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17203
Eardisland Village Hall at Eardisland, Herefordshire.

For Eardisland Parish Council.

STRUCTURAL CONDITION REPORT

Saturday, 23 December 2017

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1. INTRODUCTION

1.1. c2designs were instructed by Mrs. Alison Sutton, Parish Clerk and acting on behalf of Eardisland Parish Council, present owners of Eardisland Village Hall, Eardisland, Herefordshire, to make an inspection of the existing hall structure with a view to possible alterations and extensions.

1.2. A visual inspection of the building was made, internally and externally from ground floor levels and by means of ladder to inspect roof voids as far as safe access permitted. During the inspection notes and sketches were made and photographs taken, these have been reproduced where appropriate within the appendices of this report.

1.3. c2designs have also been asked to consider the proposed alteration options and comment on their suitability and impact on the existing building. This is outlined within appendix D accompanying this report.

2. BUILDING ARRANGEMENT

2.1. The present buildings constructed to serve as a village school probably dates between the early and mid 19th century. It continued to serve as village school until its closure in 1979. It recent years it has been managed by a village hall committee on behalf of the parish council.

2.2. The main building is aligned on a north south axis and is constructed with load bearing random ruble sandstone masonry walls to the north and east elevations, including the former entrance hall, with the present south and west elevations formed with brickwork masonry, the latter believed to be a replacement to the original west elevation.

2.3. Nominally the stonework walls are around 450mm thick and these support the primary scissor trusses of the vaulted roof structure. The main hall has three trusses, each supporting two lines of slope purlins and ridge board beneath common rafters and a slate roof finish externally. The roof is finished internally with lath and plaster.

2.4. Low arched masonry is provided over door and window openings to all elevations.

2.5. The ground is generally level around the building. However, the external tarmac turning area to the south elevation is higher than the internal slab level as you slope down immediately inside the door opening.

2.6. Internally the hall has a modern solid concrete floor finished with woodblock within the main hall areas.

2.7. The toilet and shower block extension to the north end of the building dates from around the 1960's and has recently been refurbished internally. It has a flat roof which has a roofing felt finish.

3. OBSERVATIONS

3.1. North elevation externally (partially obscured by single storey toilet block)

3.1.1. A large void was noted adjacent to the end of the exposed upper slope purlin to the west roof pitch (see figure 1).

3.2. East elevation externally

3.2.1. Evidence of masonry bee damage to either side of the right hand large window opening (see figure 2).

3.2.2. A vertical crack was noted in the masonry facing work of the original chimney stack with evidence of considerable historical repointing (see figure 3).

3.2.3. Diagonal crack over entrance hall doorway (no infilled as sign) (see figure 4).

3.2.4. Cracking through voussoirs of opening arch.

3.3. South elevation externally

3.3.1. Open pointing to the brickwork within the bellcote canopy and beneath (see figure 5).

3.3.2. Thick historical reporting to the arch construction over main window (see figure 5).

3.3.3. Vertical cracking through brickwork masonry to the left of the door opening (see figure 6).

3.3.4. Loss of mortar adjacent to ground level across the south elevation.

3.3.5. Open vertical cracking to the right of the window opening to the entrance hall south elevation (see figure 7).

3.3.6. Loss of pointing to the keystone to window arched head (see figure 8).

3.4. West elevation externally

3.4.1. Notable outward movement of brickwork masonry over the arch of the right hand window opening. (see figure 9).

3.4.2. West elevation noted as leaning outward at its eaves level compared to wall base, at its maximum between main pair of window openings (see figure 10).

3.4.3. Open pointing between door and window at north end of hall.

3.4.4. Open pointing above abutment of corrugated lean to shed.

3.5. Main Hall - ground floor internally

3.5.1. Vertical cracking was noted inside the north elevation corresponding to the reveal of the infilled window opening (see figure 11).

3.5.2. Diagonal cracking to the internal ceiling finishes.

3.5.3. Diagonal cracking noted to the reveal of the left hand internal window opening long the internal east elevation (see figure 12).

3.5.4. Diagonal cracking noted above the south elevation east door opening, similar historical cracking noted above infilled doorway to the west side of the elevation.

3.5.5. Internal stonework along the west elevation leaning outward considerably at its head between 80 and 100mm out of plumb internally.

3.5.6. Slight opening noted to the joints of the scissor trusses.

3.6. Kitchen area - ground floor internally

3.6.1. Vertical cracking noted between the north wall and the west wall of the main hall (see figure 13).

3.6.2. Vertical cracking noted between the south wall and the west wall of the main hall.

3.7. South room - ground floor internally

3.7.1. Historical cracking to the semi vaulted ceiling construction above the modern plasterboard suspended ceiling (see figure 14).

4. DISCUSSION

4.1.1. The hall building is in a fair structural condition. There is considerable evidence of historical cracking within masonry and ceiling elements and masonry to the west elevation is leaning outward.

4.1.2. The diagonal cracking noted to the main hall ceiling and the reveal of the east window are all a result of the movement that has occurred in the west elevation. The historical movement is considerable and a direct consequence of semi vaulted truss configuration of the scissor trusses that form the roof structure.

4.1.3. The scissor trusses appear to be in satisfactory condition and are supplemented with bolted steelwork plates at the eaves junction. However, there is slight opening of the joints between its inclined ties and principal rafters noted and this is indicative of the truss having spread horizontally in the past.

4.1.4. Without a direct connection between eaves levels (the scissor truss ties are inclined) any form of truss will spread horizontally to some degree under the load applied for the roof, as the tension load within the inclined tie is transferred to the principal rafter and the latter bends.

4.1.5. The effect of this horizontal spread of the roof trusses is to push outward at the head of the flanking walls, in this case the east and west elevations. If, however, one of these elevations is more heavy buttressed, such as is the case with the east elevation of the village hall due to the presence of the chimney, the lateral thrust will be applied to the side with less resistance. The west elevation appears to have taken the majority of the lateral thrust from the roof.

4.1.6. The disparity noted between the verticality of the inner and outer facing work is a consequence of the walls original construction. Random rubble walls are effectively two skins of facing stonework, the space between which is filled with smaller section of rubble and lime pointing. Typically this core material is loose and can become mobile and drop when the wall is heavily saturated. The loss of core material at the head of the wall results in the inner facing work moving outward to meet the outer facing work under the lateral thrust from the roof. Hence the wall become thinners at its head than it is at its base.

4.1.7. It would seem apparent that some movement is still occurring periodically given the disturbance noted beneath the most recent redecorations and the degree to which the inner face of the west elevation is out of plumb is considerable. However, given the basic measurements taken on site it appears that the walls mass is still being applied within its middle third of its base width, which indicates the wall remains stable at present.

4.1.8. It would be of benefit during any future roofing works to consider the connection between the roof and the wall head at close hand and perhaps improve its effectiveness through a process of fixing the wall plates down to the underlying masonry.

4.1.9. The vertical cracking between the main hall building and the original entrance hall masonry is simply a result of the added walls not being sufficiently bonded into or tied to the existing when constructed. The historical thermal movements of the added masonry has caused this joint to open further and become filled with debris and therefore not closing. There does not appear to be any significant evidence of vertical movement of foundation settlement.

4.1.10. These joints may be stitched with some resin fixed light stainless steel spire tie fixings and the joint repointed.

4.1.11. A similar form of stitching can be employed around the south elevation window of the entrance hall where the joints between keystone and adjacent voussoirs have opened.

5. RECOMMENDATIONS

5.1.1. Investigate at close hand the connection between roof and wall heads during next programmed roofing repairs/works and implement improved wall plate fixing detail.

5.1.2. Stitch vertical joints between entrance hall walls and main hall building.

5.1.3. Stitch open joints around south elevation entrance hall window opening.

5.1.4. Stitch open crack to east elevation chimney.

5.1.5. Fill deep voids within external north elevation, using reclaimed stonework where possible.

5.1.6. Rake out and repoint areas of masonry bee damaged to east elevation.

5.1.7. Areas of deep re-pointing are required throughout the elevations, these areas should be raked out to a depth of 40mm and re-pointed with a natural hydraulic lime such as NHL 3.5.

5.1.8. Where in excess of 50mm of stonework faces has spalled, these should be cut out and replaced with stonework of similar appearance and texture.

5.1.9. Consider external ground levels to prevent dampness penetrating brickwork above internal floor levels. Ensure all downpipe are positively connected to surface water drains discharge via back inlet gullies to properly designed soak-aways at a minimum of 5m from the existing building.

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APPENDIX A

GENERAL NOTES ON THE STRUCTURAL ASPECTS OF THE BEHAVIOUR AND REPAIR OF OLD BUILDINGS.

Walling

Most problems with buildings with outer walls of stone or brickwork can be attributed to the affects of climate changes.

All commonly used masonry materials will expand on wetting or heating and contract upon cooling or drying. These movements can occur vertically as well as horizontally and if there are no complicating factors tend to show their greatest effects as cracking at the upper corners of buildings.

It will be readily appreciated that a long line of bricks simply placed in contact with one another will increase in length in the heat of the summer. When the following winter arrives each brick will shorten, but the expanded length of the line is virtually unaffected. The increase in length gained is now shared out to form gaps between each point of contact. It can also be appreciated that if debris can get into these gaps during winter, the expansion of the following summer will start from a new datum, and the length of the line will increase still further.

One of the effects of thermal movement is buckling and it is most often found in, yet not confined to, very long walls. As heat rises the upper portions of the wall are usually warmer than those lower down. The only way the wall can cope with these differential thermal movements is to form a curvature. As masonry has little or no tensile strength, the buckling cannot be recovered when the masonry cools. Cracks then develop – usually where an openings reduce the cross sectional strength of the wall. And if debris gets into the cracks, the buckle becomes progressive. The only feature of masonry which can limit this thermal movement is the use of a weak, compressible mortar. With such mortars the expansion of each stones can be absorbed in the compression of the mortar filled joints at each end. As it is rarely possible to introduce expansion joints into historic wall, the only practicable solution is to introduce zones of a low strength material.

Useful improvements in the behaviour of masonry can be achieved by providing continuous ties with frequent connections to it. Such ties are best positioned at the tops of walls either by adding them in reinforced concrete; effectively tying together the separate lengths of wall plates; or by other suitable means. It is useful to make use of the roof loading to keep the tie in contact with the wall it is required to restrain, or to maintain the contact by other means - using a combination of vertical resin fixed ties.

The measures which have been described will always improve and control slightly affected areas, but badly affected places may need special attention - typically the introduction of reinforced concrete stitches or elbows. The purpose of which is to cross across existing cracks to minimise their tendency to keep working. Such stitches and elbows should be carried through the wall to the back of the outer facing masonry and connected both it and the inner masonry, with resin anchored ties.

Built in timbers

Where masonry relies on timber for its support, there will be problems associated with the lack of stiffness, seasonal swelling for drying out, rot and insect damage. It is probably best to plan to remove and replace such elements with a more stable, durable material. In inner walls, it is usually appropriate and economic al to replace with precast pre-stressed concrete lintels, often on a size for size basis. For outer wall, in-situ lightweight concrete with stainless steel reinforcement is better, being less likely to cause condensation problems.

Where for aesthetically or other reasons it is required to retain timbers externally, it is advisable to provide inverted steel angles in combination with the concrete. Note that if angle are not connected to the concrete lintel it will be necessary to provide bearings for them, which a not dependant on the timber members. Suitable details have been worked out and can be provided on request.

Damp proofing walls

Where walls are found to be suffering from the effects of rising dampness. It is important to avoid the idea that they can be damp proofed by covering them with a "waterproof" rendering. It's very common error, and invariably simply causes the problem to mover to zones where the waterproofing ends. If found such waterproofing should always be removed.

Ideally such moisture should be dealt with at source. Leaking drains should be repaired, gullies and gratings which can be blocked by leaves and other debris should be changed to back inlet types, and surface water which runs towards the building should be intercepted and carried away.

If the problem is identified as high ground moisture content, damp proofing course should be introduced. Where outside ground level is above inside, the best solution is the provision of a ventilated dry zone, which should be carried down at least as far at the lowest floor level. Where the soil is damp, as opposed to wet , the provision of a gravel filled trench with a land drain at the bottom, with or without a membrane or vertical filter drain against the building, will often be sufficient.

Floors on solid ground

Solid floors

Floors which are constructed directly on the ground present special problems. Old flagged or quarry tiled floors laid directly on subsoil become troublesome unless they are able to release moisture to the area. They must be able to act in a manner of wicks so that they keep down the moisture content of the underlying sub-soil. Cases have been known when the covering of such floors with impermeable material has caused serious problems with surrounding walling of all descriptions. Cases have also been known where attempts have been made to seal flagged floors to stop rising dampness, and small failures in the sealing has caused the flags to disintegrate locally as a consequence of the sub surface crystallisation of the salts. Generally speaking the status quo is best maintained. If it cannot be, changes which are made must be properly thought through.

Where it is considered necessary to replace existing floor surfaces with new - on damp proof membranes - attention must be paid to the consequences of the increased moisture content that will arise below the membranes. It will almost certainly be necessary to put damp proof courses into walls and beneath structural members.

Repairing materials

General

The materials used for any repair or reconstruction work should ideally be original materials recovered during taking down.

Where it impracticable new materials should have the same characteristics as close as possible to the original, unless the failure is diagnosed as an inherent weakness of the material (as opposed to a weakness resulting from the method of assembly).

Mortars for reconstruction of walls built in lime mortar should generally not be stronger than 1:3:12 cement: lime: sand, but it is recognised that this might not give sufficient durability if built in autumn or winter in exposed locations.

If suitable reclaimed or second hand materials are not available, account should be taken of the effects of introducing new ones. For example, if newly burned bricks are used they will expand during the first few years of their lives as their moisture content increases from nothing immediately after burning, to a normal long term value.. If they are built in shortly after burning, the ,spans ion will occur in their final positions, where large panel of new brickwork must be used and bricks cannot be stacked and left to take up moisture before use and cannot be missed with the originals in a ratio of less than 50:50, then the new work should be detailed to allow for the expected expansion - allow a 10mm clear gap every five metres for safety.

Concrete

When reinforced concrete is refers to, it is considered preferable for the concrete to be made with Lytag lightweight aggregate.

The resulting concrete can if necessary have the same strength in compression as normal grade concrete. It generally has a higher tensile strength, is self curing, is two thirds the weight of normal gravel concrete and is significantly less stiff. The last property means that it's behaviour will be nearer to that of soft compressible masonry than normal concrete. The aggregate material has similar characteristics to a medium strength brick and is similarly capable of absorbing moisture. The combination of better insulating properties and an ability to absorb moisture ensures that lintels are far less susceptible to surface condensation that those of gravel concrete.

Although the aggregate is significantly more expensive, it is unusual to require large quantities for tie beams, lintels and bonders etc and the improvement in properties well outweighs the increase in cost. Besides cost, the main reason why lytag is not widely used as it might be in general structural work is its low stiffness and tendency to creep under load. In normal structures these characteristics are considered undesirable, in repairs of old buildings those characteristics are positive advantages.

Steel for reinforced concrete

Ideally this should always be the best or a good quality stainless steel because the difference in cost between it and mild steel is small in relation to all other costs associated with the work. There are some places where easy accessibility for future repair may make the use of cheaper steels worthwhile.

APPENDIX B

	fig.1 3.1.1 A large void was noted adjacent to the end of the exposed upper slope purlin to the west roof pitch
	fig.2 3.2.1 Evidence of masonry bee damage to either side of the right hand large window opening.

fig.3

3.2.2 A vertical crack was noted in the masonry facing work of the original chimney stack with evidence of considerable historical repointing

fig.4

3.2.3 Diagonal crack over entrance hall doorway (no infilled as sign).

	fig.5 3.3.1 Open pointing to the brickwork within the bellcote canopy and beneath. 3.3.2 Thick historical reporting to the arch construction over main window.
	fig.6 3.3.3 Vertical cracking through brickwork masonry to the left of the door opening

	fig.7 3.3.5 Open vertical cracking to the right of the window opening to the entrance hall south elevation.
	fig.8 3.3.6 Loss of pointing to the keystone to window arched head

	fig.9 3.4.1 Notable outward movement of brickwork masonry over the arch of the right hand window opening
	fig.10 3.4.2 West elevation noted as leaning outward at its eaves level compared to wall base, at its maximum between main pair of window openings.

fig.11

3.5.1 Vertical cracking was noted inside the north elevation corresponding to the reveal of the infilled window opening.

fig.12

3.5.3 Diagonal cracking noted to the reveal of the left hand internal window opening long the internal east elevation.

	fig.13 3.6.1 Vertical cracking noted between the north wall and the west wall of the main hall.
	fig.14 3.7.1 Historical cracking to the semi vaulted ceiling construction above the modern plasterboard suspended ceiling

APPENDIX C

EFFECTS OF CONVERSION PROPOSALS ON THE EXISTING BUILDING STRUCTURE

6. STRUCTURAL PROPOSALS

6.1. The Eardisland Village Hall improvement plan outlines a three phase approach to building alterations.

6.2. Phase I

6.2.1. The wall between the main hall and secondary room was the original south elevation of the building and is likely of a similar construction and formed with random rubble stonework. Consequently any new opening will require considerable temporary works to ensure the inner and outer facing work is stable and that the core material is retained during the action of installing new steelwork.

6.2.2. I would recommend forming any opening with a new rigid steelwork frame, that is, three sets of columns with two sets of beams between. I say sets of beams, as it will require two beams sections side by side to support the inner and outer facing stonework. Consequently two columns are needed at each of the three support locations.

6.2.3. This rigid frame would enable a large opening to be made and ensure lateral stability of the building is maintained.

6.3. Phase II

6.3.1. Extending the hall to the east may be reasonably simple. There are a number of existing window openings which could be taken down to ground level to enable passage through to new spaces.

6.3.2. Consideration should be given to the loss of natural day light within the main hall of this proposal.

6.4. Phase III

6.4.1. As with phase I this option would require considerable new steelwork frames in order to support the existing roof structure.

6.5. Structural Overview

6.5.1. The phase I option is certainly viable from a structural point of view but given the form of the existing building and required temporary works the construction costs are likely to be proportionately higher than a similar modification within a newer building.

6.5.2. You need to consider your budget and how many more years you believe the building will have continued use in order to understand the pay back or return period of any investment such structural works would require.

6.5.3. I can prepare an outline scheme for phase I if required which could then be used to get budget costs against.

6.5.4. Please bear in mind that this building will require considerable ongoing maintenance which will need to be costed in additional to any new works.