STANCLIFFE HOUSE FARM, S35 7DA

STRUCTURAL ASSESSMENT OF EXISTING BUILDING

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YK0024-EMPACE-XX-XX-RP-S-0001
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Title	Structural Assessment of Existing Building
Document Status	Issued for planning
Date	31/05/2024
Prepared By	Ummer Daraz BEng(Hons) MSc DIC CEng MIStructE

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1 CONTENTS

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2 INTRODUCTION

2.1 BRIEF

2.1.1 Empace Consulting Limited have been appointed to carry out a structural investigation of an existing building at Stancliffe House Farm, S35 7DA

2.1.2 Structural Assessment of Existing BuildingThe aim of the investigation is to assess the overall structural condition of a single story shed type building previously used as dog kennels, and to provide an opinion on the feasibility of the conversion of the building to a residential development as proposed by 'Jade 3 Architecture Ltd'.

2.2 INVESTIGATIVE PROCEDURES

2.2.1 Inspector: Ummer Daraz BEng(Hons) MSc DIC CEng MIStructE

2.2.2 Also present: client, architect, and Kieran Walker of Empace

2.2.3 Date of inspection: 10/05/2024.

2.2.4 Weather: Dry, overcast, visibility good

2.2.5 Apparatus used: Digital Camera, tape measure, laser distance measurer

2.3 GUIDE TO THE REPORT

2.3.1 It should be noted that this report was written based on an inspection which was mainly carried out on a visual basis and limited to what was exposed and observable. Some intrusive works were carried out in various concentrated locations, but the majority of the underlying structure was generally concealed. Hence, although the descriptions within this report present opinions on the overall and general structural arrangement, the exact structure cannot be necessarily fully predictable.

2.3.2 It should also be noted that no calculations were carried out during this assessment and the advice given with the report is based on experience and current reasonable knowledge of structural systems. Detailed structural analysis would be required to confirm the adequacy of the existing structure to support itself in lateral stability with a certain degree of confidence.

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2.4 BACKGROUND DESCRIPTION OF THE STRUCTURE

2.4.1 The building in question generally takes the form of a single story shed type arrangement, set in the context of a larger site in a rural location.

2.4.2 It is understood that the building was previously used as dog kennels and a cattery. The age of the building is unknown but appears to have seen various alterations in its history.

2.4.3 The general topography is sloping down from the Northwest to Southeast direction. Hence groundwork is assumed to have been carried out to allow the construction of the building. This can be generally observed in the form of battered slopes and retaining walls around the building.

2.4.4 The building appears to have been segmented into 3 primary sections, each with slight variations in the structural arrangement as described further into the report.

Excerpt from topographical survey with the building in question and overall context of the site

Aerial view from Google Earth, noting the sloping ground and general topographical arrangement.

Southeast elevation view of the building noting the sloping ground.

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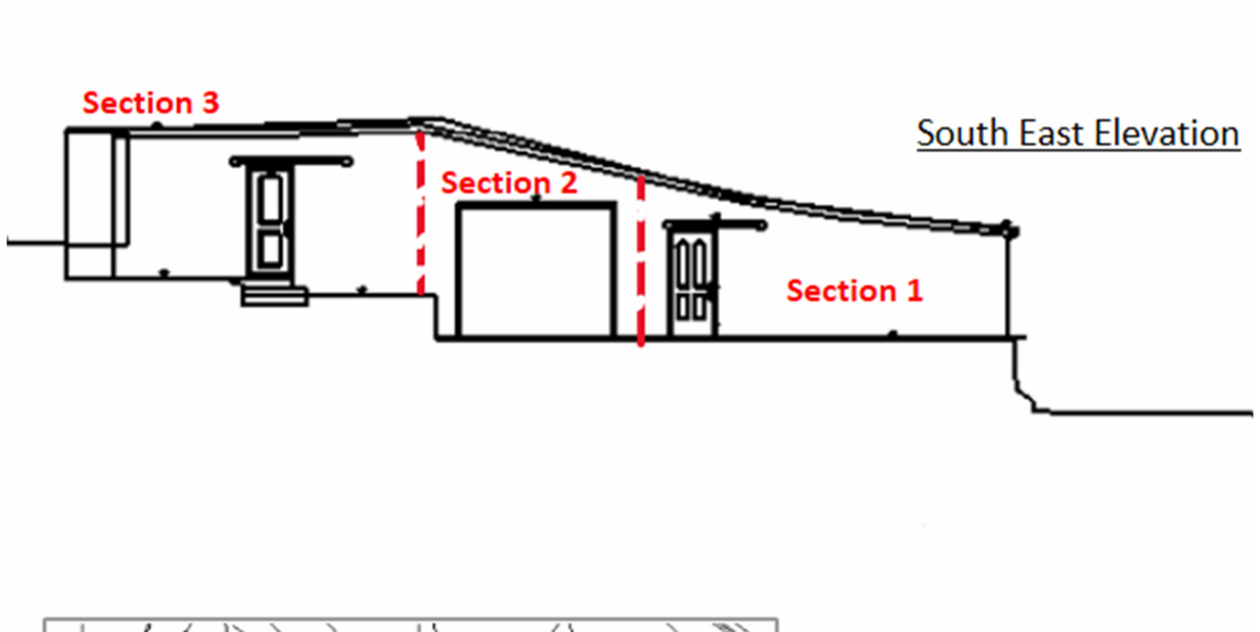
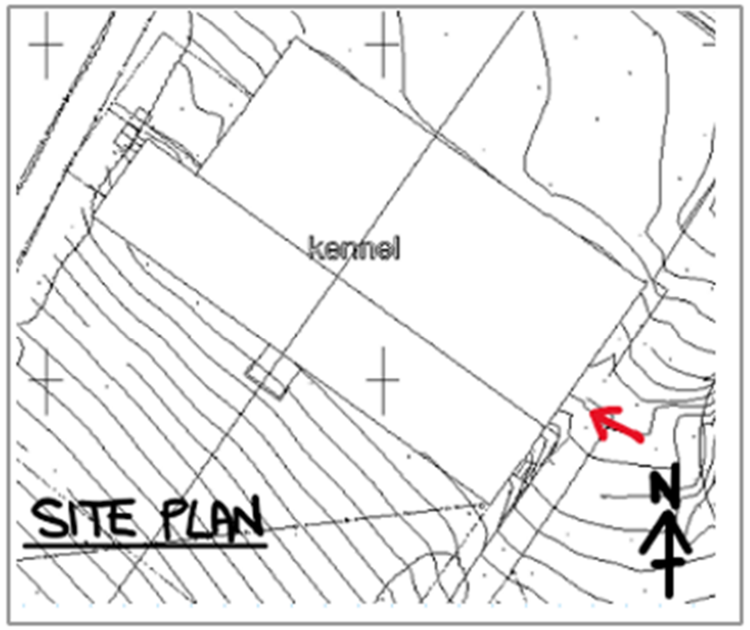
3 REPORT FINDINGS

3.1 GENERAL NOTES

The building appears to have been segmented into 3 primary sections and the following reporting will be based on these 3 segmented sections as indicated below.





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3.2 SECTION 1

Description of the section 1 segment has been provided based on tagged callouts within the images below.

In summary for this section of the building, as per the commentary and description, the presumed current load transfer system appears to be inadequate in all locations except perhaps the timber framed Purlin. However, this too cannot be confirmed to be necessarily adequate without detailed calculations which are beyond the scope of this report.

1. The Element numbered 1 is presumed to be vertically installed composite panels acting as a primary wall support structure. Presumed to be 50 mm thick and comprising light gauge thin metal panels sandwiching an insulation layer, these type of panels are not usually designed to provide primary structural support, and ordinarily utilised as secondary cladding elements. Here, they appear to provide intermediate support to the roof panels which also appear to be of the same construction. Although the panels appear to be in reasonable condition from this side, they are unlikely to be compliant to current regulation in terms of providing vertical wall (axial loading) support and resistance to bending action induced by internal wind pressures.

2. Element numbered 2 is a line of support provided by the vertical composite panel wall. Note it appears that skylights have been cut out within the composite panel without any further significant structural trimming out. These types of composite panels are not designed for creating voids within them as they tend to weaken the structure of the panel. In modern practice, where there are skylights within the roofs, roof composite panels of this type are generally trimmed out around supporting steelwork. Hence, they are unlikely to meet current codes of practice.

3. The roof panels are also then supported at location 3 on a makeshift Purlin arrangement which appears to be built-up to comprise timber framing with sheathing on one side. Although built up purlins are common practice in modern usage, the support provided to the Purlin arrangement below (as marked by location 4 on the image) is questionable.

4. The built-up Purlin above described in point 3 appears to be taking support at regular locations defined by the partition between the kennels. Although the diagonal timber member providing support may not be all that unusual, the connection of the diagonal member into the steel profiled sheet panel is questionable and unlikely to meet current codes of practice. This diagonal member appears to be screwed into a coldrolled folded plate which appears to then be connected by screws to the vertically installed (single layer of) steel sheet panels. The sheet panels also appear to be installed in their weak axis. A close-up of a similar coldrolled folded plate is described below in point 5, as can be seen in the foreground.

5. The coldrolled folded plate indicated by point 5 is similar to a folded plate which seems to be screwed to the vertical steel profiled panels providing support to the built up purlin described in point 3.

6. The vertically installed steel profiled panels appear to be bearing onto a single skin of block work wall with very nominal apparent connection.

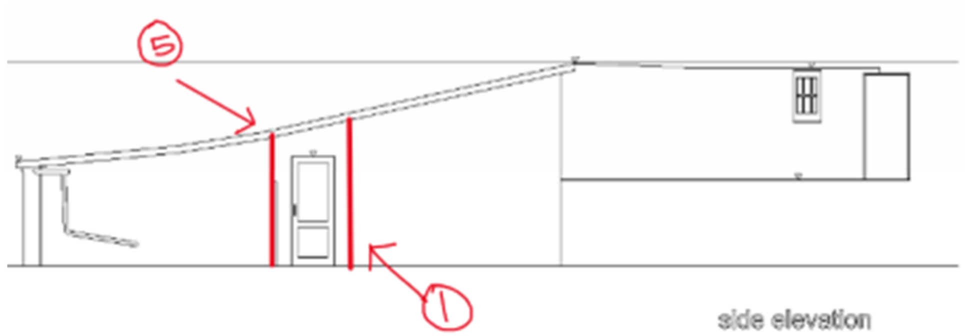
7. This vertical steel profiled panel is noted to be a single sheet of presumably light gauge steel. It also appears to be laid on its weaker axis. This is unlikely to be satisfactory to modern codes of practice.

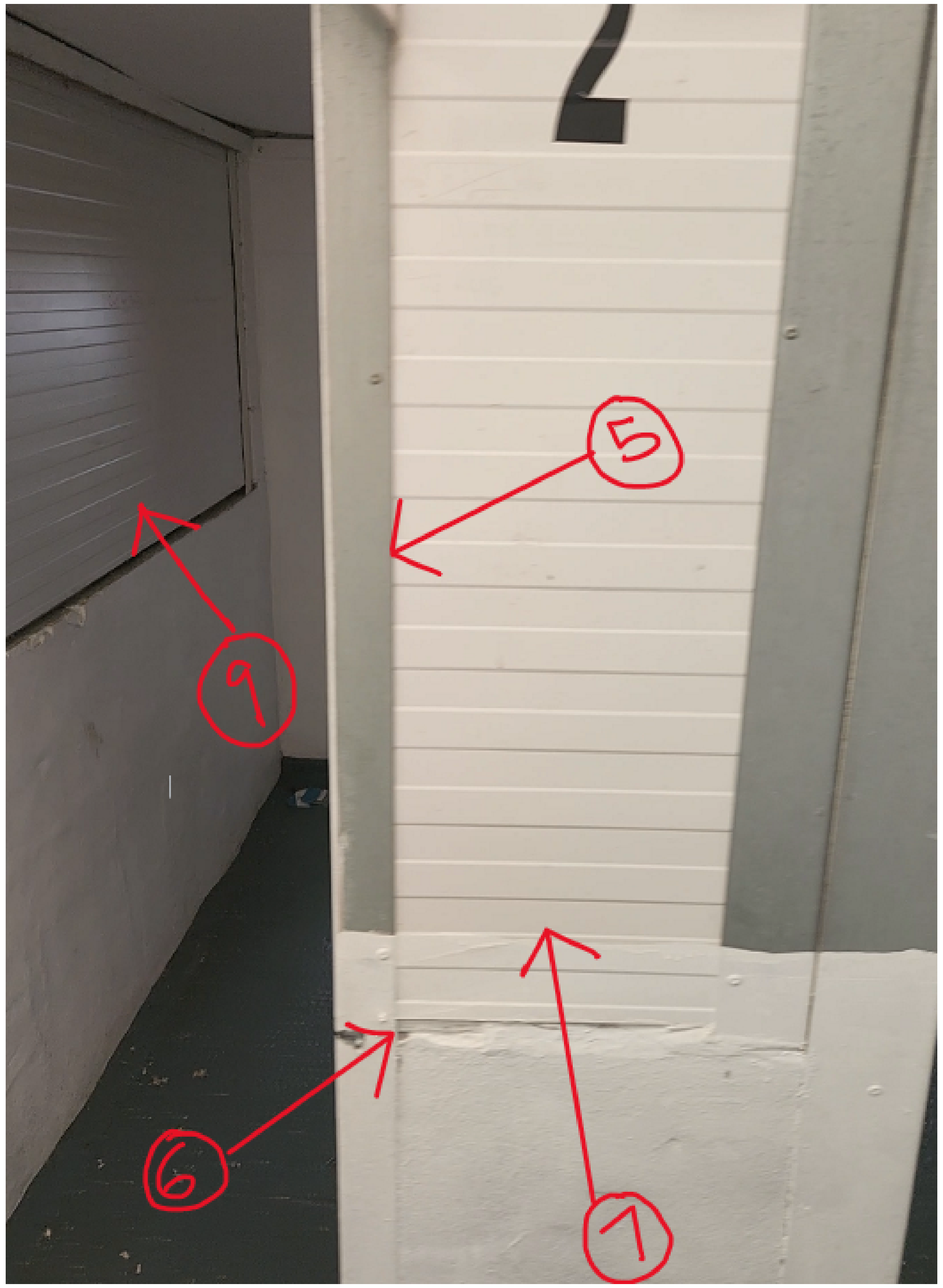
8. This element numbered 8 appears to be a timber rafter, providing intermediate support to a Purlin labelled point number 11.

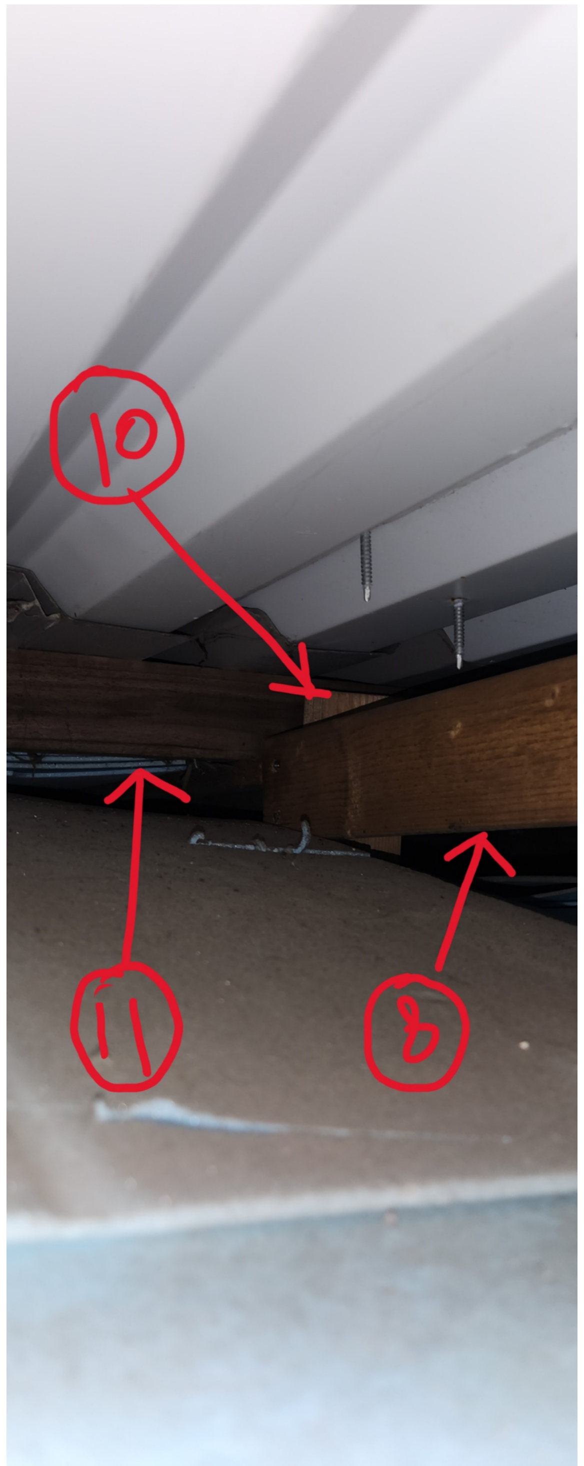
9. This element appears to be of similar arrangement to element 7

10. This element appears to be a timber stud providing intermediate support to the timber Purlin and a number 11. It is presumed to take support from the block work wall below.

11. This timber Purlin appears to provide intermediate support to the profile roof. It looks to be in satisfactory condition and may be acceptable from a structural perspective given that it is a short span. However full calculations would be required to assess the timber section for the load it is required to carry.







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3.3 SECTION 2

In summary for this section of the building, based on the below commentary, we are of the opinion that most of the elements are likely to be compliant to current codes of practice. The exception being perhaps the members acting as purlins, denoted number 4 in the photographs. This is because they are likely to be carrying the lowest load of all the structural elements. However detailed calculations are required to confirm their acceptability. Also to note the retaining wall as denoted number 10 in the photographs may also require further calculations to confirm whether it is compliant, due to its masonry construction there is a possibility that it may not be so.

1. This wall appears to be the same one from the previous images as noted by point 1. There is no evidence to suggest that it is supplemental to the wall panel as seen on the other side. I.e. that this wall is likely to be a single 50 mm thick composite panel as described previously. On this side defects in the walls can be clearly seen. The wall on this side appears to be providing support to light gauge Z shape steel members acting as rafters and are connected to the composite panel wall using an elaborate timber connection which is unlikely to be compliant to current practice.

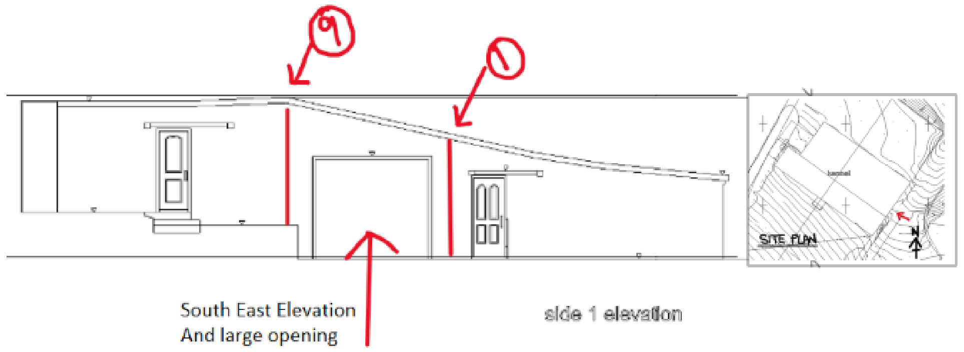
2. The roof panels appear to be of the same construction as those in section 1, i.e. presumed to be 50 mm thick composite insulated roof panels. They are assumed to be spanning approximately 2.4 m onto intermediate purlins and (of similar span) onto the wall support element 1. It is not immediately obvious whether the span of the panel are within code and hence further calculations are required to confirm their acceptability for the span.

3. Cold rolled Z shape light gauge member, 180 mm deep acting as rafter. The elements marked number 4 are purlins connected to these rafters and are presumed to be of the same structural properties, i.e. 180 mm deep Z purlin. These type of members are ordinarily utilised as purlins (secondary support) rather than as a rafter which acts as a primary support. Given that these (rafter) members are spanning about 4.4 m on pitch, and supporting purlins with a tributary roof area of approximately 2.4 m wide by approximately 5 m long (the approximate average spacing between rafters), and taking this amount of loading as a point load, it is unlikely that these rafters are within acceptable structural code and probably require a major upgrade to hotrolled steelwork.

4. Element number 4 is presumed to be of the same section properties as element number 3, i.e. 180 mm deep Z shape Purlin. Most of the purlins are spanning approximately 5 m, except one purlin which is spanning up to 6 m. The tributary area that these purlins are carrying is approximately 2.4 m wide. The 6 m spanning purlin is likely to be unsatisfactory, but the 5 m span purlins cannot be confirmed definitively to be unacceptable, and further calculations will be required to check for this.

5. Element number 5 points to the connection of the purlins to the rafters (with close up images overleaf). From the visual inspection, the connection appears to be very nominal and likely to be unsatisfactory.

6. Element number 6 points to the connection of the rafters (element number 3) into the vertical supports, i.e. the presumed composite insulation panels. There appears to be an elaborate timbered connection constructed to support the rafters onto the composite panels. Although the timbered connection is unlikely to be designed, the likely reason for the elaborate connection is to acknowledge that at the point load from the rafter would be best distributed as evenly as possible onto the vertical composite panels, as the composite panels consist of thin metal sheeting, and would likely to be sheared with concentrated forces induced by nominal metal brackets and screws. These composite panels are not ordinarily designed to support point loads of this type and hence, the timbered connection as well as the general principle of the support of this rafter point load on the wall panels is non-compliant.



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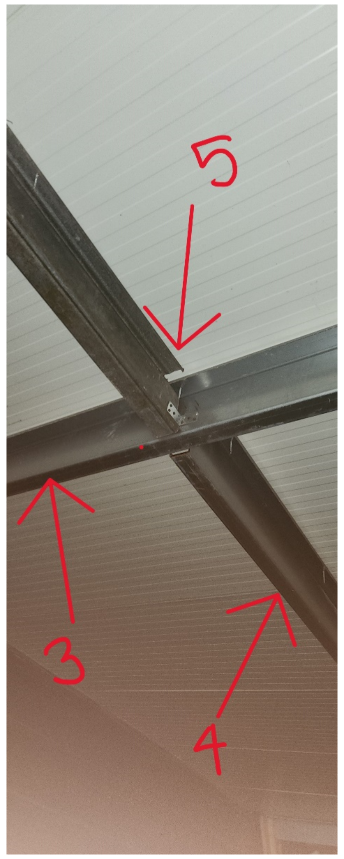

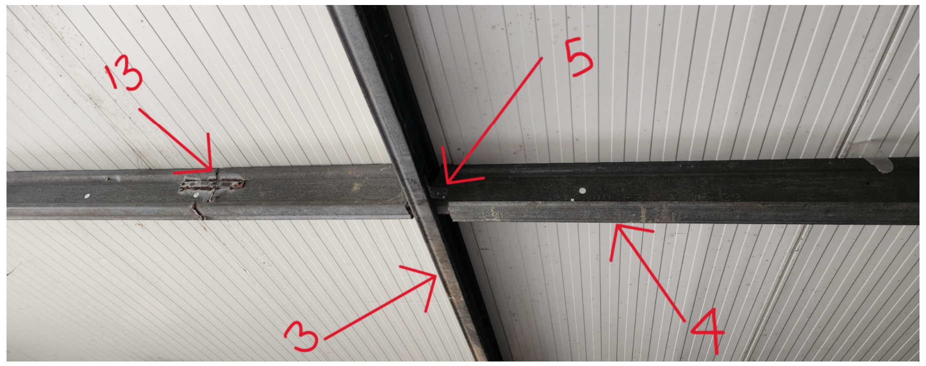

7. In a similar fashion to the previous element, this elaborate connection appears to have been constructed due to the anticipated weakness of the supporting wall. However, in this case the supporting element appears to be single metal sheet cladding/ which in turn appears to be stiffened by some nominal timber stud work. See commentary below in relation to this timber stud work.

8. The elevation to the back of the building (Northwest) appears to have been constructed using timber work. The timber framing then supports what appears to be a single thin sheet of trapezoidal profile metal. This elevation measures approximately 4.3 m wide by 3.9 m high at its highest point. The timber framing is therefore presumed to be acting as a makeshift cladding rail (façade support) arrangement with intermediate timbers. This is clearly inadequate and likely to require upgrading to major structural steelwork to comply with modern regulations.

9. Element number 9 appears to be another composite metal sheet and insulation panel acting as primary wall support to the roof structure, i.e. the rafters noted in element number 3 are connected and supported off this panel. The panel also appears to have been laid on its weaker structural axis, as can be seen by the trapezoidal profile grooves. This was likely for convenience as usually these panels span longer parallel to the stiffening axis, i.e. installing them in their stronger access may have necessitated additional work. As per the commentary in relation to the other vertically installed composite panels acting as walls (noted as element 1), these panels are not ordinarily designed to provide primary structural support and are ordinarily relied upon as secondary cladding elements which require supporting themselves. Hence this wall panel is unlikely to be compliant.

10. Element number 10 appears to be a masonry wall, presumed to be at least 215 thick and acting as a retaining wall, with the retained height of approximately 1.5 m. further investigation will be required to confirm the acceptability of this wall, in the first instance exploratory work to establish its thickness and whether there is any concrete composition involved. It is likely though that given the construction of the rest of the structure, it is probably not designed structurally and may not be compliant. Indeed masonry only walls with such a retained height do not generally comply.

11. Element number 11 appears to be some benching formed in front of the wall. The purpose of this is unknown but it appears to step along horizontal markings in the slab (which appear to have been left from previous partitions). Hence it is unlikely to carry out a structural purpose and may have been constructed for the utility of the space.

12. Element number 12 points to remnants of presumed previous blockwork partition walls.

13. Element number 13 is not shown in the main image and can be seen further down. It points to an apparent 'splice' connection to join together two pieces of the Z shaped the purlins. This connection is immediately apparent to be non-compliant structurally.

14. As per the northwest elevation, the south-west elevation appears to consist of a similar structural arrangement, comprising timber framing to support a single trapezoidal profile metal sheet.

15. Element number 15 points to the opening and roller shutter doors into this section. Ordinarily the structural design of an opening into an elevation would be trimmed out by vertical rails or hotrolled steelwork (connected to a primary steel rafter at the head) with the provision for support for roller shutter doors. However, this arrangement is clearly non-compliant as there doesn't appear to be any significant trimming structural support to the opening.

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16. Element number 16 points to the edge rafter again consisting of the coldrolled Z section member. However this member is further weakened by what appears to be a non-compliant splice connection at the location of the pointer.

17. Element number 17 is in reference again to the roof panels.

3.4 SECTION 3

This section of the building follows a similar pattern of construction and largely assumed to be not designed structurally. Note that the reference image is not current, and the kennels are now vacated but the current structural arrangement generally is as indicated in this image.

1. Element number one are the roof panels as presented in the other two sections, i.e. comprising of presumed composite metal sheet and insulation arrangement. They are spanning approximately 2 m across from the external façade support (denoted number 2) and the intermediate support provided at element numbered 5. Across then beyond this support is the wall panel numbered 9 in the previous section.

2. Element number 2 denotes the location of the roof panels being supported on the external elevation, and in certain locations as indicated here, appearing to sit directly onto the window framing. The window framing is unlikely to have been designed to take this loading, and hence a non-compliant arrangement.

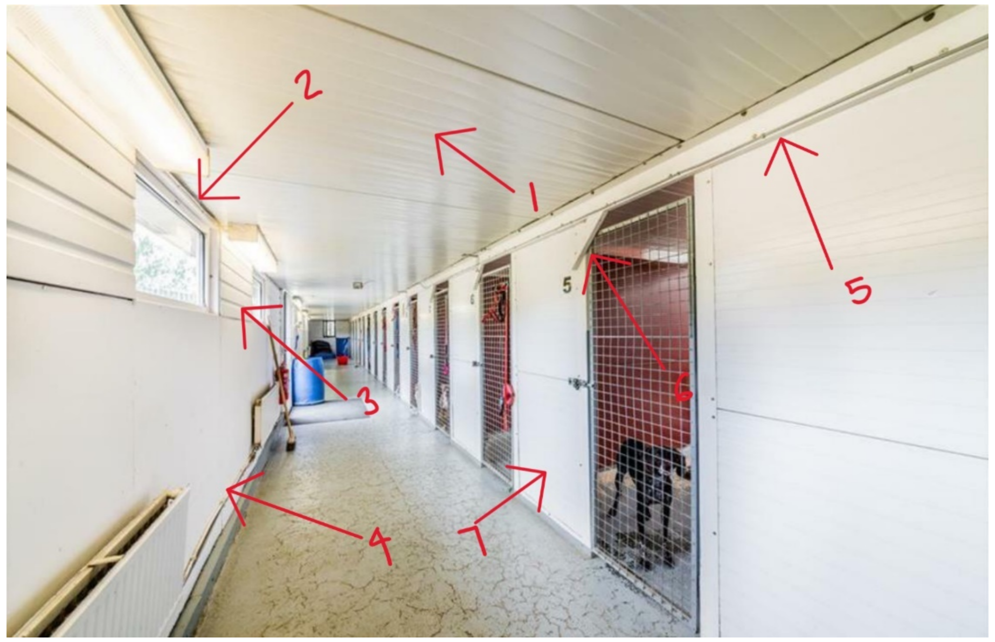
3. element number 3 denotes a part of the wall comprising apparently more insulated composite panels acting as vertical primary wall supports to the roof, also installed in their weaker axis. As discussed previously these panels are not ordinarily designed to provide primary structural support and hence a non-compliant arrangement.

4. Element number 4 denotes what appears to be blockwork walling constructed to the underside of the windows. Although the block work walling will be providing substantial structural gravity support, it is unlikely that the walls are compliant as they don't appear to be restrained at the head with any substantial steelwork. Partially built block work walls (also known as dado walls in portal frame sheds) usually require restraining at the head and are generally also not used for primary structural support as it appears to be in this case.

5. Element number 5 is providing intermediate support to break the span of the roof panels. It appears to be a similar arrangement to that described in element number 3 in section 1, i.e. a makeshift Purlin arrangement which appears to be built-up timber framing.

6. Similar to the arrangement described in section 1, element number 3, the Purlin noted above then appears to be taking support at regular locations defined by the partition between the kennels. Although the diagonal timber member providing support may not be all that unusual, the connection of the diagonal member into the steel profiled panel is questionable and unlikely to meet current codes of practice.

7. Element number 7 appears to be a non-compliant full height composite panel again laid on its weak axis providing primary structural support as well as acting as a partition wall.



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3.5 TRIAL PITS AND FOUNDATIONS

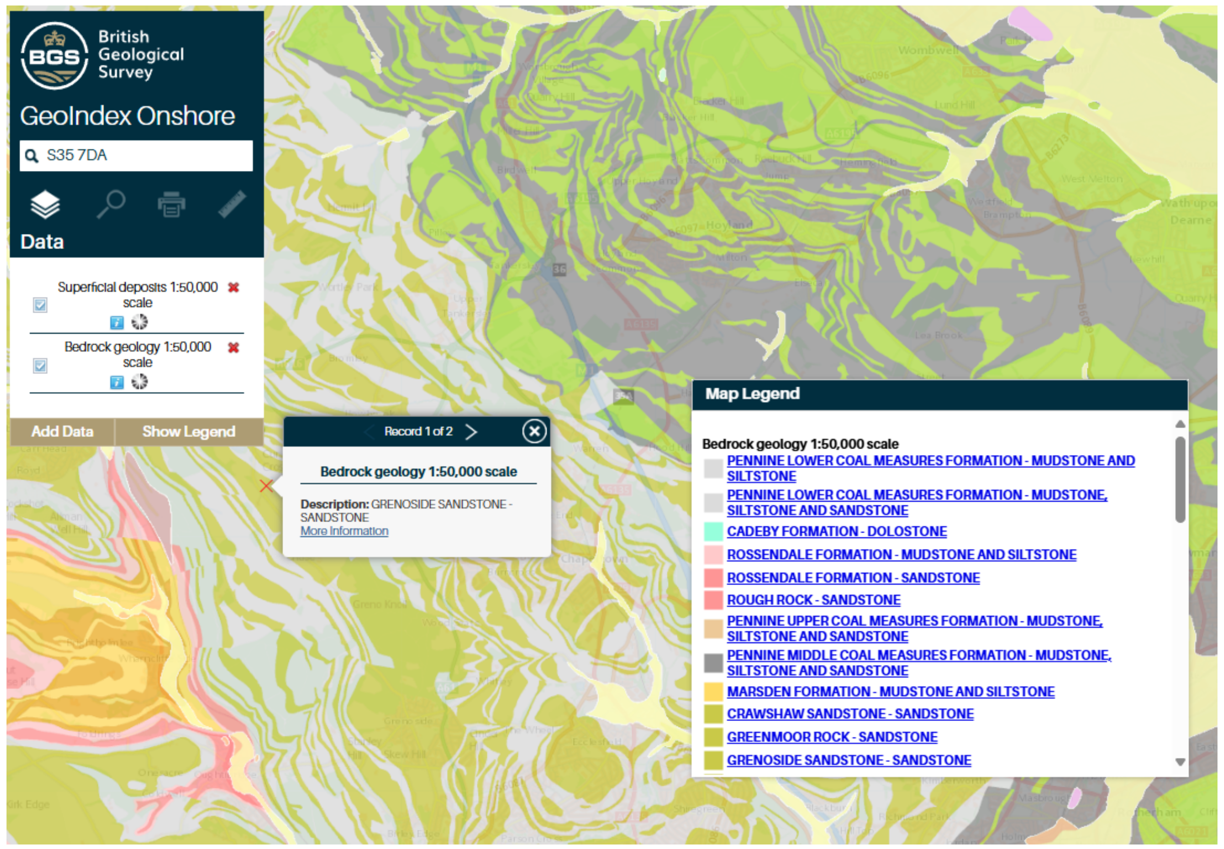
3.5.1 Trial Pits and Foundations

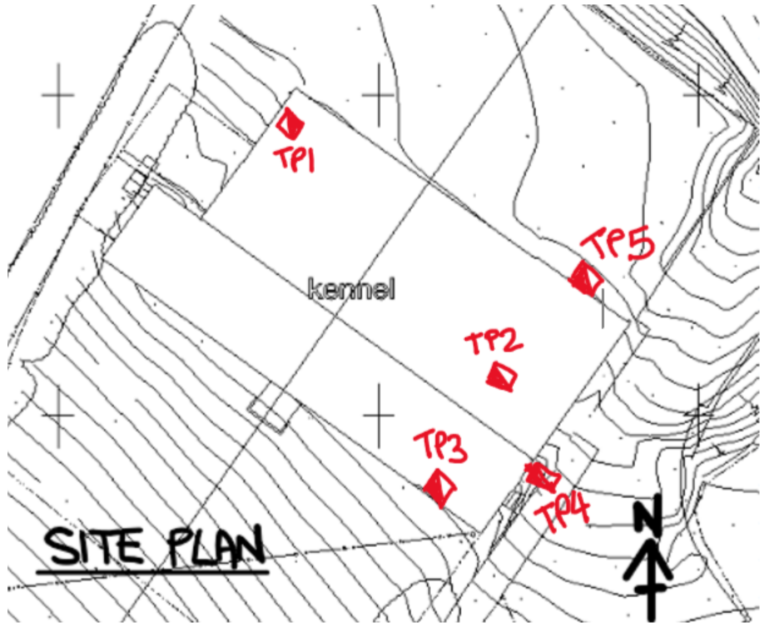
Trial pits were dug at various locations internally and externally around the site to ascertain foundation details and ground conditions.

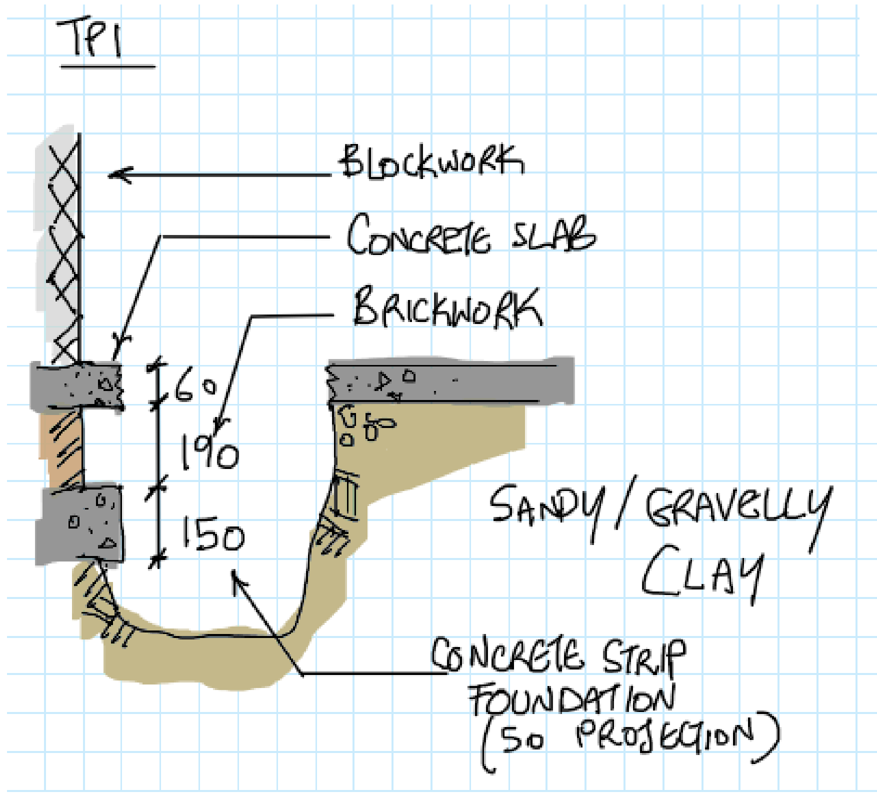
The observations indicated that the ground conditions are typically sandy/gravelly clay down to an approximate 1 to 1.5 m depth as observed in the various trial pits. There were signs of pieces of rock which would indicate potential rock further down. Indeed records from the British geological survey indicate sandstone bedrock in the locality as indicated in the image below.

The foundations were found mostly to consist nominal concrete strips in most locations including the internal retaining wall dividing sections 2 and 3 as indicated in the report.

Generally, the existing foundations are unlikely to be suitable for any modernisation of the existing arrangement. Indeed, they are likely to be inadequate or compliant to support the *current* structural arrangement. As discussed in the previous sections, a building of this scale ordinarily requires substantial supporting framework, usually steelwork which then necessitates at the very minimum mass concrete pad type foundations for columns of significantly larger sizes than the current arrangement. In a modern compliant steelwork portal shed arrangement (which would be the usual for this kind of building) there may be strip foundations present only to support non-structural short dado walls which act as cladding in between the primary structural steel framing.







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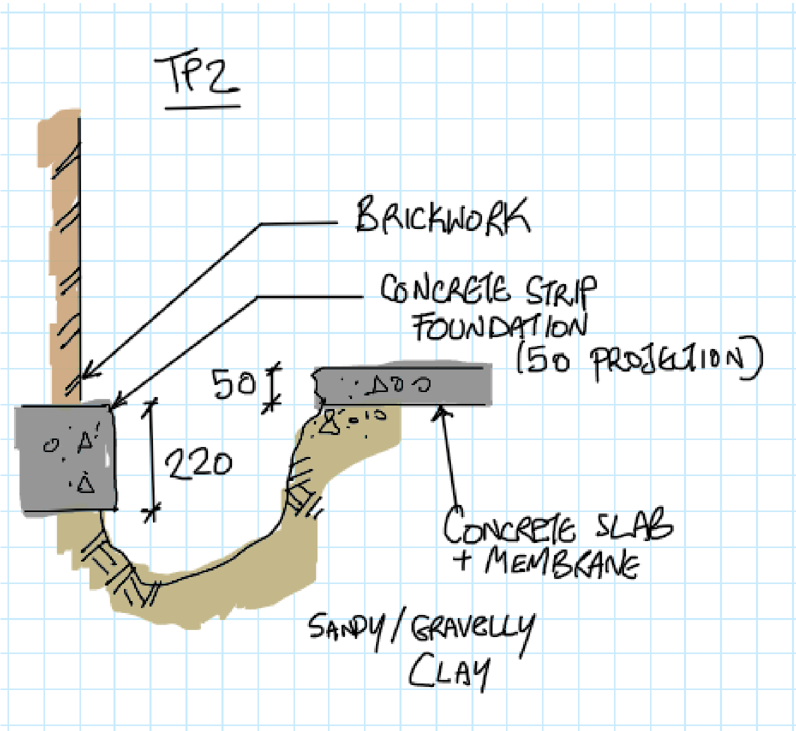

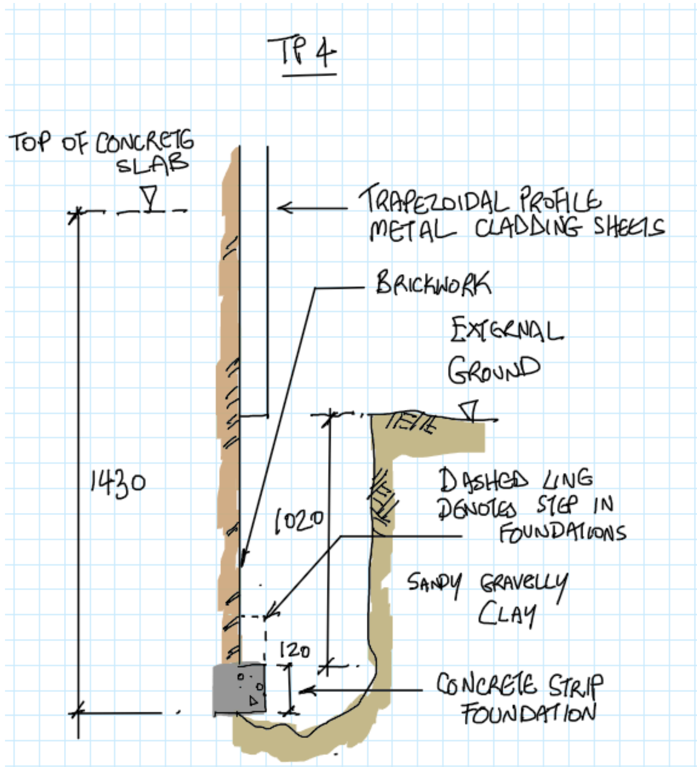

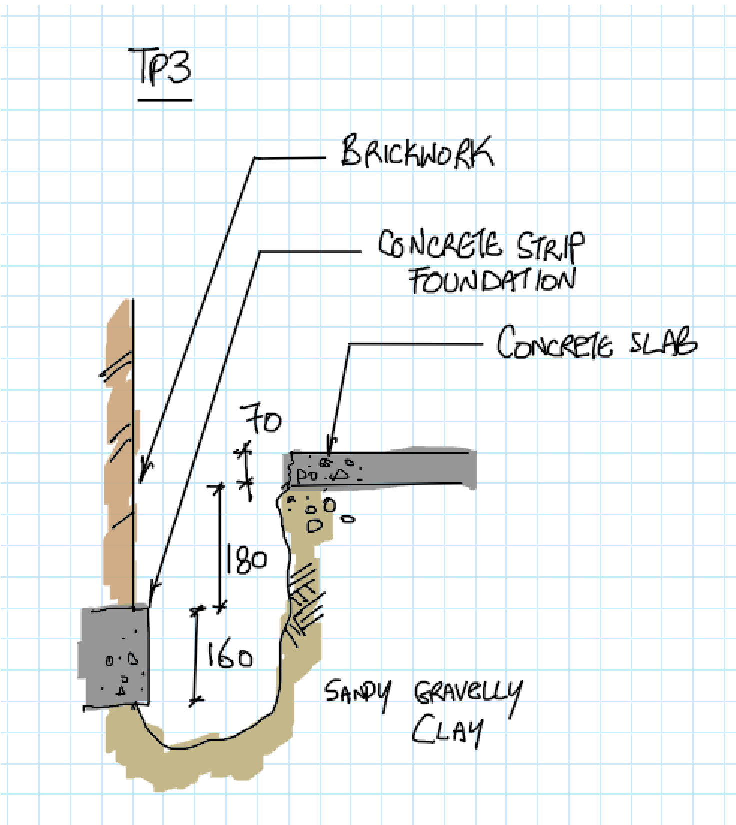

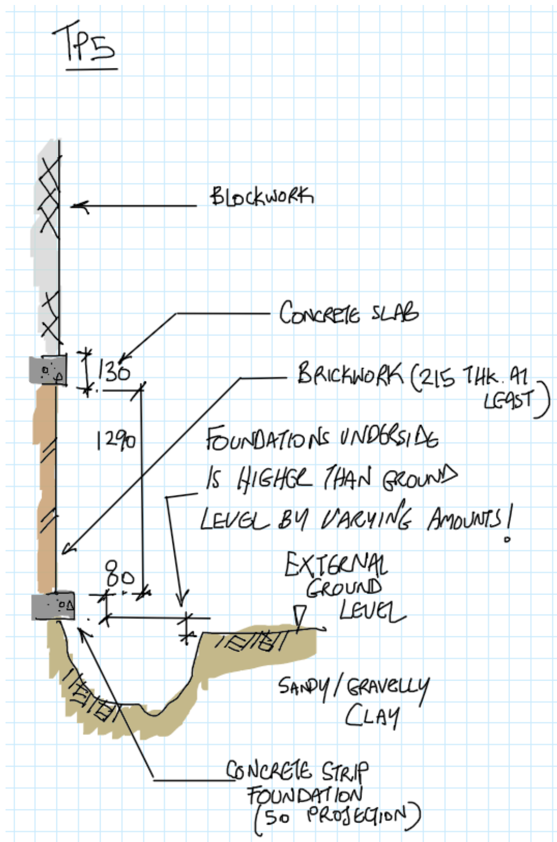

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3.6 OTHER OBSERVATIONS

3.6.1 Soil washout under Northeast Elevation

The north-east elevation displayed signs of soil wash out from under the foundations across its entire length. As can be seen in the image below and as indicated in trial pit number TP5 the underside of the foundation is actually at a higher level than the adjacent ground level.

Presumably, in order to avoid undermining the foundations under the building, it appears that timber shuttering was installed to confine a strip of adjacent soil due to the difference in levels. This indicates that the ground level adjacent was indeed likely to have been reduced either during construction of the building or after.

The timber shuttering as can be seen in the image has badly degraded to the extent that it has collapsed, and this has subsequently allowed the soil to migrate and wash out under the stepped strip foundation.

Although this hasn't led to any significant collapsing structure, it is an unstable situation which would require attention at the earliest opportunity to remediate. Indeed at the far end of the elevation it can be seen that the corner of the building has begun to subside as indicated by the stepped cracking in the images below.

3.6.2 Thermal cracking

It is quite apparent that, there are no movement joints in the building. Ordinarily masonry requires movement joints at regular spacings. I.e. no more than a 6m horizontal length of blockwork and 9m of brickwork should be constructed without introducing a movement joint.

The lack of the movement joints has forced the building to create its own movement joint in the form of a vertical crack located at the longest continuous blockwork wall in the building, i.e. the Northeast elevation. The crack can be seen in the images below and runs vertically from the top down also including the brickwork wall below.

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4 CONCLUSIONS

4.1 The inspection and report contained herewith provide a detailed opinion on the current structural arrangement of the building on site which we believe is representative of what was observed on site.

4.2 Generally, the existing structure appears to comprise an inadequate overall framing system for the scale of the building. Indeed it appears that there is a distinct lack of substantial structural support system and that the primary framing system for the overall building relies mainly on cladding panels. It is our opinion that it is unlikely that the building would pass lateral stability checks against wind due to the absence of any significant lateral stability system, or indeed vertical gravity support checks against snow or snowdrift. Hence, it is apparent to us that the structure has unlikely undergone any actual structural design originally.

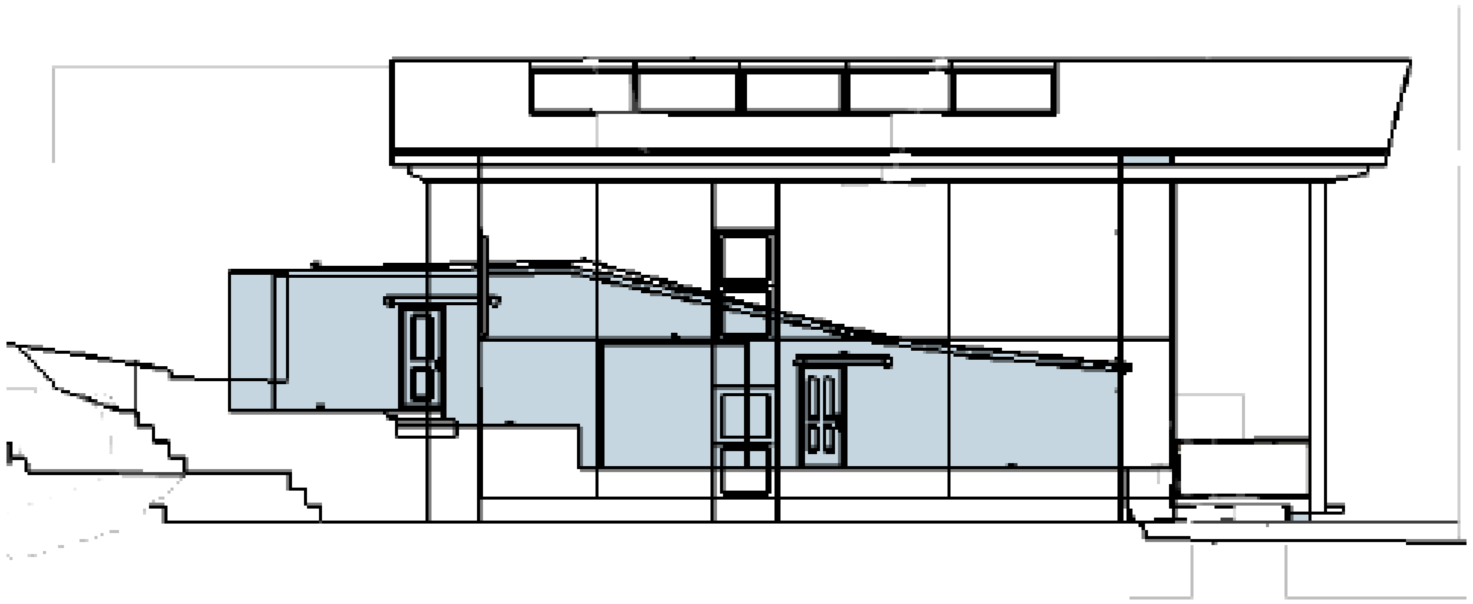
4.3 The building appears to be currently relying on lateral stability presumed to be provided by inherent nominal diaphragm type stiffness as a result of the wall and roof panels composed of a mixture of trapezoidal profiled sheets and metal sheet composite panels, with peripheral light gauge steel work acting as purlins and rafters, along with (inadequate) timber façade framing to elevations providing lateral support against wind loading. Some of the internal block partition are also likely contributing to the overall stiffness.

4.4 In conclusion therefore, we are of the opinion that (with a few noted exceptions) most of the existing structure inspected by us is currently unlikely to be compliant with modern codes of practice and will therefore probably not meet minimum building regulations safety standards (in reference to part A of the building regulations).

4.5 In order to bring the structure up to current acceptable minimum safety standards, structural intervention to the current building will involve substantial and significant alterations. Indeed we are of the opinion that the intervention would likely take the form of new and modern hot-rolled steelwork (as opposed to the light gauge steelwork seen in certain parts of the building), comprising steel columns and beams generally, but also (importantly) requiring new foundation works consisting of mass concrete 'pads' for any new columns. The foundation works are likely to be quite involving and taking a significant form in terms of overall size and depth required for excavation. This means that certain parts of the structure would be required to be essentially 'underpinned' to allow for the installation of new foundation works. However, so far the commentary in this paragraph relates to bringing the existing structure back into modern acceptable standards. With the plans for the site, the proposals would necessitate significantly more steelwork structure and indeed render most of the existing structure redundant. Hence the feasibility of the retention of the majority of the existing structure is questionable from an economic and sustainability point of view.

4.6 Also to note significantly, the Northeast elevation of the building is experiencing soil washout under the foundations and requires attention at the earliest opportunity to stabilise the existing building.

4.7 Hence, based on the above, it would be difficult to see an argument for the retention of the majority of the building in consideration of aspects such as economic feasibility and indeed sustainability impact.



Outline of proposed development overlaid over the existing building shading in grey.

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