JASPER KERR
CONSULTING

OVINGHAM FIRST SCHOOL

Structural Engineering Report

Structural report into the integrity and condition of the existing building, based on visual inspection and isolated outline calculations.

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Ovingham First School, General Condition & Serviceability

Structural Inspection

Introduction

On Friday 13th November 2020, Simon Brent of Jasper Kerr Consulting Engineers visited site at Ovingham First School at the request of Kristian Forster of d3 Associates (Architects), to carry out a visual structural inspection of the existing building. Concerns had been raised regarding horizontal deflection to wall panels, particularly on largely glazed elevations where issues of unopenable windows were developing. There were other isolated concerns, such as possible localised settlement and cracking, which were inspected along with a general survey of the wider structure.

The inspection was accompanied by Nick Hogg, Caretaker for both Ovingham First School and the nearby Middle School, who provided access where necessary and identified specific areas of concern. Kristian Forster of d3 Associates also accompanied for the initial site walkover, to provide his input and ensure that areas of concern were suitably addressed.

The inspection was purely visual, with no intrusive works carried out. Condition and form were assessed based on the elements that could readily be viewed, as well as engineering judgement regarding spans, dimensions and general condition. Where possible, individual elements were measured on site and basic calculations carried out. The purpose and limitations of such calculations are expanded upon further in the relevant section of this report.

The ultimate intent of this report is to draw conclusions regarding the suitability of the existing structural frame, as well as highlighting any serious or immediate areas of concern.

Figure 1 - Ovingham First School, showing the junction between an original and a relatively new element of the building.

Observations

The primary structural frame of the building appears to be of timber construction. Internal walls are assumed, in some areas, to be constructed from load-bearing stud, due to the observed spans. There are two areas where extensions have been built relatively recently (within the last five years), and these utilise structural steel at least in isolated locations.

In some areas, wall panels are largely glazed. Upon inspection the regularly-spaced structural timber posts seem undersized for the vertical span and area of glazing restrained. Only slight pressure being applied to these posts resulted in noticeable deflection, and it was stated by Mr. Hogg that many of these windows had begun to exhibit difficulty in opening; this was tested and verified on site. On the external wall of the Main Hall this issue was also immediately evident, with seemingly-undersized posts and excessive deflection. These posts were available for measurement in several locations, meaning simple calculations could be carried out to determine their capacity. Without even applying any pressure, it was evident from the shape and form of the PVC frames, that excessive lateral deflection had occurred in this wall panel.

On the eastern elevation of the school, an external timber lean-to has been constructed, with primary timber posts immediately adjacent to the perimeter of the main building. The two frames appear to be structurally independent, meaning no additional load is applied to the above-ground structure of the building as a result of the construction. There are, however, localised signs of compression or settlement at the base of the timber columns framing out the external door of the main building. Mr. Hogg has previously carried out a localised trial hole (since back-filled), and photographs of this prior investigation seem to indicate very shallow foundations beneath the main structural frame, as well as an excavation for the new posts which extends down below the formation level of these original foundations. It is considered feasible that the excavations carried out for the installation of these posts undermined the existing concrete strip foundations and caused localised settlement.

Some cracks were observed to the ceiling of the classroom to the far South-East of the building, including alongside the rooflight (which, in itself, is significantly larger than would be expected in a building of this construction type). Based on the timber frame observed across most of this building, it is considered likely that the members supporting the edge of this rooflight may be over-capacity and therefore deflecting more than standard limiting values, therefore causing the cracking to the ceiling. Due to the solid ceiling, the structural members of the roof were not available for physical inspection.

There were several locations within the building where clear spans seemed large based on the form of construction and individual member sizes observed. It should be noted that neither the roof structure itself, nor the loading applied from above, was accessed for inspection, aside from small access hatches which determined only the span direction in isolated locations. For this reason, no explicit concerns are raised here, but the structural members observed elsewhere give at least some indication that the roof structure itself may be under-designed. This problem can be exacerbated over time with long-term deflection of timber ("creep"), causing ponding of water and therefore additional load. Again, the top surface of the roof structure was not accessed, so these concerns are based purely on experience and engineering judgement.

In some locations, PVC panelling was sufficiently loose to allow inspection of timber posts and sole plates. Some signs of damp and localised damage were evident, which would be detrimental to the capacity of the structural elements. These instances were not sufficiently serious to cause immediate structural concern, however they will deteriorate further over time and continue to degrade the integrity of the structural frame.

Calculations

Where individual members were available for on-site measurement, calculations have been carried out to determine their capacity. It should be noted that modern standards of analysis and design have been applied, and it is frequently the case that otherwise-satisfactory historical buildings are shown as being inadequate when such codes are applied. This in itself should not be a cause for concern, and the conclusions of this report give appropriate consideration to this fact. It is also necessary to consider that several assumptions have been made in the completion of these calculations; grade of timber, connection details and roof build-up are all items that are not known and have been afforded reasonable assumed values in the analysis carried out. Nevertheless, when viewed alongside the visual inspection, and with appropriate engineering judgement applied, the results of these calculations can give worthwhile insight into the capacity and suitability of individual members.

The regular timber posts, measured in multiple locations around the perimeter of the building, were analysed both as Grade C16 and as Grade C24 (the two most likely grades of timber used in the original construction). Detailed wind loading analysis was carried out in order to determine the possible wind gust loadings applied in the school's specific geographic location and altitude, with such loadings being applied to all external members analysed during this report. These particular members were shown to be susceptible to significant deflection, way in excess of normal design limits, and certainly beyond the limits which should be applied to members restraining glazing. This was true whether the members were Grade C16 or Grade C24, and the result is as expected, based on the observed size of the members and the noticeable deflection under manual pressure. Another important result of this analysis is that the columns are susceptible to failure through combined loading (axial compression through vertical loading and bending through wind loading) and also in overall member stability. Again, this is true of both Grade C16 and Grade C24, although Grade 16 analysis also shows the members to be susceptible to failure purely through horizontal loading. As mentioned previously, a failure to modern standards of analysis does not necessarily cause concern, however the degree to which these calculations indicate possible failure, particularly in the Grade C16 timber (which is perfectly plausible as being the actual constructed timber grade), indicate that these members are under-designed and may be at risk of localised structural failures.

The timber columns on the glazed external elevation of the Main Hall are of a slightly larger cross-sectional size than those mentioned previously, however they restrain a significantly taller section of wall. The results of the analysis are similar to those of the regular timber posts, except that the degree of failure is more significant, and even the Grade C24 analysis shows the members to be susceptible to failure even in purely horizontal bending. The result of this analysis is that the existing timber posts on the glazed elevation of the Main Hall are under-designed and may be at risk of localised structural failures.

The final calculation carried out was on the internal columns supporting the Main Hall roof. There were two columns evident, on internal elevations, and they were sufficiently visible for on-site measurement. It should be noted that the assumptions made regarding roof construction and high-level loading are more critical in this calculation, and relatively low values have been assumed, however these members do not indicate susceptibility to structural failure even when assuming the lower, C16, timber grade. This calculation is not sufficiently informed to definitively conclude that these members are structurally sufficient, but it does not raise any specific concerns.

Conclusions

The fundamental conclusion of this report, based on physical inspection and verified by calculation, is that the primary structural frame of this building is beyond its serviceable design life. This assessment is expanded upon below, but it is considered likely that the original design intent for this building was for a semi-temporary structure only, with a limited lifespan.

The calculations carried out, particularly on the perimeter members, clearly raise concerns regarding the structural capacity, however it should also be considered that the building is likely to have experienced significant wind loads over its design life, and has not shown signs of failure (other than in serviceability) up to this point. In conclusion, this report determines that the perimeter members of this structure are not fit for purpose and should be strengthened or replaced. Based on visual inspection only, the building is not considered to be at immediate risk of collapse, or even localised failure, but these members should be rectified as soon as reasonably practicable. These under-sized members are the most likely cause of the malfunctioning windows at the school, which are not suitably restrained by the primary structure, however this is considered to be a serviceability issue and not the primary concern of this report.

There are no significant indicators of likely structural failure either in the roof structure or the foundations, however it should be noted that very limited visual evidence was available to verify this. The exception to this is the eastern elevation, adjacent to the external lean-to, where there seems to have been localised settlement as a result of undermining from the installation of the external posts. The ceiling cracks mentioned earlier in this report are likely to be from deflection of individual members rather than imminent failure, and although this may raise the possibility of ponding and therefore overloading at roof level, this is only speculation at this point.

Recommendations

It is a strong recommendation of this report that the primary timber posts on the glazed elevation of the Main Hall are replaced by new members which are capable of resisting appropriate levels of vertical and horizontal load.

It is also recommended that the vertical posts on other glazed elevations around the building are either replaced or strengthened.

Where the timber lean-to abuts the main building, localised trial holes should be carried out at column locations. These are anticipated to establish that the newer, external timber posts extend down further than the original foundations, and in such instances localised underpinning should be carried out in order to stabilise the foundations.

It may be considered beneficial to carry out a larger-scale, intrusive survey of the building, which could assess the roof structure, foundations and horizontal stability of the frame. This would be a relatively time-consuming and intrusive process, which is likely to identify similar issues to those covered in this report, on a wider scale. For example, it is likely that roof joists will be deemed as under-sized based on modern analysis methods, and the foundations may also be deemed inadequate. This is of course conjecture at this stage, with intrusive works not yet having been carried out. Such works could be targeted to some degree, carrying out intrusive works in isolated locations, but some level of estimation or engineering judgement would always be present due to the lack of complete existing structural information.

No remedial works will exacerbate the issues identified here, and they could be carried out in isolation in order to extend the design life of the building. It is difficult to quantify the remaining lifespan of the building if left unattended, particularly as it has already exceeded its serviceable life, but the isolated

repair works mentioned in this report will extend this current design life, although again, the exact time-frame by which they would extend it by is impossible to specify.

Ultimately, the extent of required repairs already identified, along with those which may be highlighted through further intrusive analysis, should raise the possibility of developing a complete new-build school. This will of course be a decision which will have to consider multiple factors, and should be considered between all relevant stakeholders.

We will be more than happy to assist in the development of further investigation works, or indeed with detailing specific remedial works, and if it would be beneficial to discuss any items further, either over the phone or in person, we will be happy to do so.

We trust we have addressed your requirements correctly but if you have any comments or queries please do not hesitate to call.

Yours faithfully,

[redacted]

Simon Brent MEng CEng MIStructE– Senior Engineer, Jasper Kerr Consulting Engineers Ltd

Images

Figure 2 – Glazed elevation of the Main Hall, with timber posts significantly undersized to restrain the windows over such a span.

Figure 3 - Typical elevation, with some largely-glazed elevations containing insufficient timber posts to suitably restrain the wall.

Figure 4 - Timber lean-to, installed relatively recently, adjacent to the main original building frame.

Figure 3 - Door frame immediately inside the timber lean-to, showing apparent signs of settlement.

Figure 6 - Cracks to the ceiling of the South-Eastern classroom, adjacent to the long-spanning rooflight.

Figure 7 - Timber sole plate at the base of an external wall, showing some signs of deterioration.

Figure 4 - Localised damage observed to the base of a structural timber column.