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HOLY INNOCENTS CHURCH, THORNHILL LEES

DEWSBURY, WEST YORKSHIRE

SPIRE STABILITY

4th August 2021

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1 BRIEF

Jen Read, The Mission & Pastoral Secretary to the Church Buildings & Pastoral Reorganisation Team of The Church of England Diocese of Leeds has instructed Brian Jones of Brian Jones Structural Design to carry out an assessment of the stability of the spire at Holy Innocents church, Thornhill Lees, Dewsbury, which has been recently closed.

A photographic survey by drone has been carried out by Taylor Hastwell Steeplejacks in April 2021.

A Fabric Condition Survey has been carried out Pearce Bottomley LLP IN May 2021.,

The BJSD inspection has been made on Wednesday 14th July 2021.

2 CONCLUSIONS OF PREVIOUS REPORTS

The Steeplejack's report is prefaced by the statement:

"Due to the condition of the spire a laddered close inspection was not safely possible so the inspection was carried out with a drone." "Spire wall thickness was found to be only 220mm"

The photographs taken by drone have been made available to assist in producing this report by BJSD. The observations in the Steeplejack's report are also noted.

The Chartered Architect's report defers to the Steeplejacks findings for the Spire external condition but includes comments on internal observations made from the bell chamber. Both reports recommend that a structural engineer should be engaged to comment on structural stability of the spire.

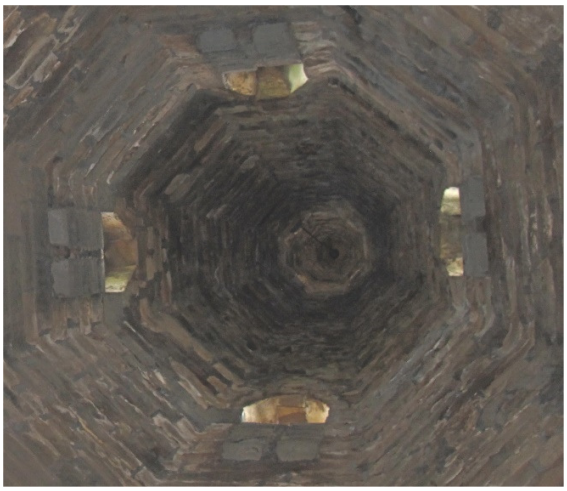
3 ASSESSMENT METHOD

During the site visit the spire was observed through binoculars both externally and internally and with the aid of a hand-held spotlight for the upper reaches.

The photographs from the steeplejacks' drone survey augment these observations.

4 OBSERVATIONS

TRANSITION FROM SQUARE TO OCTAGONAL FORM



The spire springs from 1 metre thick walls surrounding the 4.5 metre square by 5.2 m high bell chamber. The broaching that facilitates the change from a square to an octagonal form takes place using an arch form to each corner, as can be seen in the adjacent photograph.

The ladder, on the east wall, seen in the photograph gives access to the parapet ledge at spire base level but is not safe to use.

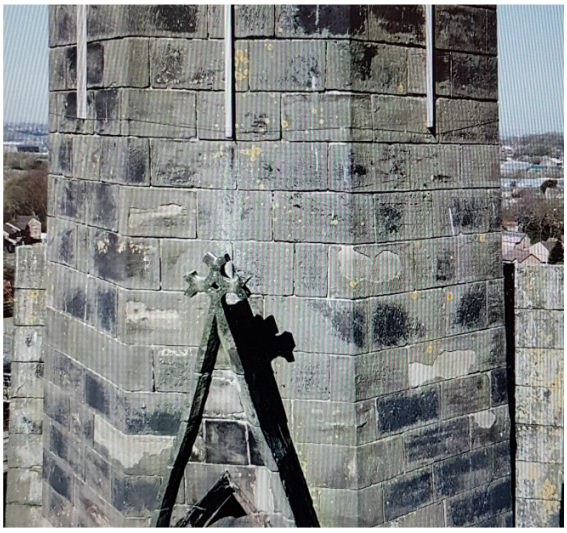
The internal masonry is faced up to the head of the lower lucarnes. The upper courses consisting of a single stone thickness are rough-hewn.

The masonry in the transitional zone was sound despite some erosion to the facings. The metre thick walls give substantial robustness at this level. There are no signs of disruption from corroding embedding ferrous ties. The form of the transition suggest use of such devices would not have been considered necessary.

The thickness of the spire walls is likely to be reasonably substantial up to the level of the lucarnes where internal and external facings form the construction. The thickness can be assessed at the crown of the openings. The crown of each lucarne is formed from three components with the flat top forming a lintel that appears to define the masonry thickness at that level.

Scouring has been limited due to the masonry having been face internally.

LIGHT PENETRATION AT CROSS TREE LEVEL



ABSTRACT FROM DRONE PHOTO SE FACE

The adjacent photograph of the apex interior has been trimmed from a general shot taken from bell-chamber floor level. There are two important features shown. One is the restraint rod extending down from the finial and the other is the band of light at upper lucarne level where the cross-trees appear to have been located.

The presence of these high level openings helps the masonry to be seen as well as the absence of the cross tree structure that restrained the finial. The band of light appears to be on a ring of finer stone similar to that at the lower level. The masonry above this level is likely to have been that which was found to be unstable.

Externally, the spire shows no signs of deviation from the overall geometry such as bursting, twisting or distortions to the faces. The structure is most vulnerable at lucarne level where erosion is much more likely due to weather penetration. Internally there is a band of higher quality fine grained sandstone stretchers at crown springing level, which has effectively formed a strong ring to resist bursting.

Externally, on the adjacent drone photo, a change in the stone thickness can be detected above the finial level. It is probable that the true thickness of the outer leaf shows below the change but that squint or external angle stones have been used above that level.

The craft of spire construction, similar to mill chimney erection, was well tried in the nineteenth century as ever more new buildings were erected. The outstanding example locally at All Saints at Little Horton in Bradford by the same architect demonstrates what could be achieved and what is being successfully maintained, despite the thin wall thicknesses used.

The photograph above also shows where the restraint angles and circumferential wires start. The purpose of this intervention is not reliably known but can be speculated upon.

VIEW FROM THE SOUTH-EAST

OBSERVATIONS (CONTINUED)

The drone photographs taken by Taylor Hastwell Steeplejacks in April this year have been used for this part of the report without reproducing them. Essentially, they enlarge upon the view on the last page taken on 14th July.

The cross, finely crafted in copper-work is set into a cast iron capping, which is pitted by erosion. Bolt heads are visible that are clamps for the square stem of the cross near the top and the restraint that extends down internally. It is probable that the top eight courses are single stones that relied on the internal rod for restraint.

It is most likely the galvanised steel angles were introduced to restrain these topmost courses. It is likely the anchorage cross-tree corroded away some considerable time ago due to exposure to the weather sweeping through the upper lucarnes. There is no explanation for the internal rod not being vertical, but as it remains suspended its role in resisting lateral displacement of the upper courses remains effective, as a dowel.

The galvanised steel angles have been fixed by 16mm diameter stainless steel rods chemically bonded into the masonry with what appeared to be nuts vulnerable to corrosion causing staining. A sample had been left on the bell-chamber floor, which if typical, indicated a minimum embedded length of 200 mm, which might be confirmation of a 9" (225mm) stone thickness.

Light-gauge wire girdles have been installed at half metre intervals, some threaded beneath the angles. At the very top, the wire was threaded through alternate angles, ringed round the top stone. It is noted that the Steeplejack commented the temporary work was probably done in the early 2000s by steeplejacks.

Galvanising in exposed locations has a limited life expectancy due to the gradual loss of zinc. The later stages of effectiveness are characterised by discolouration, which was apparent on these sections. After two decades, corrosion could be expected to ensue.

The lime mortar joints to the whole of the spire were very thin and lightly eroded back from the stone facings. The ashlar faces were in remarkably good condition with loss of face showing in isolated places only at lower levels. The critical upper level surfaces remained very sound as far as could be seen on the drone photographs and with binoculars from the ground.

There were some open joints to the lower level lucarnes and more loss of face, indicated by light patches at broach level where the wall thickness was much more substantial.

The pinnacles and rectangular tower do not form part of this report.

CONCLUSIONS

From the observations on the day of the inspection and perusal of the drone photographs it has to be concluded that the defect that led to installation of the restraints is latent rather than progressively active. A progressive condition would most likely have led to collapse.

The wire girdles are unlikely to provide restraint if the masonry is disturbed but the angles and masonry anchors may well do so. It is not possible to determine whether a collapse would have occurred without the angles and their fixings. The photographs indicate that the upper courses have not slipped on the bed joints, where these were visible. As the internal restraint rod is still attached to the apex it seems unlikely the solid single stone courses at the very top have been displaced during an incident. The most likely reason for adding the external restraint was the loss of the internal one. In the absence of records to the contrary this is what will be assumed.

The masonry in the critical zone above the upper lights is remarkably well preserved, given the degree of exposure to the weather. The combination of thin joints and hard ashlar material has withstood the test of time. The blackness of the stone face from coal-fire pollution may have protected it from acid rain and other more recent pollutants.

The cast iron finial looks rather worse for wear but there is likely to be a substantial amount of metal thickness left. Unlike steel, the material sheds granules rather than laminating and becoming hygroscopic. The process of corrosion is therefore much slower. Nevertheless, it would benefit from refurbishment.

Comments about the lightning conductor and the cross finial have been made elsewhere. The patina on the copper helps prevent further oxidation. A twin earth tape, as recommended, would make testing from the ground far easier. There is a risk of tape theft, which is reduced by the use of aluminium that has far less scrap value than copper.

Internally, the scouring due to weather is not severe enough to warrant overall treatment. Where the masonry is only faced on the outside, above the lower lucarnes the inner face is roughhewn and therefore more vulnerable to erosion The upper lucarnes appear to have been successful in performing a secondary role as ventilators, preventing condensation, which can cause erosion problems just as troublesome as those caused by driven rain. The condition of the internal stone face above the upper lights is harder to be sure of due to the twenty-four metres height above floor level.

It is fortunate that mortar repairs have not been carried out previously. Re-pointing thin joints is a difficult task. In some instances where remedial work has been carried out elsewhere in the twentieth century, mastic has been used and in others the joints ground out to allow cement mortar to be used, with very unfortunate consequences. It is probable that some mortar loss greater than a few millimetres has occurred in places, particularly on the perpendicular joints but this alone would not be justification for overall re-pointing unless part of other works.

RECOMMENDATIONS

The listed status of the building will remain, whatever the future use. It is usual good practice for any remedial works to be designed to last a sixty-year span, to hand on an artefact in good state of repair for future generations. The external restraints fitted to the spire are not suitable for the longer term, both because of the limited performance term of galvanised steel with high exposure to weathering and the unsightly nature of what was intended to be a temporary solution.

The long-term solution would be to reinstate the internal restraint assembly, which would obviate the need for the external temporary intervention.

Leaving the present arrangement in place is not an option in the longer term, so deployment of high-level access at some time in the medium term will be unavoidable. Masonry repairs at the lower level have already been recommended by the Architect, so excluding spire work from the contract would miss an opportunity to do a thorough long term job including both tower and spire.

It is probable that the angles and associated anchorages were installed without conventional scaffolding, to save expense. Permission to fix anchorages into the listed fabric would not have been given lightly but was probably the only feasible option at the time, even though a temporary measure, inevitably requiring a revisit with a more permanent solution at some time in the future. Reinstating an internal restraint is usually done by dismantling the top courses. Doing so makes sure the workmanship is suitable for the longer term. Devising a method to avoid dismantling, that would be certain to be successful in its execution, could be very difficult to achieve but would be the most favourable way of dealing with the problem. Close collaboration between designer and stonemason at design stage could make this a feasible option, provided procurement rules could be followed. Conventional falsework design procedures restricted by software proformas would be unlikely to lead to a solution .Innovative thinking would most probably be required.

Providing safe access to make the top of the spire secure will also allow access for the lightening conductor remedies to be carried out that have been recommended in the Steeplejack's report, together with carefully controlled re-pointing, localised facing treatments and perhaps re-bolting and cloaking of the cast iron capping.

Were records to be found or recollections heard giving reasons for the intervention, these would be invaluable.

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