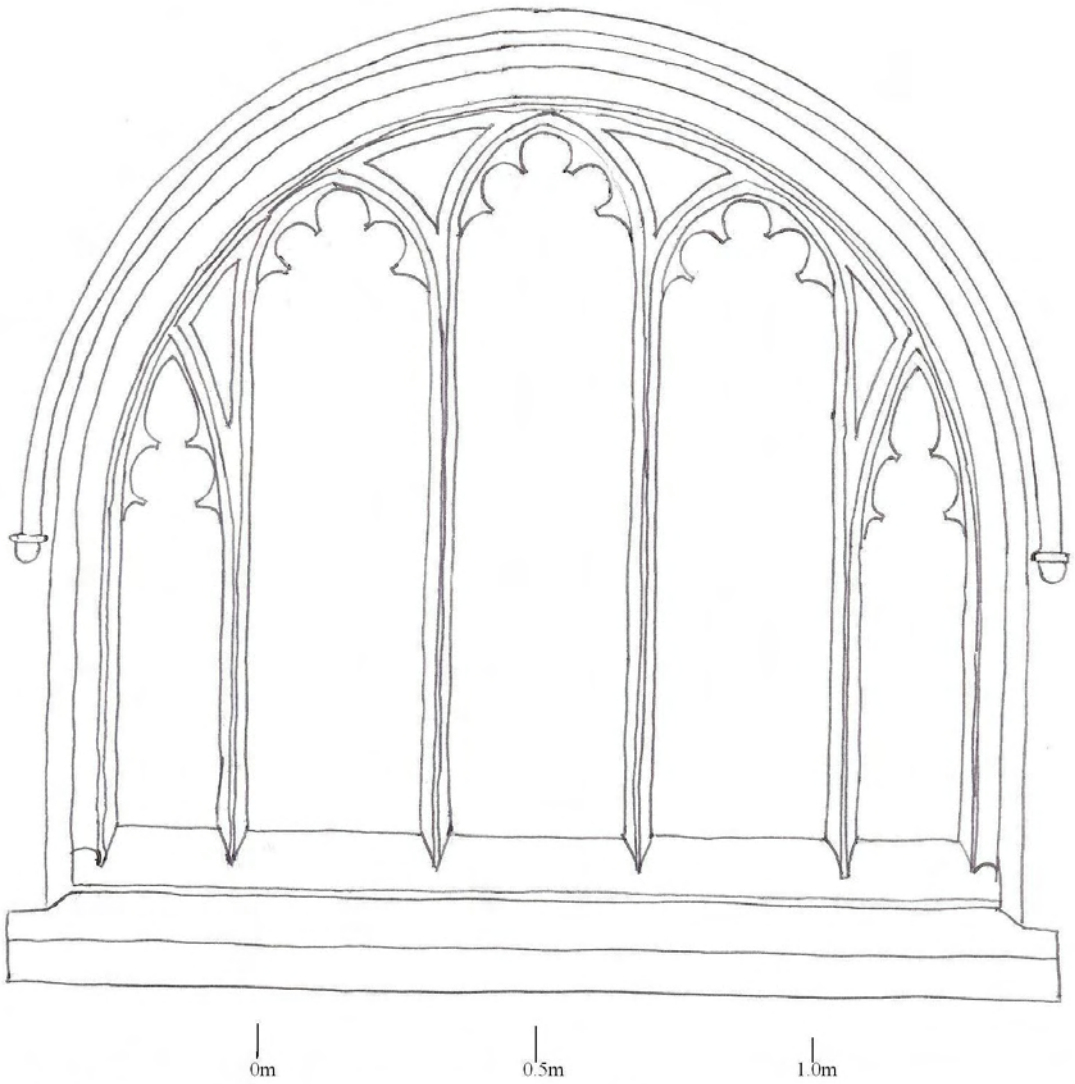
11 Allow to pin/cross stitch mullion stones using stainless steel dowels set in resin adhesive.

12 hairline crack evident in the jamb at this point. Indicates stress induced by corrosion jacking in the ferrous window bars.

0m 0.5m 1.0m

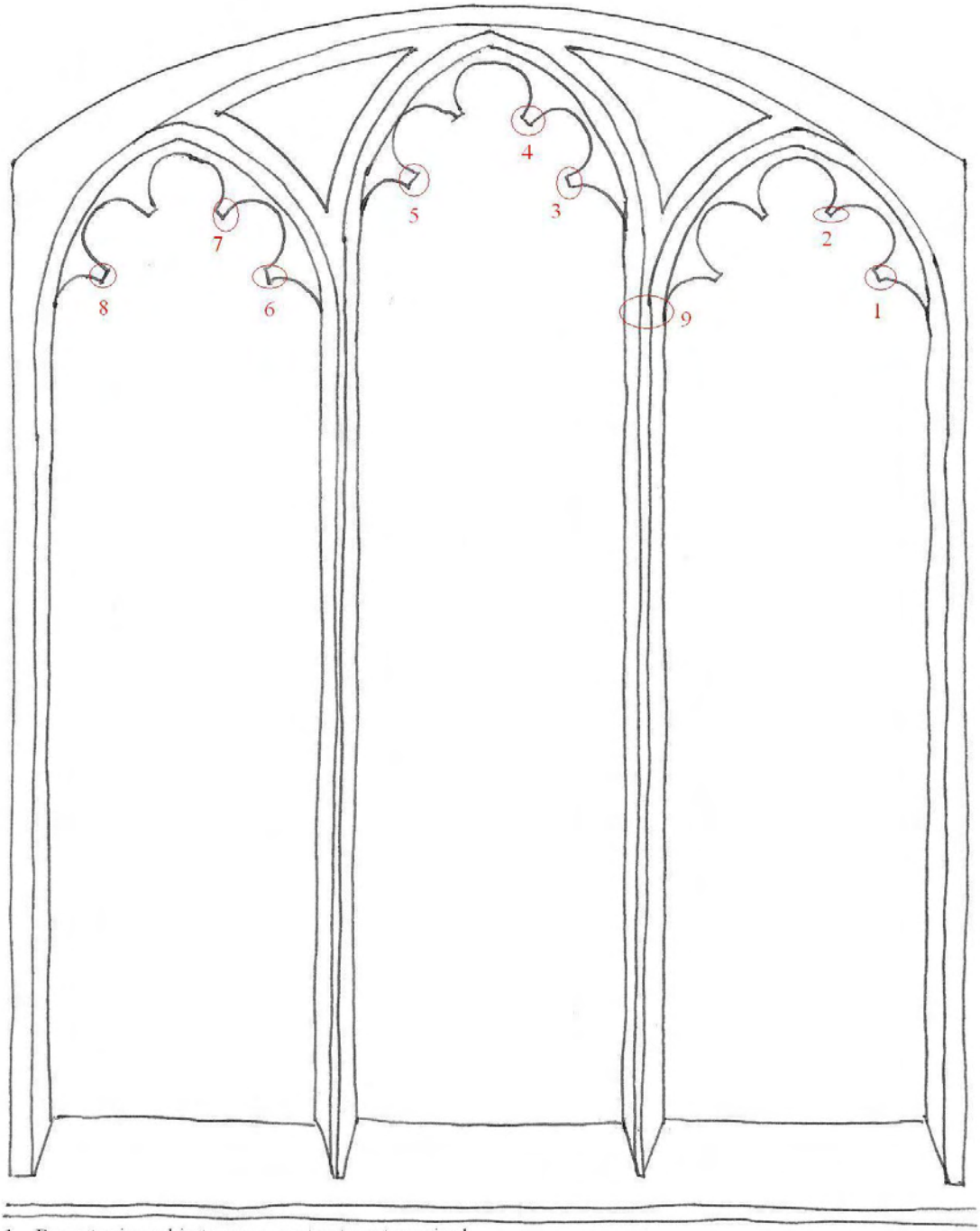
No. 18 Roof elevation.

24th March 2008



This window elevation has general light friable stone deterioration.

No. 17 Nave elevation. 24th March 2008

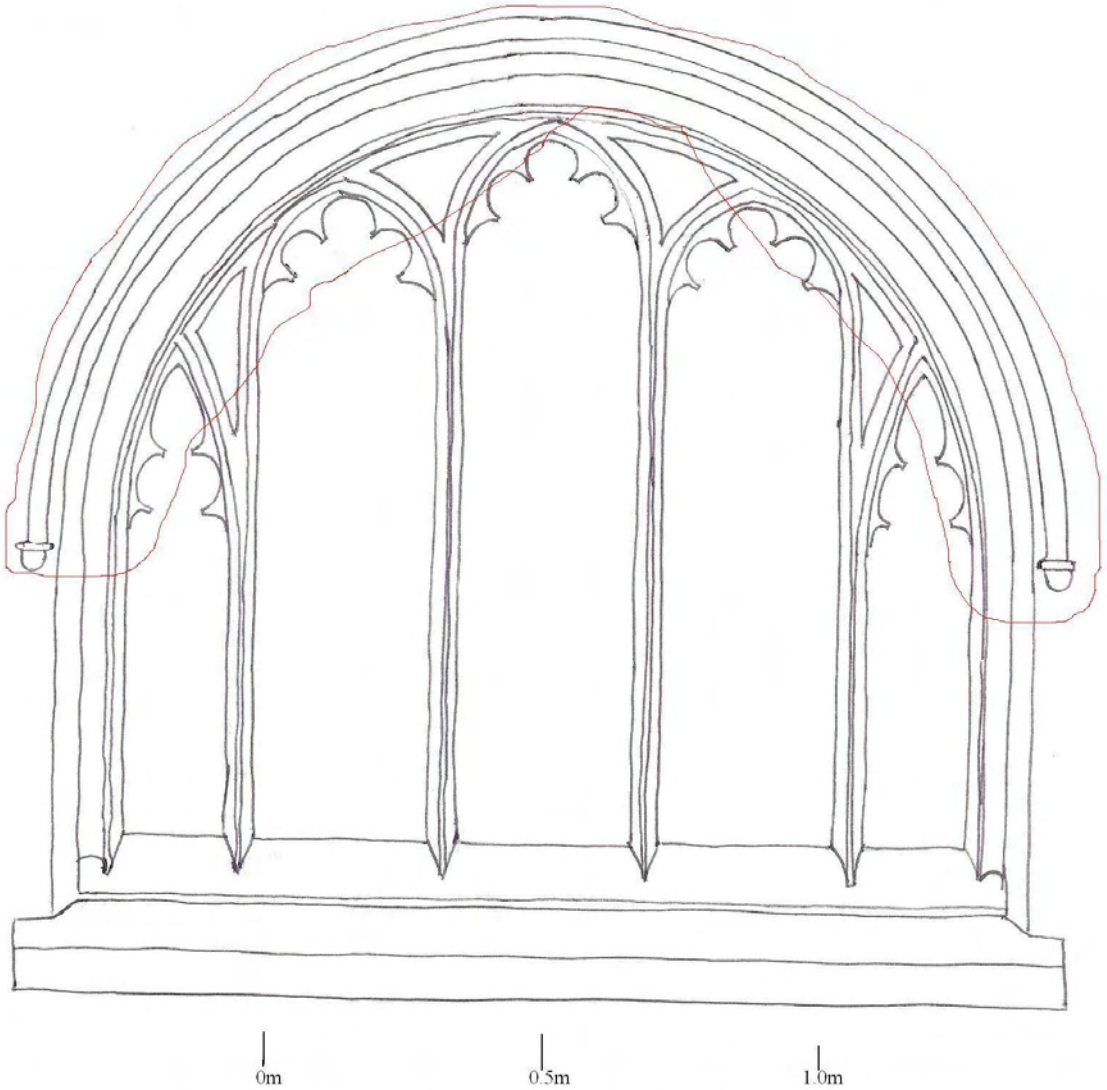


1 Recent minor chip to cusp - no treatment required.
2,3 & 4 Old chips to cusps - no treatment required.
5 Recent minor chip to cusp - no treatment required.
6 Old chip to cusp - no treatment required.
7 & 8 Recent chips to cusps - no treatment required.
9 Joint at head of mullion is cracked. This is not recent but may indicate movement within the structure due to corrosion jacking in the ferrous bars at this level. If agreed remove all ferrous bars and replace with eqivalent new bars to specification to be agreed. Allow to pin/cross stitch the heads of two jambs and two mullions if required during these works.
10 Allow to pin/cross stitch mullion stones using stainless steel dowels set in resin adhesive.

0m 0.5m 1.0m

No. 17 Roof elevation.

24th March 2008



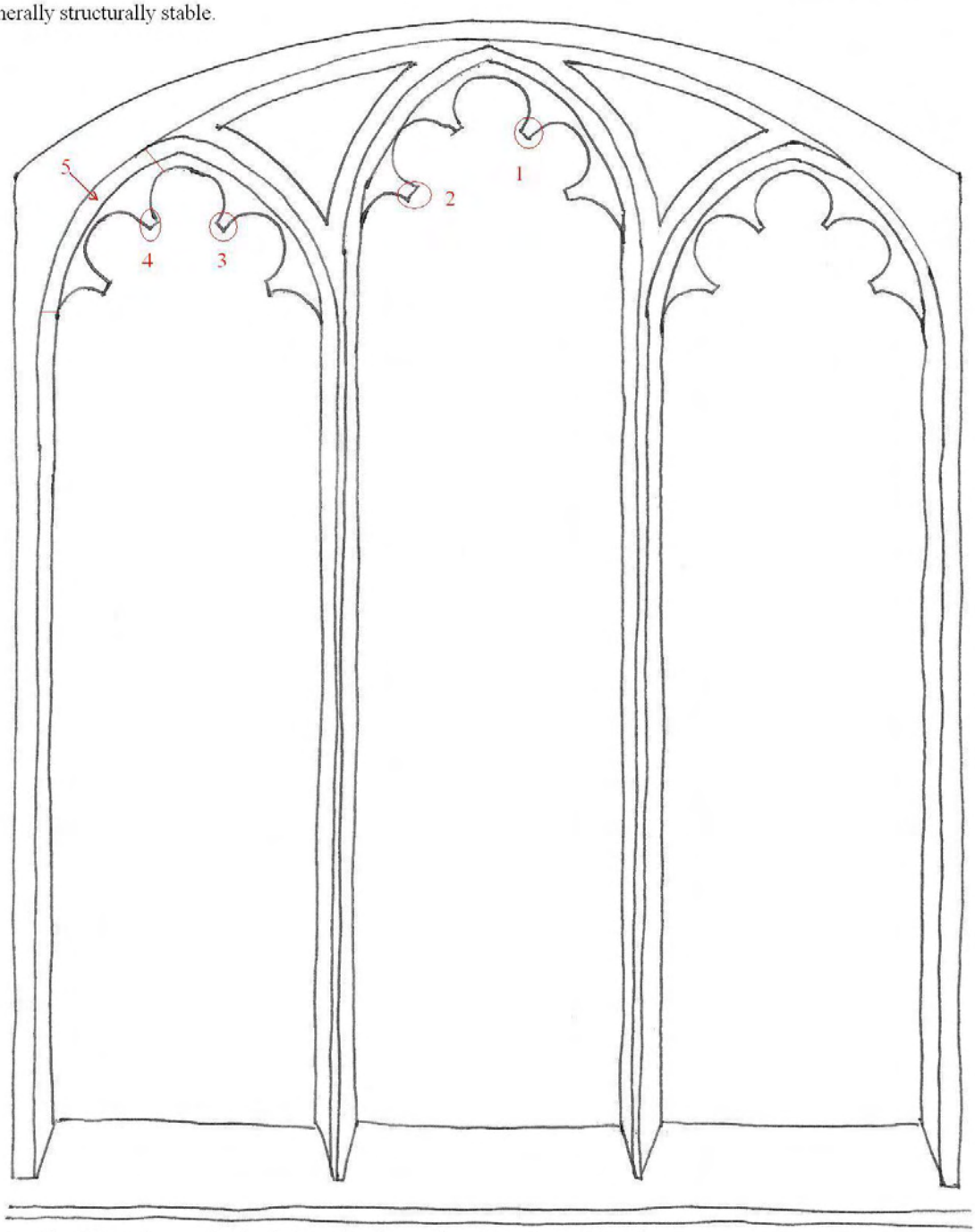
The area outlined above in red has considerable generally friable surface that requires dentistry repair and lime washing in the short to medium term.

It is noted that a roof void air vent is located directly opposite this window and it raises the question whether this is causing a localised deterioration; compare this to window 20 where a similar degree of deterioration is occuring and which is also opposite a ventilation window. The extent of friable surface is notably worse in these two windows when compared to the others along this elevation.

This requires further investigation and consideration.

No. 16 Nave elevation 24th March 2008

Generally structurally stable.

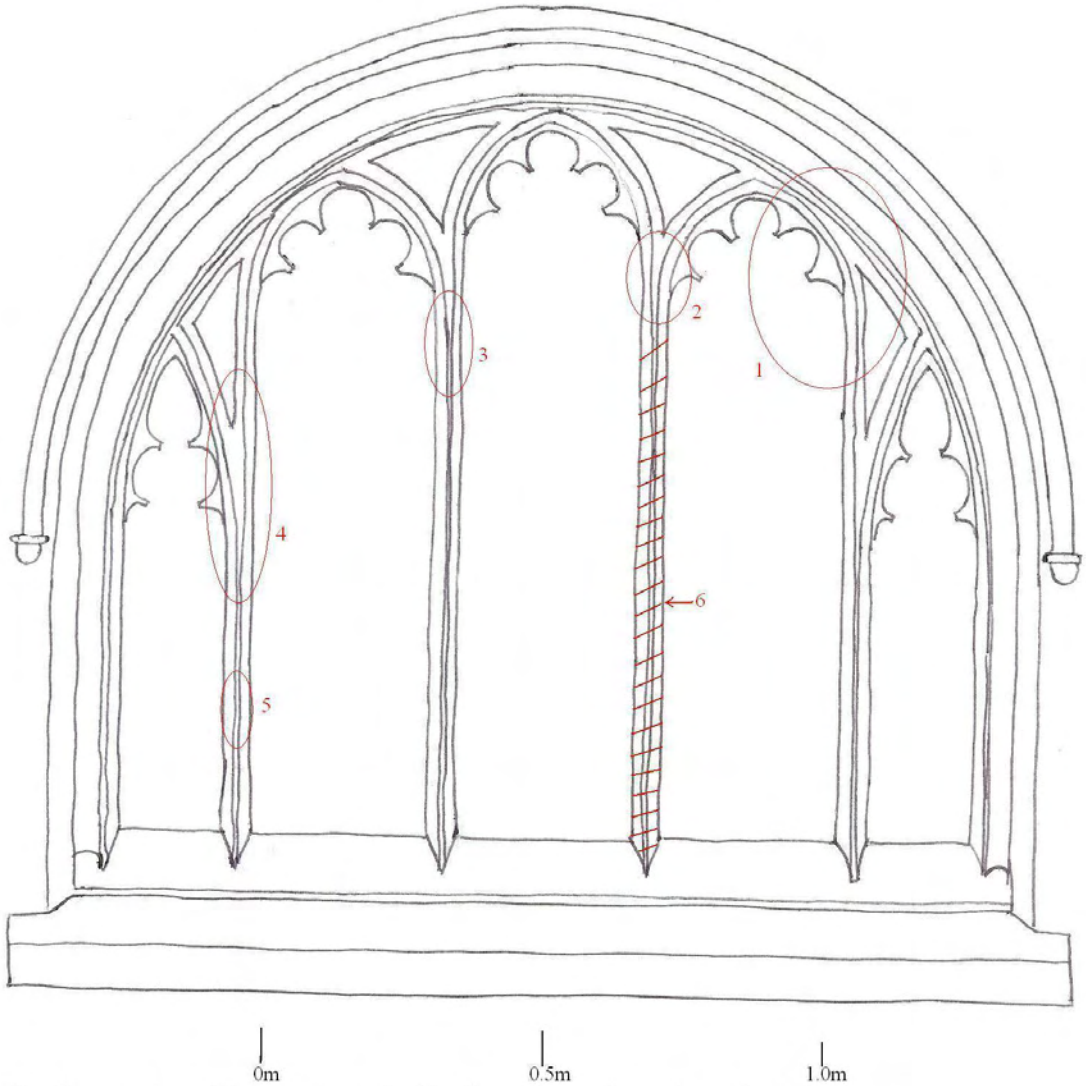


1 Tip of cusp damaged - (part old and part recent) - no repair suggested.
2 Cusp missing - (old damage) - no repair suggested unless required for stability of glazing; consult with Chapel Studios.
3 Cusp chipped - (recent damage) - no repair suggested.
4 Cusp missing - (break surface appears recent but in an area of old making good and repair; see roof elevation) - check if piece is extant and refix or consider making good using mortar repair.
5 Stone cracked - check in detail and consider pinning and cross stitching with stainless steel pins.
6 If agreed remove ferrous bars and replace with equivalent new bars to specification to be agreed. Allow to pin/cross stitch the heads of two jambs and two mullions if required during these works.
7 Allow to pin/cross stitch mullion stones using stainless steel dowels set in resin adhesive.

0m 0.5m 1.0m

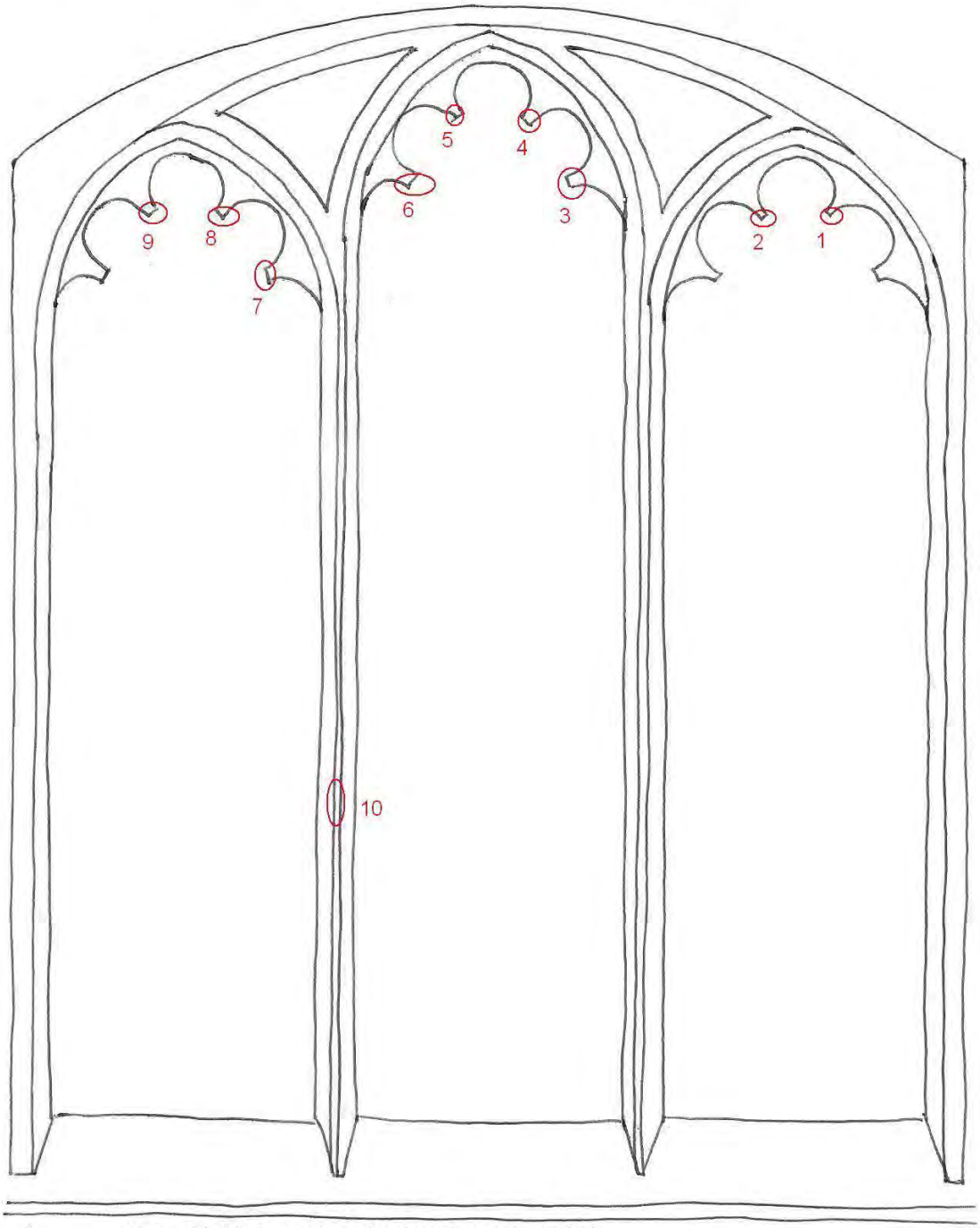
No. 16 Roof elevation.

24th March 2008



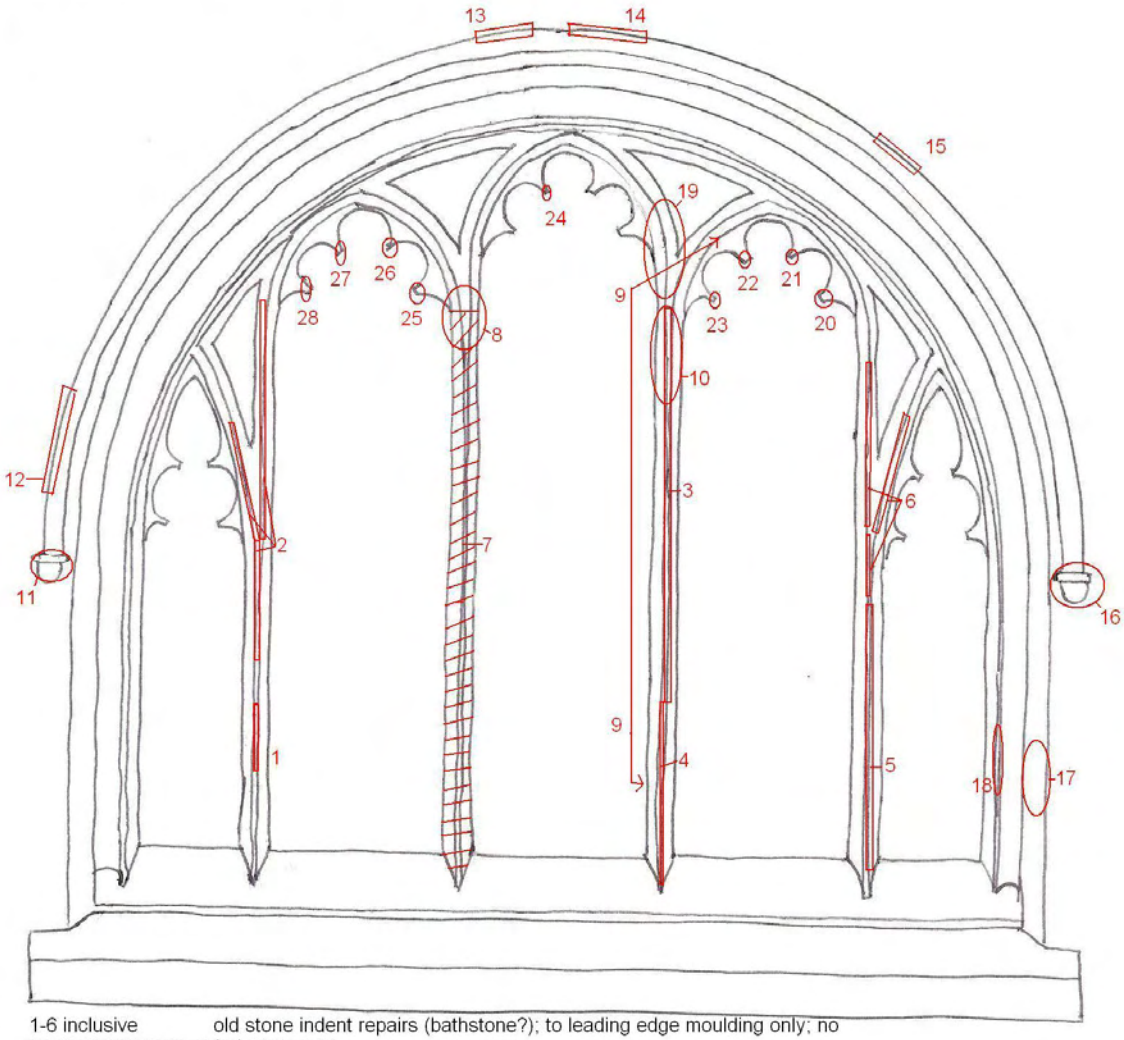
1. Cusps and mouldings made good with old mortar repairs - not causing any sign of deterioration therefore no treatment suggested as necessary.
2. Cement mortar repair - it would be desirable to replace this with a lime mortar repair.
3. Cement mortar repair - it has been recently re-adhered using a clear silicone adhesive - it would be desirable to remove this and replace it with a lime mortar repair.
4. A substantial area is made up of cement mortar repair work - it would be desirable to replace this with a lime mortar repair.
5. Cement mortar repair - it would be desirable to replace this with a lime mortar repair.
6. Mullion is a replacement in new stone.

Choir north elevation window NT14



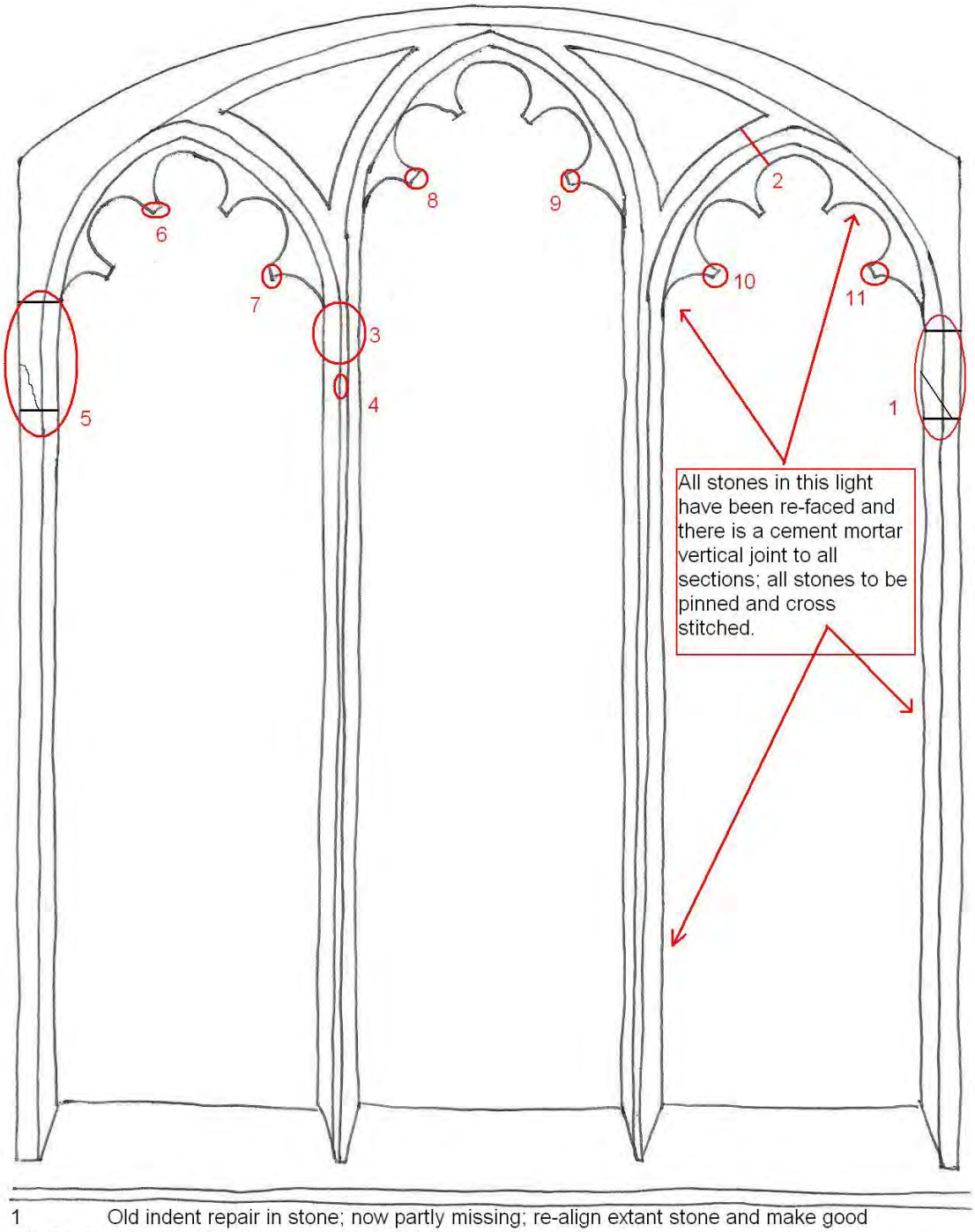
1	minor old chip to cusp; no treatment recommended
2	cusp missing from old damage; consider repair by lime mortar plastic repair
3	cusp chipped; no treatment recommended
4	cusp chipped; no treatment recommended
5	Tip of cusp missing
6	Cusp missing; consider repair by lime mortar plastic repair
7	Tip of cusp missing; no treatment recommended
8	Cusp shipped
9	Recent chip to cusp; no treatment recommended
10	impact damage to frnt moulding; no treatment recommended

Choir north side elevation window NT14 (roof side)



1-6 inclusive	old stone indent repairs (bathstone?); to leading edge moulding only; no treatment recommended at present.
7	mullion refaced in limestone (bath stone?); for treatment see 8 below.
8	repaired face of mullion moved out of alignment and temporarily bonded with wire and more recently resin during removal of glazing; mullion to be be realigned and cross stitched/pinned to choir side elevation stones.
9 to 9	mullion badly cracked in vertical from top to bottom; the crack moves from being on the choir side at the top to the roof side at the bottom; investigate cause and allow to pin and cross stitch with stainless steel pins.
10	face of stone previously cracked and repaired and filled; investigate and replace if required.
11	stone indent; no treatment recommended
12	stone indent; no treatment recommended
13-18 inclusive	stone indents; no treatment recommended
19	Area of significant loss of surface moulding; no treatment recomeended at present.
20-28 inclusive	old chips to cusps; no treatment recommended.

Choir north elevation NT13



1 Old indent repair in stone; now partly missing; re-align extant stone and make good missing section with lime mortar plastic repair

2 Hairline crack through stone; also runs across into the loft side elevation; cross stich with stainless steel pins

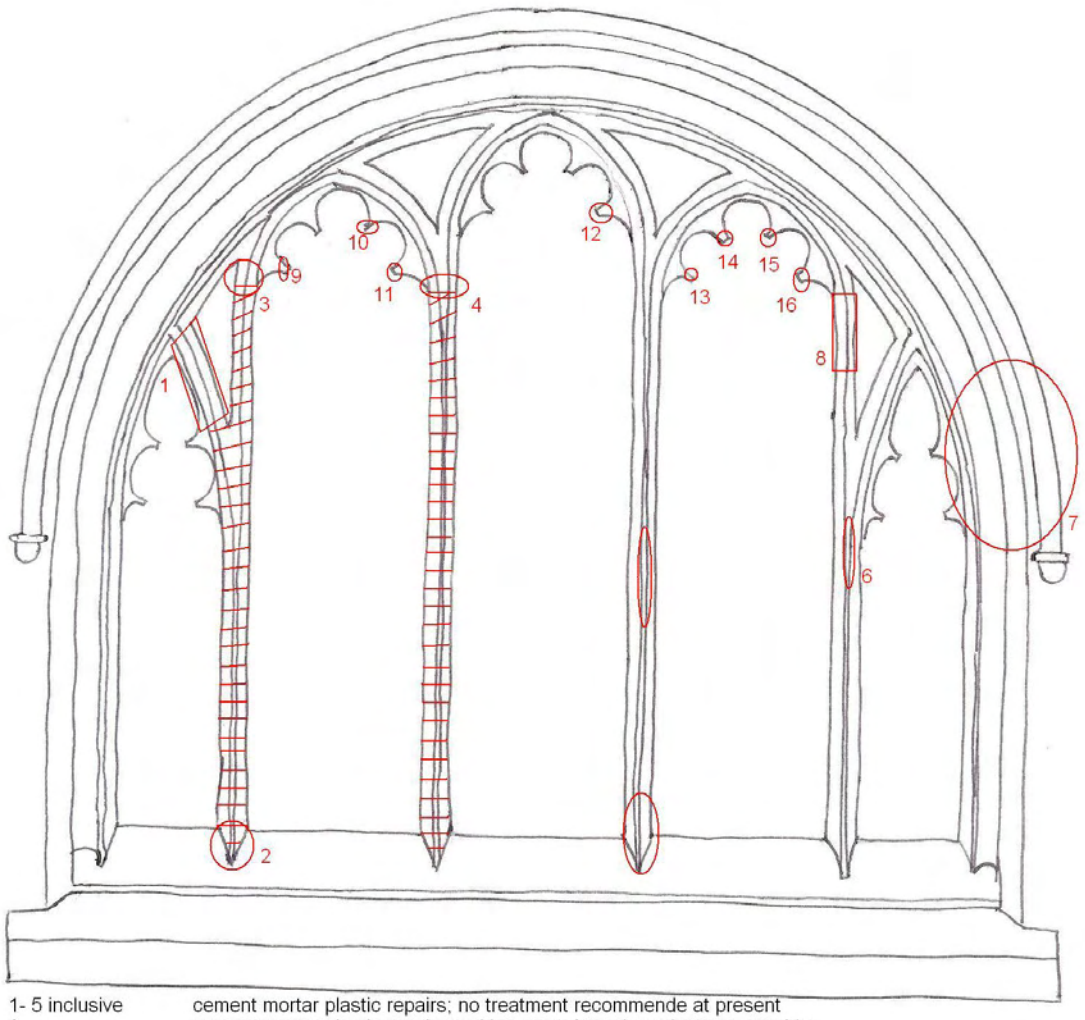
3 Old previous repair; consider removing and remaking in lime mortar

4 Old large round/drilled hole filled with lime mortar; no treatment

5 Hairline crack running though stone; check and consider pinning.

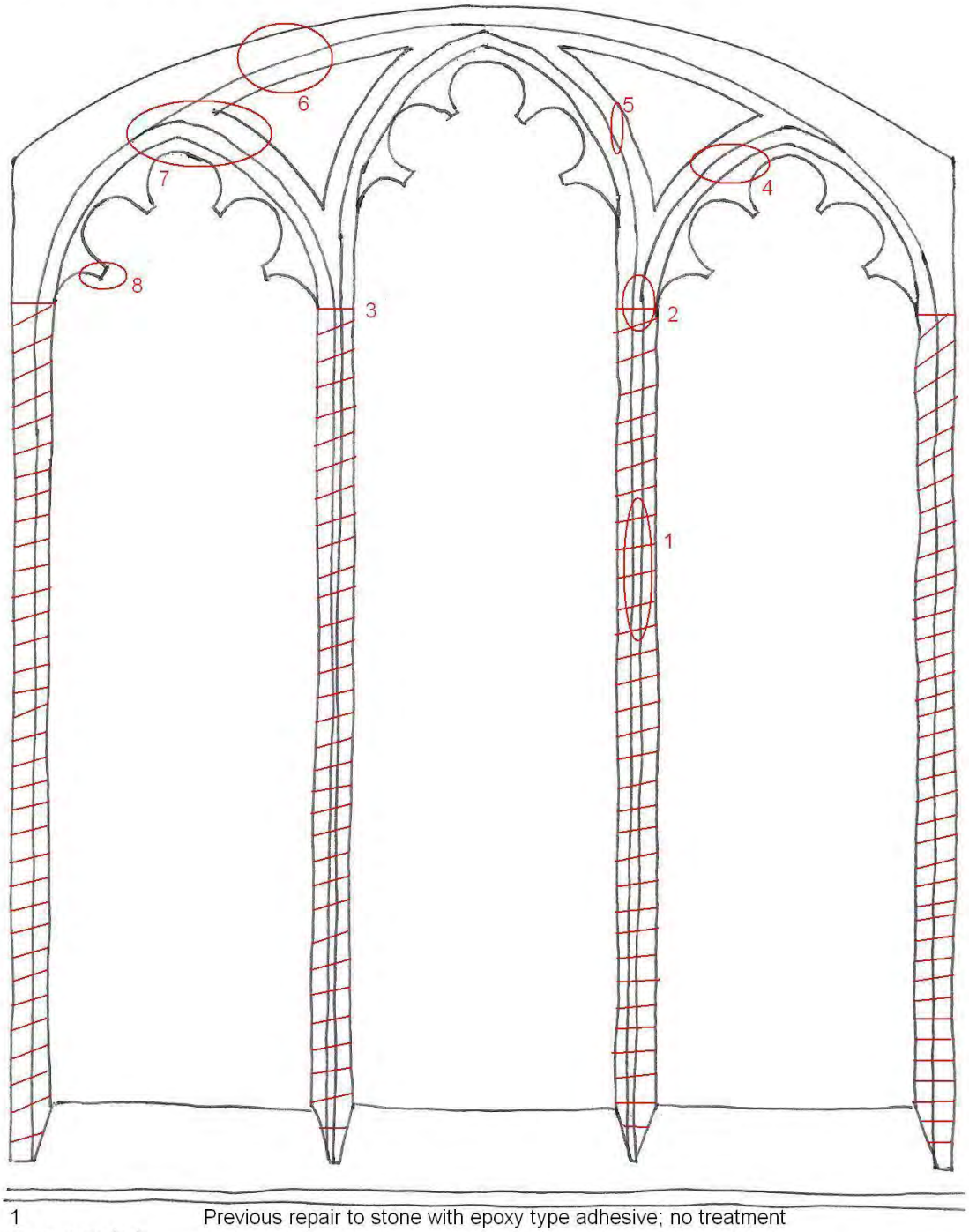
6 - 11 inclusive Old chips to the cusps; no treatment recommended.

Choir north elevation NT13 (roof side)



1- 5 inclusive	cement mortar plastic repairs; no treatment recommende at present
6	cement mortar plastic repair cracking away from the substrate; consider replacement.
7	very extensive cement mortar repair; no treatment recommended at present.
8	indent stone repair - possibly ragstone - in very poor condition ; consider replacement with Totternhoe stone.
9 - 16 inclusive	old chips to the tips of the cusps.
17	Front edge iof moulding cracked - delaminating - requires urgent pinning and grouting

Choir south side elevation window ST13



1 Previous repair to stone with epoxy type adhesive; no treatment recommended

2 Joint cracked; old epoxy type repair to front arris; investigate cause of crack and consider pinning

3 Joint cracked; investigate cause and consider pinning.

4 Area of loss to face of stone; no treatment recommended at present.

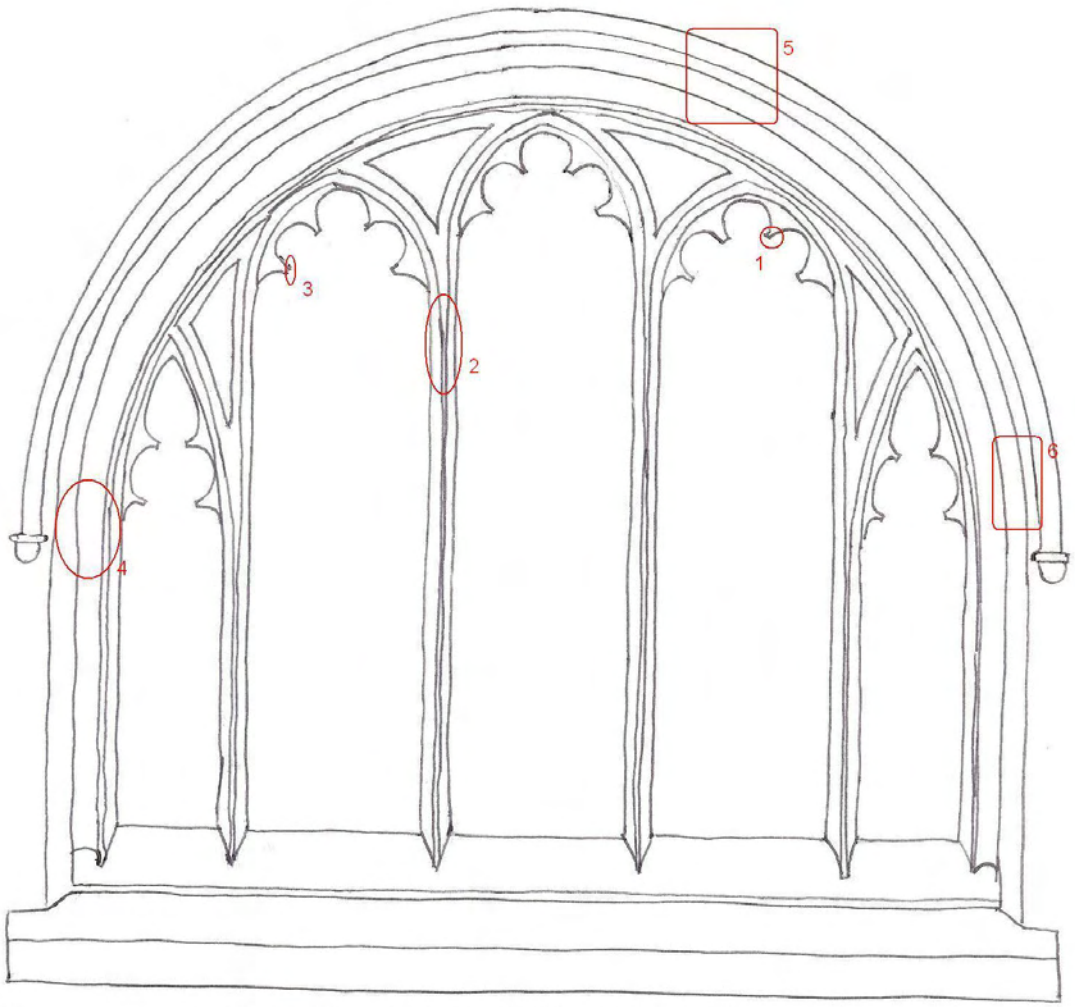
5 Old filling associated with the joint; no repair recommended at present

6 Old filling filling cracked; investigate and consider replacement

7 Old filling to this area - note shrinkage cracks; investigate and repair/replace if required.

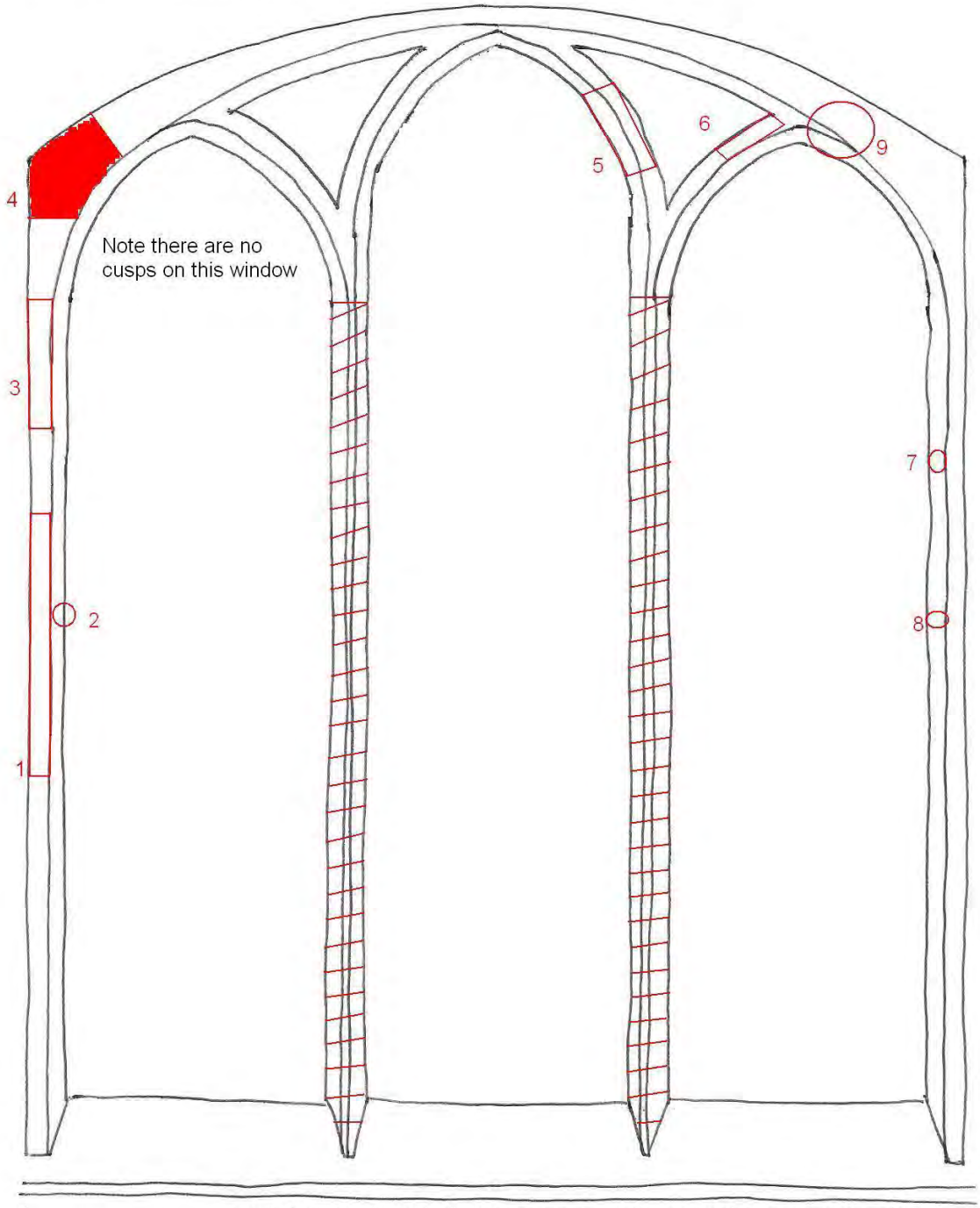
8 Cusp replaced in stone but to a badly executed interpretation of the form; no treatment recommended at present.

Choir south elevation window ST13 (roof side)



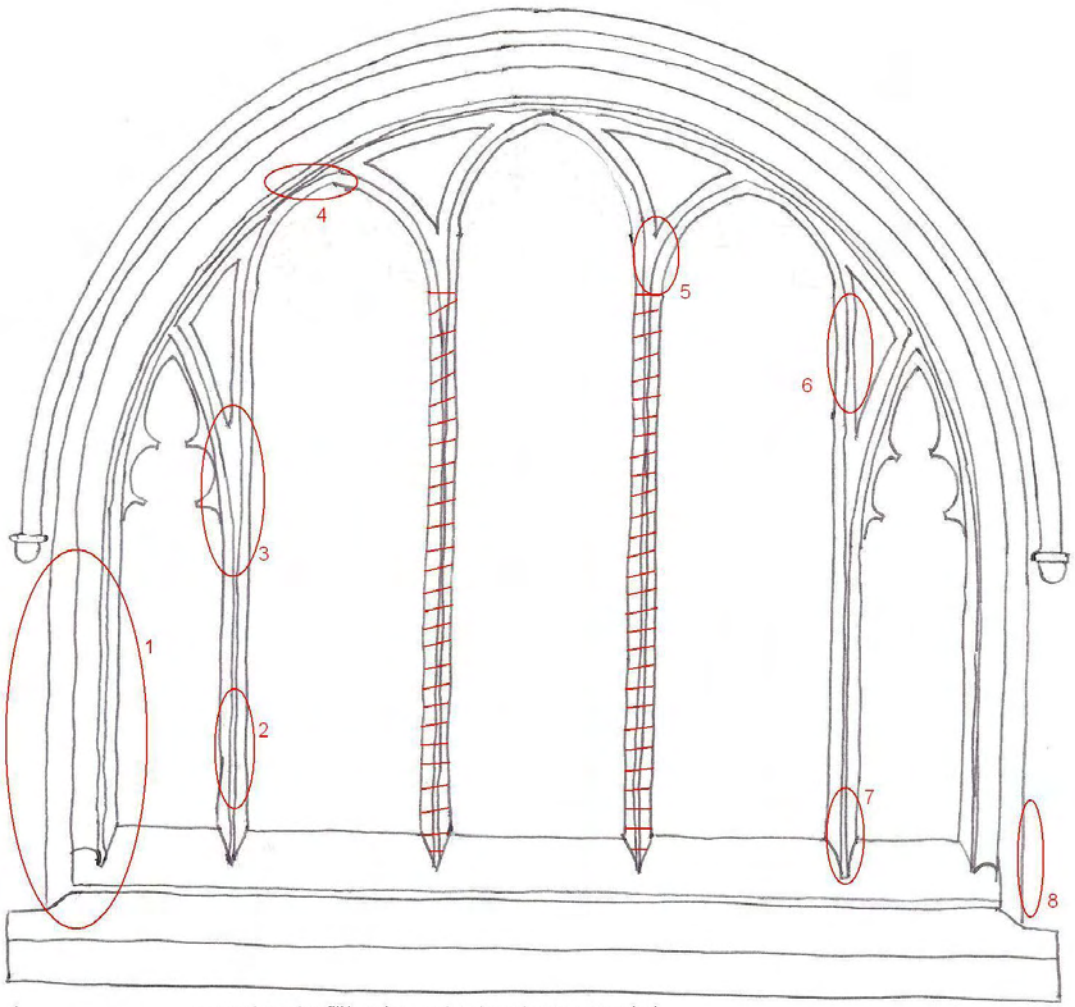
1 Tip of cusp missing - old damage; no treatment recommended
2 Front face of mullion missing - old ferrous pin visible in the top stone; check stability and treat if required and consider lime mortar plastic repair
3 recent chip to cusp; no treatment recommended.
4 area of stone very friable; no treatment recommended at present but monitor.
5 large area of stone missing; no treatment recommended at present
6 area of stone very friable; no treatment recommended at present but monitor.

Choir south elevation window ST14



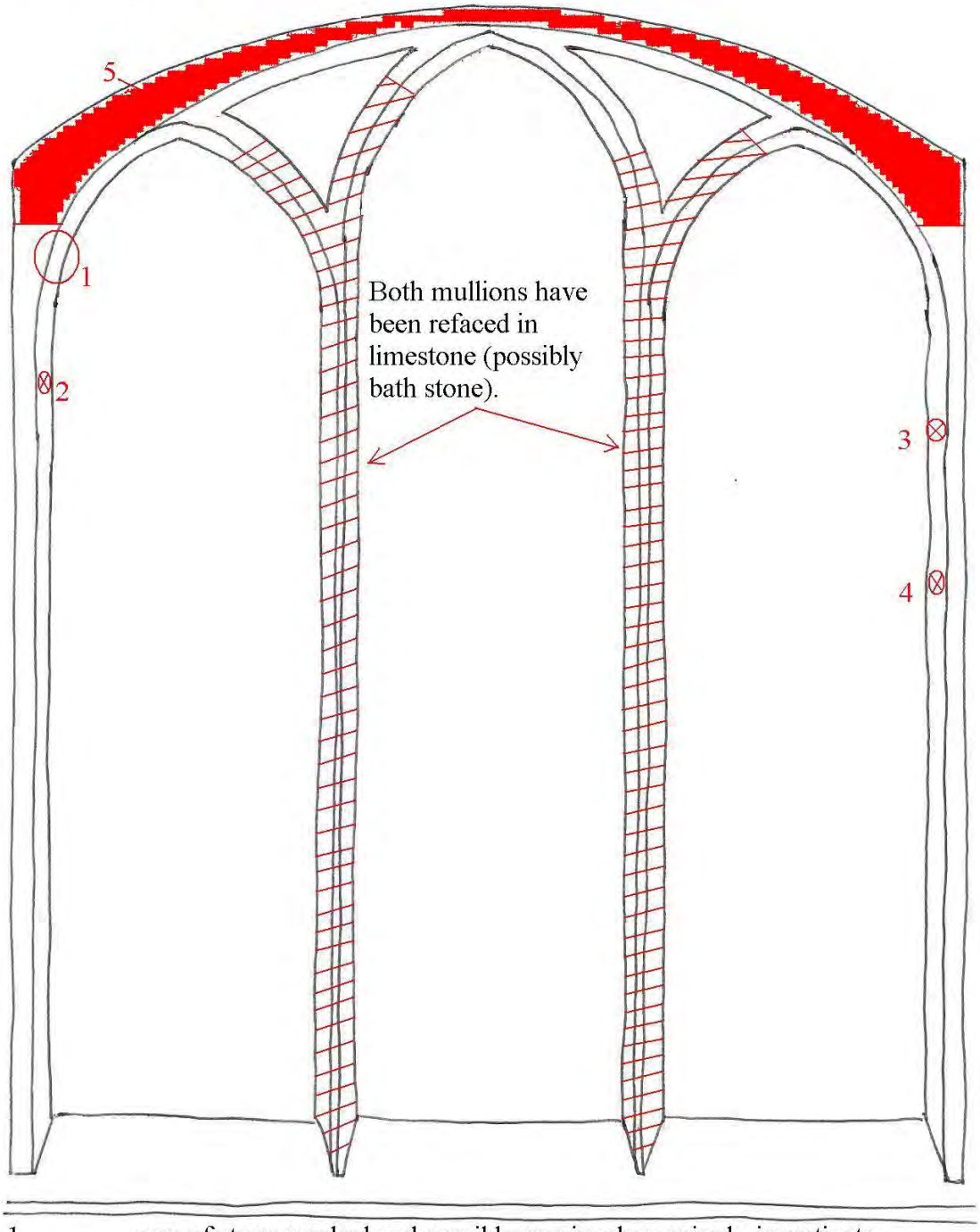
1	stone indent repair - note it crosses a stone joint; no treatment recommended at present
2	ferrous fixing visible in stone; investigate reason for its presence (is it tying the stones together?) and consider removal/replacement with non ferrous fixing.
3	stone indent repair; no treatment recommended at present.
4	area of old mortar repair; investigate and consider replacement. The winow heads on this window have been much repaired and indented a detailed investigation is required to clarify the extent and condition of this; allow for some repairs.
5 & 6	stone indent repairs; no treatment recommended at present
7 & 8	ferrous fixing as 2 above.
9	area of old mortar repair; see 4 above

Choir south elevation window ST14 (roof side)



1	cement mortar fill/render; no treatment recommended
2 & 3	area with loss of surface moulding; no treatment recoemmended at present.
4 - 8 inclusive	cement mortar filling; no treatment at present.

Choir south elevation window ST15

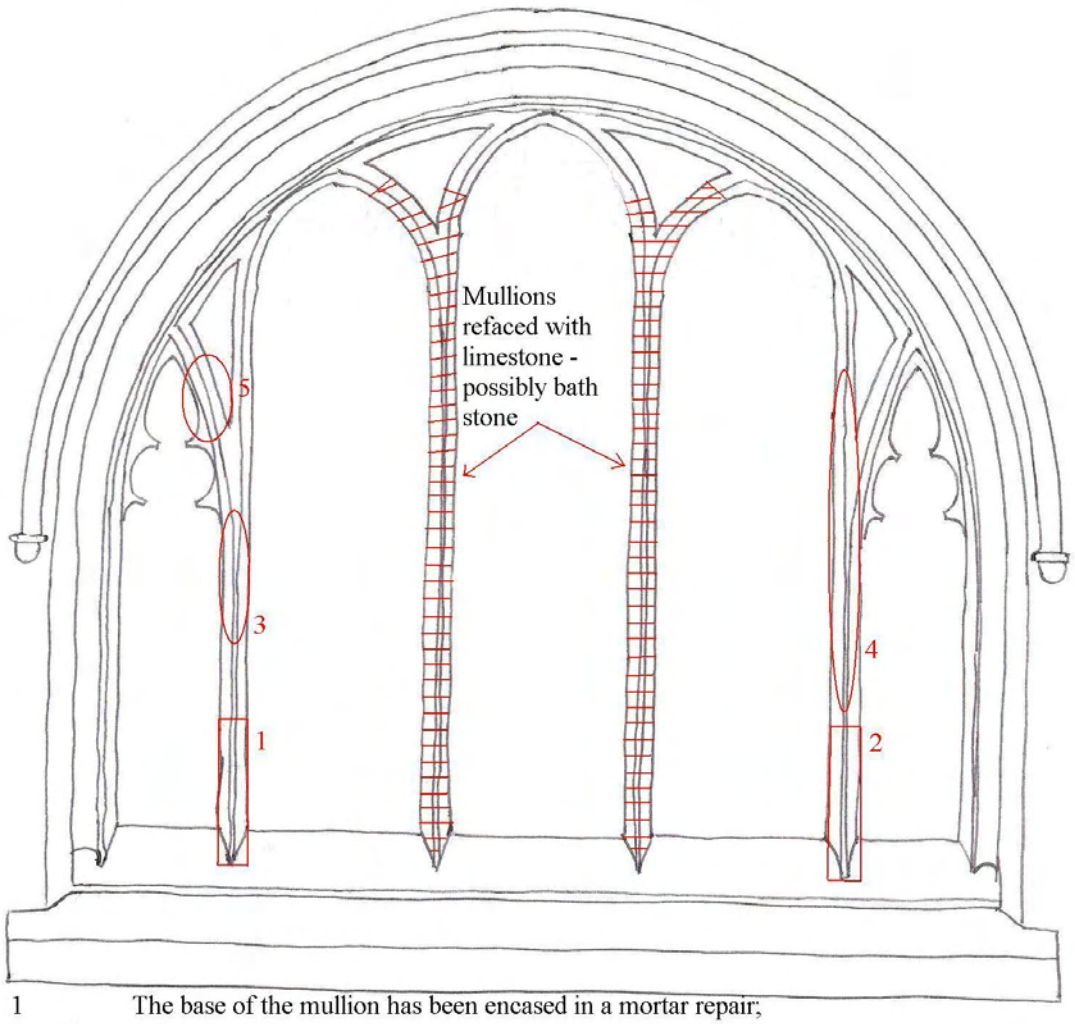


1 area of stone cracked and possibly previously repaired - investigate and pin if required.

2,3 & 4 old ferrous cramps that appear to be bonding the two faces of the jambs; investiagte and allow to replace with stainless steel of bronze.

5 the area above the window head mouldings appears to be completely refaced with mortar; investigate but do not replace unless structural failure appears likely.

Choir south elevation window ST15 (roof side)



1 The base of the mullion has been encased in a mortar repair; investigate and replace if necessary
2 As per number 1 above
3 Substantial mortar repairs to the front moulding of the mullion
4 Substantial mortar repair; cracked and broken and repaired using silicone resin adhesive - possibly caused during removal of the glazing
5 Much moratr repair to the face of the mouldings.