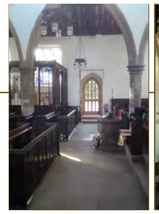
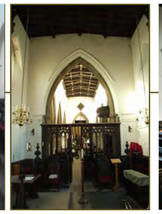
ST MARY'S CHURCH - SPROTBOROUGH


1 Existing

STRUCTURAL REPAIRS TO ROOF

Submission for the King of Prussia's Gold Medal Award - 2010 - by Andrew Wiles

Historical background

St. Mary's Church lies at the centre of the small village of Sprotborough about 6 miles West of Doncaster. It was founded around 1250 and throughout the centuries it was expanded and beautified by the Copely family of nearby Cusworth Hall. It is Grade I listed.

The patronage of this family paid for the tower to be raised in height three times and broad aisles added to the nave at the north and south. In the sixteenth century the roof was changed from a steeply pitched medieval form to a shallow lead covered structure, set within an encircling castellated parapet. The new structure of the roof included heavy tie beams and timber bosses, which were highly decorated with paint and gilding.

In the centuries that followed the changes focussed on the interior with the addition of a fine range of Jacobean box pews, screens and a pulpit. The interior was also partially re-ordered by Ninian Comper.

The need to repair the roof

Andrew Wiles of Wiles & Maguire became the inspecting architect in 2003.

Our first quinquennial inspection highlighted significant questions about the and general condition of the roof. St. Mary's historically had a full set of lead roof coverings but in the late 1980s these were all stolen in a very short spell of time. While Sprotborough these days is a relatively well to do suburb of Doncaster, during the eighties it was right in the centre of the social battleground of the miners' strike.

The lack of financial opportunity in the district may have led to the theft in the first place. Shortage of money also meant that there was no revenue in the parish to renew the lead now it was missing. As a supposed 'temporary' repair
they opted to seal in the roofs with a combination of asphalt sheet and poured liquid asphalt laid directly onto the historic boarding. The quality of workmanship was quite dreadful but the roof had remained, to outward appearances, weather tight since that time.

In the late 1990s the parish tackled a significant breakout of death watch beetle in the historic roof timbers. The interior of the church was scaffolded and the historic timbers drilled and irrigated from below and irrigated to treat the infestation. Again, due to shortage of resources, the work was restricted to the chemical treatment only rather than any structural repairs that may have resulted.

Developing the tender pack

Over the last 10 years the parish had built up a modest financial reserve, and they were willing to commission a programme of investigations similar to those in an English Heritage repair grant scheme. Selected areas of the boarding to the roof and gutters were opened up and from these modest openings a not untypical list of defects were observed. We also observed that the timber decking was very weak and this limited the amount of opening which felt could be safely undertaken. As a consequence we only had a small snapshot of the true condition.

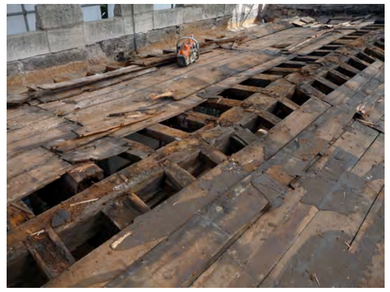
A temporary scaffold was erected internally to inspect, and probe the exposed portions of the major timbers close to the wall plates. From what we could reach we observed some weakness due to past insect damage but overall
the beams seemed to be firm. We did not feel that we needed to examine the ridges closely.

The church commissioned us to produce drawings and a specification for a full re-roof of the church. As the roof surfaces are invisible from all vantage points and the risk of lead theft remains strong in the district, it was agreed with the authorities to use a terne coated stainless steel finish. This would be laid over a layer of acoustic and thermal insulation. We felt that there would be a significant degree of repair work to the structural timbers that could not be forseen at the outset. To meet this risk we included a whole schedule of rates for splicing rafter ends, new wall plates and purlins. We also allotted a fairly substantial contingency to the project.

The tender was won by local firm A.K. Bridgett & Son, a very experienced firm of joiners, roofers and sheet metal workers. The paish resources in hand meant that we could only commission the refinishing of the nave roof and the chancel roof, leaving the aisle roofs as something for a future English Heritage grant application.

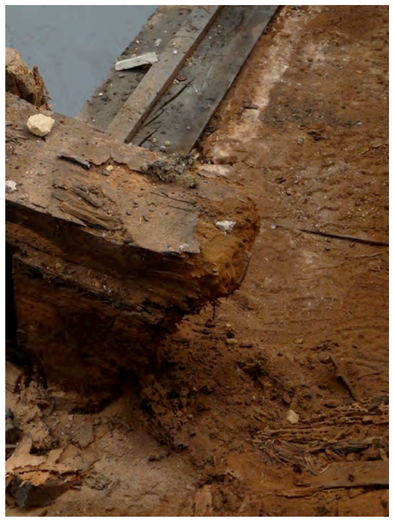
Existing asphalt roof coverings.
The gutters were poured asphalt.

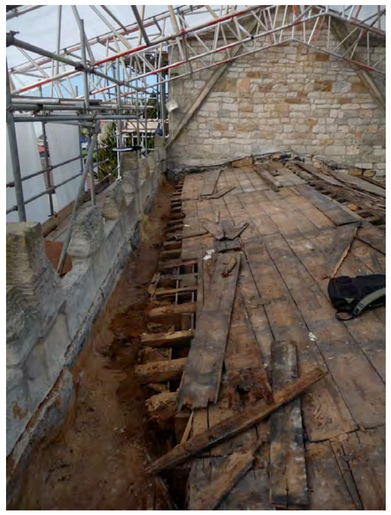
Decay of ridge member.

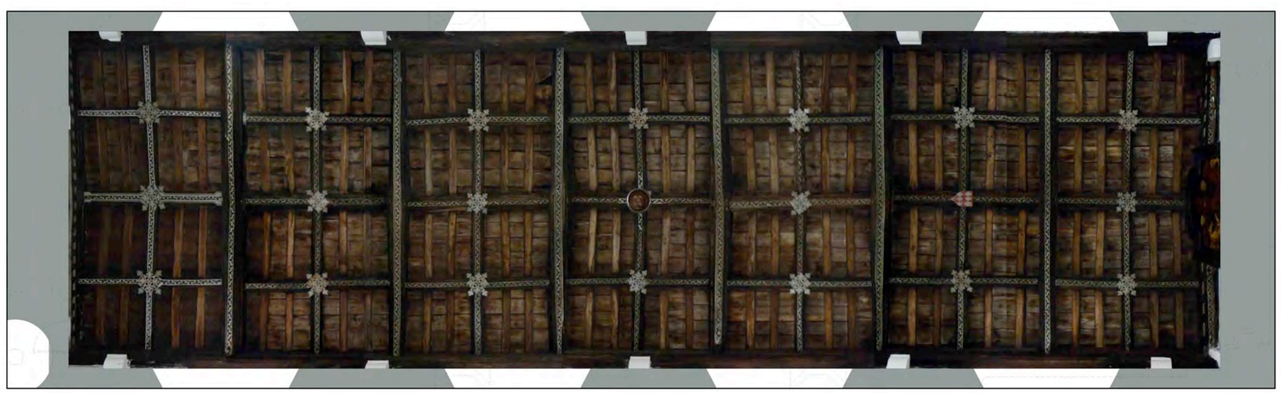


Ridge had snapped on the centre line.

Typical condition of beam and rafter ends.
The remains of the wall plate could be removed with a vacuum cleaner.







Survey photograph of roof structure prior to works

Discoveries following opening up

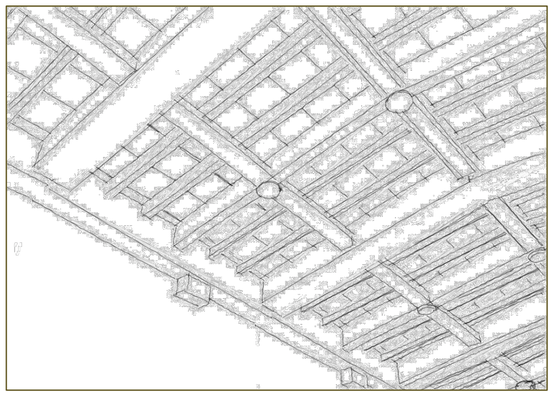
A temporary roof was erected over the nave and an internal birdcage scaffold installed to maintain safety. With the roof under cover, the stripping back of the asphalt sheeting could commence. It was with some dismay that we received the first phone call from the contractor indicating that the condition of the roof may be much worse than had been expected.

Visiting the site we observed that, as the contractor had begun to remove the damaged roof boards , the previously hidden upper faces of the tie beam trusses were honeycombed by death watch beetle. The decay was so advanced that the heartwood at the end of several tie beams could be excavated with ones fingers several inches past the bearing point on the masonry. The purlins and their joints seemed to be in fair order, but the heavily profiled ridge beam was exceptionally weak, particularly at its lapped connection to the truss, in one place it just snapped across its width.

If this was not alarming enough, the condition of the timbers in the wall plate area was very difficult to believe. What was once a massive oak timber was so weakened by historic insect infestation that the contractor could remove the structure with a vacuum cleaner – there was nothing solid left.

It became clear to us that whent the death watch beetle infestation had been tackled in the 1990s the contractor had faced up the historic wall plate with thin new timber to simply cover the weakened rafter ends. When we had investigated the roof from below prior to starting the works these facings (along with wide areas of the trusses) had firmly resisted a probe and seemed like the sound timber.- The real problems were hidden deep behind.

After viewing the opened up roof we best summarised the roof structure as one that had previously been stable only as sum of all its parts, it was almost as if the roof had been acting as a stressed skin structure. We thought it was lucky that we have not had significant levels of snowfall in the county for quite some years, because we doubt it could have supported a substantial weight of ice.



Survey sketch of roof prior to works

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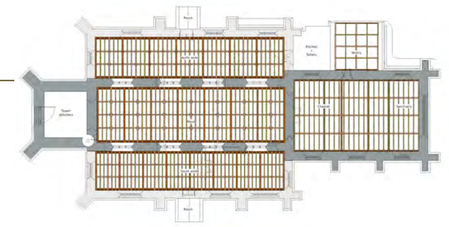

2 Repairs

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Developing a repair solution

Now that the structural condition of the timbers could be evaluated the method of repair needed to be completely rethought.

When approaching the preparation of the tender pack we had been expecting to undertake various localised areas of timber repair using traditional scarf details. The extent of decay now encountered would mean the important sixteenth century timbers and their paintwork and mouldings would be decimated by introduction of new material. We felt that an innovative solution was required that allowed these timbers to be retained.

The feasibility of using the hollowed out backs of the timbers to introduce a blade of steel was explored but rejected as it would compromise the mortise and tenon connections at the purlins. Building up the missing volume of the timbers with a resin was also discussed but rejected. This was because there would need to be a significant amount of 'mining' the frassy timber to allow the resin to get a key. Again this would strip away large amounts of historic material.

The repair option we identified in the end was considered by English Heritage and the DAC to be simple, innovative and guaranteed the retention of the maximum amount of historic material. In consultation with a structural engineer (Brian Jones) we proposed to install on the line of each historic tie beam a low profile steel portal frame truss with purlins spanning between. These trusses rested on pads in the empty wall plate void and provided a 'strong back' to which the weak historic timers could be suspended with secret fixings. The prortal frame was manufactured to follow the pitch of the original roof boarding meaning the entire roof deck only needed to be raised 150mm above the original line.

The new steel structure also took the weight of the new plywood deck and insulation for the stainless steel roofing. The historic structural members and the joints needed only to support their its own weight now, almost like a suspended ceiling grid. As they had no structural role we did not need to excavate the frass back to sound timber and the beam's shape, and the historic decorated finish was retained almost one hundred per cent. Sadly the original roof deck boards were weakened by insects beyond repair and new wide deal boards were secured in their place.

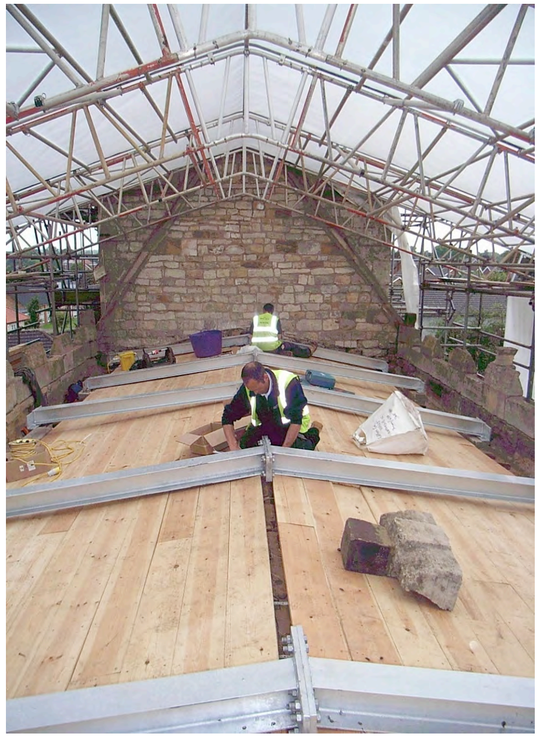
Conclusions

It is understandable that the costs of the repair to the nave roof increased above what was in the tender. The final account however was far less than it would have been if we had scarf jointed the moulded beams and added new oak sections. It proved to be quite an economical form of repair.

Thankfully the chancel roof had not yet been scaffolded so that element of the project could be put on hold and the resources transferred to help with the nave roof. English Heritage were also involved throughout the re-specification process and they now understand the need for financially supporting repair to the remaining roof areas.

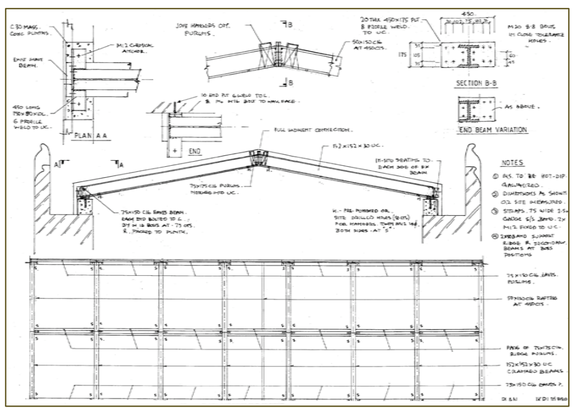
We feel that the finished work represent a tidy and sustainable result for the parish. It has delivered a complete structural repair with significant retention to historic material that would have otherwise been condemned.

The complete roof.

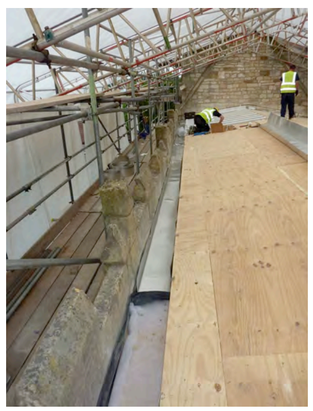


Roof repairs showing new roof boards and the steel frame.

The completed roof from below.



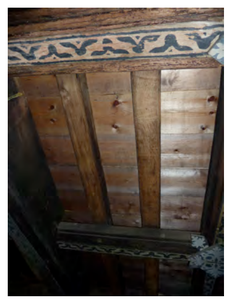
Structural design by Brian Jones, Engineer



Finished roof prior to laying of stainless steel. The steel work is below the plywood deck.

Photograph showing that the finished roof line is only 150mm above the original line.

Photograph showing one rafter end following trimming of frass. It falls short of the bearing by 50mm.



Detail of new boarding.

Project Duration: March – July 2010
Contract Value: £130,000

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Director in Charge: Andrew Wiles AABC,
Project Architect: Robert Mortimer AABC

Structural Engineer:
Jones Kingwell Partnership
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