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and Associates

Report
To
Department of Housing and Works
On
Deanmore Primary School – Status of Building Deterioration.

Issue 26/06/2007

Introduction:

As instructed, J. S. RYAN AIT MIEAust CPEng attended the site on 14th June 2007. A brief was discussed on site and confirmed. The general purpose of the investigation was to provide a structural overview of the status of the buildings based on the visible items of deterioration identified.

Ian Weston from DHW was present along with Richard Murray from Ronley Holdings who is currently involved in some corrective action and was available to remove covering to expose structure where necessary and practical for the purpose of this exercise.

The site is taken her to face east to Deanmore Road for purposes of reference in this report.

Any dimensions provided are for the purposes of description and analysis only; any works should be based on site measurement.

Methodology:

The methodology adopted for this investigation was:

Some drawings of the original construction were provided and perused. The structural systems adopted were noted where they were clear from the drawings.

A general inspection of the external surfaces and some internal areas was undertaken.

Items of deterioration were pointed out.

Sample structural maintenance work in progress was exposed and inspected. This was on the east side of the administration building.

The general condition of the buildings was assessed and the structural significance of the items of deterioration identified was assessed.

Drawings:

The drawings provided were incomplete and some were duplicated.

The oldest of them were undated but were stamped "Revised 1966".

Another part set was dated February 1966 and shows 8 classrooms in both the north and south blocks including four future classroom, one on the west end of south block and three on the west end of north block.

There is a part set dated September 1973 of additions and alterations including the library resource centre.

As regards structural engineering drawings:

There is one structural drawing for the library resource centre which appeared to be generally as constructed.

Structural information on an architectural drawings relating to the classroom blocks but it was not an accurate representation of the "as constructed" building, the column system is different.

Drawings prior to 1973 refer the campus as North West Scarborough Primary School.

The drawings were useful for the purpose of a general overview, but not in detail.

Description:

There are several building types with different structural systems applied, all are single storey.

The classroom blocks are mid-sixties construction. They have a structural steel frame spanning across, with timber purlins and a metal deck roof. The metal deck roof is relatively recent and we were advised that asbestos was replaced by the metal roof. The side walls are pre-cast concrete panels with exposed quartz aggregate finish, timber framed windows with light weight sheeted panels, or a combination of these. The end walls were double skin brick. We are advised that the classroom blocks were constructed in two stages which is also indicated on the drawings, but the construction is the same and the transition is, for all intents and purposes, seamless as regards structure. The classroom blocks are described as north block and south block.

There were covered walkways on the sides of the classroom blocks which appeared to have been added at a later time.

The administration building on the east side of the campus has a similar wall structure as the classroom blocks. The drawings imply a different roof structure, but that is not confirmed.

There is a more recent covered assembly area. It is a standard design applied to many schools at the time of construction. There were no drawings, but it is estimated to be around 12 to 15 years old. It has a three dimensional steel framed roof support and metal deck roof and clay brick surround. On one side there is a canteen facility constructed with calcium silicate bricks.

The free standing library is a different construction, the steel frames (UB rafters and 100SHS columns) supporting the roof have the columns exposed outside wall panels. The drawings of this building appeared to be reasonably accurate.

There is a separate open sided canopy over the play area (including a sand pit). This has free-standing light steel portal frames and steel purlins.

Observations:

Classroom blocks and Administration

The roof sheet was removed from the south side of the south classroom block over a steel rafter. It was noted that:

There is a full strength butt weld at the apex.

The 150 x 75 TFB rafters are fully welded to the box section columns. So there is portal action operating.

The structure exposed, namely the steel frame and timber purlins were in good condition.

Where there are concrete wall panels they are fitted between the steel columns, the outside face of which is exposed. The vertical sides of the concrete wall panels have a recess that fits over a square section (20 x 20 solid steel) which is welded continuously to the sides of the columns. This welded square section provides a key for the panels and provides a connection for the panels to the columns, apparently the primary connection.

There is also appears to be a timber section cast into the top to allow fixing of higher level windows and other fittings. To that extent there is a top fixing for the panels, albeit secondary and not as reliable.

Other than at the ends, the rest of the walls are timber framed windows or lightweight sheeted panels.

The end walls are double leaf brick.

Items of deterioration brought to notice or otherwise identified are listed. Comment on their structural significance is provided in *Italics:*

Concrete wall panels and columns:

There was cracking along the vertical edge of some concrete wall panels. The edge had detached in various locations, more commonly near the footings but not exclusively. There were multiple examples where there was cracking over part of the height. The most

advanced was on the east side of the administration building where the cracking had reached a stage where it had been removed externally full height, in some cases on both sides of the panel. In one case the edge was also detached on the inside.

The steel square sections welded to the columns are corroding causing expansion inside the key and breaking off the edges of the concrete panels.

This is significant structurally as the primary connection of the concrete wall panels to the columns is this key system. Minor cracking can be tolerated, but when it gets to an advanced state, such as the east side of administration, it needs to be addressed. The method being adopted is appropriate in my opinion, however it is recommended that stainless steel pins be inserted prior to replacement of the removed material to ensure that there is added stability in the event that future cracking occurs. 5mm diameter stainless steel pins at 300mm vertical centres epoxied into the body of the panel would be adequate for this purpose. This was discussed with the contractor currently working on the repair works.

Precautions to ensure that the panels cannot fall in, in the event of a significant external event such as a mini-tornado or earthquake, are recommended where cracking has not reached such an advanced state. Installation of a plate (nominally 75 x 8 flat bar x 300 long) near the top on the both sides of the panel on the inside would be one method of reducing this risk. They can be welded to the inside face of the columns. Where there are cross walls framing into the panel under scrutiny, this precaution should not be necessary, but each case would need to be considered on merit.

Where the panels are in the process of repair, either this precaution can be taken or temporary propping would suffice.

The columns supporting the concrete panels were rusted near the base. The expansion caused by the rusting was causing the concrete outside the columns to break away but this is not a structural consideration and is more a matter of appearance. The wall thickness of the square section was established at 8 - 10mm. It appeared that the columns were in fact a fabricated section composed of two angles continuously welded. The rusting was occurring at downpipe discharge points, but not exclusively.

The rusting was estimated to have removed less than 2mm of material and the remaining material provides ample structural capacity. Notwithstanding, the deterioration needs to be monitored and progressively addressed, logically as the concrete panels are addressed.

Better control of discharge from downpipes would assist in minimising this problem at downpipe locations and consideration might be given to this.

Between the columns and the edges of the wall panels there was either no sealant or the sealant had deteriorated to a point of failure. The sealant failure was evident for example on the north side of the south classroom block under the walkway where it had pulled away from the sides – a clear indication that replacement is due.

Where the sealant has failed it should be replaced in accordance with the manufacturer's recommendations. Ideally all joints would have been sealed as this would have limited the amount of water penetrating into the column/panel key and reduced the rate of corrosion, however it does not appear to have been an integral part of the original design. It is recommended however that the opportunity be taken to create a sealant gap and seal against a backing strip as and when the spalled key ends of the wall panels are addressed. This was discussed with the contractor currently undertaking the repair works.

Window frames:

The window frames were swelling where they were being wet, and were rotting in some locations, particularly near the ground. Both are due to absorption of moisture into the wood material. The rotting tends to be more common where the wood is continually moist.

The timber window frames are not structural but there will need to be material replaced and the painted surfaces will need to be maintained at a high standard to preclude moisture penetrating into the wood.

Administration End Walls:

The brick south end wall had a deformation. There was a curvature from top to bottom evident from comparison with the corner steel column. The south east corner at the top had mortar fretting to a point where the bricks had detached.

The detached bricks need to be re-laid immediately to ensure none fall to ground. The fretting also needs to be addressed by removing unsound material, sealing and pointing up.

The cause of the curvature should be further investigated, initially by establishing the extent of the deformation by measurement and by removal of some bricks to establish to what extent the connection to the column has been affected. It may be lead to stabilising or replacement of the wall, but that will need to be determined.

Shelter, south end of administration:

This is a steel tube framed structure with open sides and metal deck roof. It is rusting to a point of structural failure. It is not tied down to foundations and it is not connected to the brick end wall.

This structure is in poor condition and is regarded as unsafe. In the event of a strong wind from particular directions there is a potential for it to lift and break up. It is recommended that it be removed from the site and replaced with a conforming structure if required.

General:

There was no indication of an overall stability risk and the structural system has multiple redundancies working against such a scenario.

Covered Play Area

There was minor surface corrosion such as at mitre welds where the column meets the rafter. The structure appeared to be in sound condition.

No action recommended beyond normal monitoring and maintenance.

Covered Assembly:

This is a relatively recent structure and no defects were identified that would suggest that the structure requires short term reinstatement beyond normal maintenance.

For example there was cracking of the concrete floor around the columns in some locations. This is due to differential movement between the materials and has no structural significance.

Canteen:

There calcium silicate bricks would be original construction. There is cracking in the west end wall adjacent to the opening and some cracking in a wing wall that projects into the assembly area. No potential instability was identified.

The cracking might be seen as aesthetically undesirable, in which case the general repair notes appended would provide a method of structural reinstatement. It was not regarded as a potential structural instability though if not addressed it would need to be monitored and addressed progressively.

Covered Walkways:

There was corrosion of the RHS roof framing, particularly near the north end near the classroom block. The corrosion had not reached a point where structural stability was considered a risk.

The corrosion of the roof support frame needs to be addressed in the short term to curtail the reduction in metal thickness.

The hit-and-miss brickwork at various locations had fretting of the mortar to a point where there was little left in isolated locations. There was evidence of fretting having been addressed in the past.

The fretting of the mortar in the hit-and-miss walls needs to be addressed urgently.. The mortar needs to be taken out down to hard sound material and pointed up. In some cases all of the mortar will be removed in which case wedging will be necessary until the new mortar is installed and cured.

The steel columns were rusting at the base in similar fashion to the classroom blocks. Again this was evident where downpipes discharge but it was not confined to these locations.

Again, control of downpipe discharge would assist in limiting this effect.

Boys Toilets:

It is a non-structural item, but the base of the terrazzo partition adjacent to the urinal had rusting internal reinforcement causing spalling.

The rusting can be addressed but it is likely that the partitions will eventually need to be replaced.

Library:

The rusting at the base of the columns of this building has been addressed in the recent past. The repairs to the bases of the columns is performing adequately.

Summary:

It is my opinion that:

There were no instances noted where the overall structural stability of a building was considered to be at risk.

The original parts of the building are forty plus years old. There is inevitable deterioration that requires regular monitoring and maintenance. Over and above the maintenance and repair items that are identified in normal service, an overall building status inspection is recommended at around two year intervals.

The requirement for continuing monitoring and maintenance is ongoing. It is required in any structure, and becomes unavoidable in a building of this age.

The most structurally significant deterioration observed as regards cost of repair was that of the concrete wall panels. However if the corrosion of the side key system is addressed progressively, and the general recommendations outlined above are pursued, a structural instability should not develop. It is something that needs to be regularly brought up to standard. It is recommended that exposed reinforcement be addressed in the short term, and any panel exhibiting the vertical cracking along the edge to the extent of 25% of the panel height or more should have the reinstatement work done full height.

To take the current investigation further would require intrusive demolition which would involve significant expense and would be disruptive. Other than where identified, it is my opinion that there was no indication that this is justified based on observations.

Closure:

No other matters were investigated as part of this commission.

This is a structural report and though mention may be made of non-structural items including finishes and services it should not be regarded as comprehensive and such matters should be covered by others.

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Wall Crack Repair:

These are generalised notes on the repair of wall cracks. Queries specific to any particular site to be referred to the engineer.

Where wall repairs are recommended they fall into two categories:

1. Adopting 'maintenance techniques'.
2. Adopting 'structural repair techniques'.

'Maintenance techniques' are to be taken as superficial repairs to improve or reinstate appearance, as might normally be done by a tradesman painter.

'Structural repair techniques' are to be taken as requiring reinstatement of the structural capacity, more commonly against lateral loads such as wind or seismic activity. There are a number of acceptable approaches, one being:

> Where the cracks follow mortar joints, rake out minimum 35mm of mortar on each side for internal walls and minimum 70mm of mortar where only one side is accessible. This to be done in lengths and in stages short enough to ensure continuous stability of the wall(s) at all stages of the process.
>
> Thoroughly clean and refill with an approved adhesive enhanced (epoxy based) mortar in accordance with the manufacturer's recommendations. Leave 5 to 10mm for pointing up in face work as necessary.
>
> Where cracks run through bricks, the cracked bricks to be removed and replaced to re-establish bond across the crack. Alternatively galvanized 2/6mm rods x 700 long can be inserted across the crack at 172mm vertical centres and bedded (all faces) in the epoxy-based mortar. The rod to be 350mm into each side of the crack.

Point up and clean where appropriate and finish to match existing work.
Where brick ties are encountered in internal leafs of external walls techniques adopted to rake mortar shall be such as to not damage the ties.

Where these general techniques are found to be difficult in particular circumstances encountered on site, refer to the engineer for advice.

There are a number of suitable products for mortar replacement in the structural repair including the Chemset product or the Concresive primer and mortar mix (2525 & 2526 by Degussa). There are others and all need to be recommended by the manufacturer for the purpose and be used in strict accordance with the manufacturer's recommendations.