MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

10 May 2019

Pat Johnson
Sector Manager, Parliamentary Group
Office of the Auditor-General
PO Box 3928
WELLINGTON 6140

Dear Pat

**Christchurch Schools Rebuild – Christchurch Girls High School**

The Secretary for Education, Iona Holsted, has asked me to respond to your letter of 23 April 2019 requesting further information in relation to alleged issues with the programme of work at Christchurch Girls High School (CGHS). You asked for the following information:

1. An explanation and any relevant supporting documents that show which option the Ministry chose for the main block and why, including any supporting cost analysis.
2. A chronological history of the expected completion dates, budget, and actual costs over the life of the project to date. It would be helpful if that history included reasons for any changes to the timing, cost and budget.

As agreed in the meeting with you and Ministry staff on 1 April 2019, I will address question 1 in this response. We anticipate we will be in a position to provide you with a full response to question 2 by 31 May 2019. As agreed, the information provided in the second response will be limited to the Phase 1 project for the Main Block.

**The CGHS programme of work**

CGHS was extensively damaged in the 2010 and 2011 Canterbury earthquakes. The gymnasium, technology block and the arts block were also affected by weathertightness issues. Although the school was due to enter the Christchurch Schools Rebuild (CSR) programme in 2018, in 2015 the programme was accelerated to help the school regain full functionality earlier. Work to date has included the following.

- Remediation of weathertightness issues to the Arts Block (unrelated to earthquake damage).
- Upgrade and extension of the gymnasium. The extension was funded by the Board of Trustees as CGHS wanted a larger gymnasium than entitled to under Ministry policy. The Ministry managed the project and held the risk on cost escalation, including the Board's portion.
- Demolition of the damaged school pool and remediation of the area.
- Provision of a relocatable building for additional teaching space in preparation for installation of the Main Block foundation (location of an existing relocatable was unsuitable).
- Removal of the previously utilised relocatable from the site.
- Demolition of the building linking the Technology Block with the Main Block.
- Construction of the new Performing Arts Centre.

- Assistance with project management and engineering services for the rebuild of the school boarding house (Board funded project).
- First stage remediation of the main block to 67% of the National Building Standard (NBS).

**Main Block remediation and strengthening decision**

The Main Block is a four level concrete building and includes teaching spaces on the upper levels and food preparation, library and administration areas on the ground floor.

An initial feasibility study performed by Opus in July 2012 (item 1 enclosed) confirmed that budget savings were available through remediation of the Main Block as opposed to demolition and rebuilding. Approval was granted to bring forward the demolition of the auditorium and begin masterplanning in 11 April 2014. This approval included the remediation of the Main Block, which was expected to provide cost savings to the overall programme (item 2 enclosed). Please note, this document refers to both the Main Block and Auditorium despite being two buildings.

In 2014 the Main Block at CGHS was assessed by Opus engineers and was not deemed to be earthquake prone (item 3 enclosed). The assessment findings certified the Main Block as fit to occupy. These results were provided to the CGHS Board at a meeting on 22 October 2014.

The RDT Pacific letter of 13 March 2015 (item 4 enclosed) referenced in your information request letter, which outlined high costs for the remediation options (against a new build) was based on work performed by Tonkin and Taylor (item 5 enclosed). These findings were reviewed by Holmes Consulting Group due to the significant increase from the previous estimates the Ministry had for the building's remediation.

On 28 March 2015 Holmes Consulting Group concluded (item 6 enclosed) the following:

> *The budget blow-out appears to be primarily a consequence of a mixed brief – containing both repair and strengthening components. If repair only is being completed, the scope of work is largely the same as previously contemplated, subject to the required further investigation being completed to finally confirm scope. Strengthening and replacement of services could be deferred until the MLE upgrades are implemented, for the sake of efficiency.*

Following this peer review, remediation of the Main Block was still considered the preferred option, subject to the recommended testing. Planning continued on this basis. The remediation option was confirmed and agreed with CGHS at a meeting with the Board on 29 April 2015. While the minutes for this meeting are not available this was confirmed in subsequent emails from the Board Chair and Project Manager (items 7 and 8 enclosed).

As recommended by the Holmes Consulting Group, the Main Block was further assessed by a direct pile coring investigation, undertaken by Lewis Bradford consulting engineers, to determine the extent of the damage to the building foundations. The findings indicated that the main block performed well in the recent earthquakes and could be retained rather than demolished and rebuilt. Further costings were provided by Aecom (items 9 and 10 enclosed).

Lewis Bradford consulting engineers provided structural engineering input, which consisted of a high-level assessment of the building and completion of a detailed report and concept sketches for two options of strengthening levels as requested by Ministry (item 11 enclosed).

On this basis the construction budget was established with the view to strengthening the building to 35-45%NBS with future strengthening to increase it to above 67%NBS to be performed at a later date outside of the CSR Programme (items 10 and 11 enclosed).

This approach was supported by the then Head of Education Infrastructure Service in consultation with the Ministry's Engineering Strategy Group (ESG) and reflects Ministry policy (Structural and Geotechnical Guidelines for School Design Version 1.1, June 2015), which states:

> *If buildings are assessed as earthquake prone, and require urgent strengthening work, we will make a decision about whether to strengthen the building to:*
>
> - *above 34% of the New Building Standard (NBS) immediately so the building is not earthquake prone, and further strengthen to above 67% of the NBS at a later stage, or*
> - *above 67% of the NBS straight away."*

On 11 December 2015 concern was raised in a meeting with the Board about the phased strengthening of the Main Block (item 12 enclosed). The Ministry subsequently agreed in a letter dated 16 December 2015 to strengthening the Main Block to 67%NBS as part of the project (item 13 enclosed).

While planning continued at this stage the focus of the programme shifted to the Gymnasium and Performing Arts Centre projects.

In late 2017 the Ministry tendered for the construction works to be completed on the Main Block. In the request for approval to proceed with construction from RDT Pacific on 2 November 2017 (item 14 enclosed) they note likely budget figures for the evolved scope that are significantly reduced from their March 2015 figures (item 4 enclosed, as referred to above), with a phased approach to minimise decanting costs.

I hope the information provided is sufficient to address your query. My staff remain available to discuss this at the convenience of your office.

Yours sincerely

**Kim Shannon**
Head of Education Infrastructure Service

Enclosure 1: CGHS Feasibility of Earthquake Remediation, July 2012
Enclosure 2: Approval Memo CGHS Auditorium, 10 April 2014
Enclosure 3: Detailed Engineering Evaluation Quantitative Assessment Report, 10 July 2014
Enclosure 4: CGHS Main Block Master Planning Assessment, 13 March 2015
Enclosure 5: CGHS Conceptual Repairs to Main Block Foundation, 6 March 2015
Enclosure 6: CBHS & CGHS Preliminary Views, 28 March 2015
Enclosure 7: Email from the Chair of the CGHS Board of Trustees, 29 April 2015
Enclosure 8: Email from the RDT Project Manager confirming the go ahead, 29 April 2015
Enclosure 9: Email from RDT with initial findings, 9 June 2015
Enclosure 10: Discussion Paper – CGHS Main Block Structural Options, 1 December 2015
Enclosure 11: CGHS Filenote, 14 December 2015
Enclosure 12: Christchurch Schools Rebuild Minutes - CGHS, 11 December 2015
Enclosure 13: Letter to the CGHS Board of Trustees, 16 December 2015
Enclosure 14: CGHS Request for Approval to Proceed, 2 November 2017

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# Christchurch Girls' High School
# Main Block
# Feasibility of Earthquake Remediation

# Christchurch Girls' High School
# Main Block
# Feasibility of Earthquake Remediation



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Date: 17/07/2012
Reference: 6-DP109.00
Status: DRAFT

# Contents

# 1 Background

Opus International Consultants Limited has been engaged by the Ministry of Education to carry out a feasibility study regarding maintaining use of the upper levels of the Main Block building at Christchurch Girls' High School whilst any necessary repairs are carried out on the ground floor.

The intent of this report is to provide a description of the repair option and an approximate construction methodology for this option. Approximate time frames and indicative costs are also provided.

# 2 Building Description

The Main Block of the CGHS campus was constructed in 1983 when the school was relocated to its current site. The Main Block is a four storey (three suspended levels) building and includes teaching spaces on the upper levels and food preparation, library and administration areas on the ground floor. The building is approximately 60m long and 29m wide. The upper levels are serviced by a stairwell at both the western and eastern ends, along with an elevator at the eastern end.

The Main Block is a concrete structure with a gravity system including precast double T floor units supported by the web onto precast concrete beams with corbels. The beams are supported on concrete columns and walls. The roof structure is a series of steel portal frames.

The lateral load resisting system in the transverse direction includes full height shear walls at the ends of the four storey sections and at the eastern end of the administration area. In the longitudinal direction the lateral load resisting system relies on the stair and elevator core walls along with a full height shear wall on the southern side at the eastern end. As these lateral load resisting elements are located more towards the southern side of the building, some moment frame action may be utilised on the northern side of the building.

The in ground structure includes 12.5m deep in situ concrete piles under either deep ground beams under the concrete walls, or pile caps under the concrete columns. The piles penetrate through the upper layers of sand and silty soils to found onto a gravel layer. The ground floor slab is typically a 100mm thick slab on ground with slab thickenings on the column lines.

# 3 Earthquake Damage

The Main Block suffered minor damage during the February Earthquake, which has worsened slightly in the subsequent aftershocks. Various site inspections have been undertaken since this time, including some intrusive inspection of critical areas. A selection of photographs showing some of the damage is included as Appendix A.

The main areas of noticeable structural damage are:

- The sub soil to the northern side of the building and under the whole foot print of the building has subsided and spread towards the adjacent stream. This subsidence has caused the ground bearing floor slab to settle. This is most noticeable in the food tech room and sewing room on the southern side of the building along with areas within the library on the northern side of the building. This settlement is up to approximately 60-100mm in some areas and had caused damage to the slab on ground. The slab settlement is most pronounced at the mid span points between the columns and walls. There is also damage to the in ground perimeter beam on the northern side of the building.

- Cracks in concrete shear walls, most obvious at elevator core wall on ground floor (approx. 0.5mm crack).

- Non-structural damage to concrete walls adjacent to joints where the mastic joint sealant has pulled cover concrete from the walls. Most notable on the upper levels at eastern end.

- Fine cracks at some beam column joints on the ground floor on the northern side of the building.

- The restraint cable fixings for the extractor fans on the roof failed and one of the extractor fans had fallen onto the roof.

- Damage to awning structure on the northern side of the building due to ground subsidence.

# 4 Engineering Evaluation

An initial detailed engineering evaluation has been completed for the Main Block building and is covered by a separate report, which is due to be issued shortly. The initial outcomes of the report indicate that significant remedial work is required, particularly to the foundations and ground floor structure. The superstructure appears to have generally performed well, therefore the feasibility of maintaining occupancy of the Main Block whilst the repair are undertaken has been further investigated.

# 5 Ground Floor Repair Strategy

The repair strategy being proposed for the Main Block centres largely around the replacement of the damaged ground floor slab on ground. In order to provide a replacement that will comply with the Christchurch City Council Building Consent requirements, a like for like replacement will not be sufficient. Ground improvements will be required in order to minimise future ground settlements and therefore minimise potential future damage to the replacement slab.

The below approximate repair strategy has been compiled with the requirement that the upper levels of the Main Block building remaining functional.

The repair strategy below also relies partly on the demolition of the damaged Auditorium and Tech Block Link. This will free up land to install temporary facilities for the continuing use of the school. Should it be decided that these buildings are to remain and be repaired, alternative locations for the temporary facilities would be required.

For the sake of the descriptions below, "Level 1" refers to the Ground Floor of the Main Block. This has been adopted to be consistent with original drawings.

| No | Item | Description | Timeframe (days) | Rough order cost (x$1000) |
|---|---|---|---|---|
| 1 | Demolish Auditorium and Tech Block Link | To Be Confirmed by the Ministry of Education. Demolish the Auditorium and Tech Block Link. Clear and prepare site for temporary buildings. If these buildings are to remain, alternative sites for temporary buildings to be prepared. | 30 | Not included in report |
| 2 | Design and documentation. | Design and documentation of permanent repairs and temporary facilities. Building Consent and peer views required. The figure shown here is based on approximately 10% of the total cost of these works. | 90 | $1,200 |
| 3 | Contractor site occupation and set up. | Head Contractor to set up facilities prior to beginning of repair phase. | 5 | $10 |
| 4 | Construction of temporary facilities | Construct temporary facilities for the school functions on Level 1 (admin areas, the library and several teaching spaces).<br>Likely to include some purpose built temporary structures for the library and admin areas. Could potentially re-use some relocatable classrooms as they become available from other schools. | 90 | $1,500 |
| 5 | Relocate Level 1 functions | Relocate Level 1 functions to temporary facilities. | 10 | $10 |
| 6 | Level 2 access | Level 2 access will be available via the existing stairs and elevator. No general access to any other Level 1 areas will be available from this period. | 15 | $15 |
| 7 | Construct temporary access to Level 2 | Two access points required to be constructed to service Level 2 without needing to go through any part of Level 1.<br>This is to include a temporary lift, likely at the western end. | 15 | $15 |

| | | | | |
|---|---|---|---|---|
| 8 | Temporary relocation of electrical services | Detach switch board and distribution boards from partition walls and fix temporarily to concrete walls.<br>**There may be some electrical down time during this process.** | 15 | $50 |
| 9 | Relocate IT Server | Relocate IT server to suitable location on Level 2.<br>**There may be a short IT shut down required to complete this work. This is likely to be 2 days.** | 15 | $15 |
| 10 | Carry out temporary works to other services | This will include:<br>• The removal of heavy kitchen gear from food technology rooms.<br>• Cap off all services in this area.<br>• Diverting waste water services to run at underside of Level 2 slab.<br>• No work required to ventilation system.<br>• No work required to gas supply system.<br>**There may be a short period of down time for the building services required to complete this work. This is likely to be 2 days.** | 15 | $20 |
| 11 | Soft strip out | Remove all non-load bearing and fit out items. | 15 | $60 |
| 12 | Remove Level 1 external cladding | Remove external glazing and claddings that are currently supported by the Level 1 slab. Store for reinstatement following slab repairs. | 15 | $10 |
| 13 | Level 2 access | Level 2 access will be available only via the temporary stairs and elevator. No general access to any other area of Level 1 will be available. | - | - |
| 14 | Demolish Level 1 slab on ground | Demolish Level 1 slab on ground leaving existing slab thickenings in place to provide lateral restraint to pile caps/column bases.<br>Provide protection to in ground service.<br>Maintain the function of the existing elevator by not demolishing the lift pit and other areas adjacent to the elevator.<br>**This item of works is likely to be highly disruptive and it is not recommended that the upper levels of the Main Block are occupied during this time.** | 20 | $100 |

| | | | | |
|---|---|---|---|---|
| 15 | Carry out ground improvements | Carry out ground improvements over the area of the Main Block and to surrounding areas. This will be done using the compaction grouting technique.<br>The total area will include a 10m strip on the northern side of the building and a nominal 5m zone around the remainder of the building.<br>**It is likely that this item of works will be at least partly disruptive to the upper levels of the Main Block.** | 95 | $4,250 |
| 16 | Install new slab and in ground structure | This will require a staged process to remove the existing slab thickenings that are restraining the pile caps/column bases one at a time and install new ground beams.<br>**It is likely that this item of works will be partly disruptive to the upper levels of the Main Block, although it is envisaged that occupancy of these levels will be possible.** | 60 | See below |
| 17 | Re-install external cladding | Reinstate external cladding and weather tightness<br>**It is likely that this item of works will be partly disruptive to the upper levels of the Main Block, although it is envisaged that occupancy of these levels will be possible.** | 15 | See below |
| 18 | Refit Level 1 | Reinstate Level 1 fit out and services. This would represent an opportunity for the Level 1 internal layout to be altered if desired.<br>**It is likely that this item of works will be partly disruptive to the upper levels of the Main Block, although it is envisaged that occupancy of these levels will be possible.** | 70 | $3,750 including the cost of Item 16 and Item 17 |
| 19 | Occupy Level 1 | Replace all temporarily removed items into newly fitted Level 1. | 10 | $10 |
| 20 | Remove temporary access and accommodation | Remove temporary access and accommodation structures from site. | 30 | $100 |

# 6 Summary

The total estimated cost for the reinstatement of the Level 1 slab and in ground structure, including a 20% contingency is **$13,340,000**.

This figure **includes:**

- The temporary housing of the Level 1 facilities on site while maintaining function to the upper levels of the Main Block building during the repair of the Level 1 structure.
- A 20% contingency associated with the works.

This figure **does not include:**

- Any repairs to the superstructure.
- Any costs associated with the Auditorium or the Tech Block Link.
- It is assumed that the re-fit out of Level 1 will be to the same layout as the original fit out and therefore no costs have been estimated for any changes to accessibility or fire compliance items.

The total estimated time frame for this work is **500 working days**.

Please note that this total time frame is based on a continuous construction programme with required works done concurrently where possible. The Ministry of Education will need to work with Contractors and Consultants to determine how to best fit these works into the school year in order to minimise disruption. This may involve the carrying out of certain potentially disruptive items during times when the school is not occupied by the students. It may be worth considering a work programme that includes gaps in between the disruptive items if it is not possible to complete all of these during one break.

Please also note that should it be beneficial to the function of the school, Room 105 could remain functioning during the repair process. It is still a requirement that this building undergo the same repairs as the other areas of the Main Block Level 1 structure, including the ground improvements. Completing these works at a later time is likely to incur additional costs relating to Contractor set up. The above costs and time frames are based on the demolition and replacement of Room 105 at the same time as the main repair and replacement works to Level 1.

# 7 Post Repair Level of Compliance

Following the completion of the above outlined works, the level of structural compliance when compared with current standards will be in the order of **50-70% NBS.** Preliminary analysis indicates that this is based on the tensile capacity of the existing piles at the ends of the main shear walls.

In order to increase the overall level of structural compliance for the Main Block it may be necessary to install new tension piles or ground anchors. This would add cost and time to Item 16 on the above work schedule.

# 8 Conclusions

The above repair strategy for the Main Block as outlined above is physically possible and can be programmed to fit in with the school year. Certain items within the repair strategy will be highly disruptive and it is recommended that these are carried out during periods when the school is not occupied.

The cost estimate of the repair works is **$13,340,000.**

The total estimated time frame for this work is **500 working days**.

# 9 Recommendations

We recommend that the cost of the repair works to the Main Block be compared against the cost of a new building of similar size and function. The out come of this comparison may inform the continuing amount of detailed structural analysis required.

It is also recommended that the options provided within the reports for the Tech Block Link and the Auditorium be considered during the decision making process with regard to the Main Block.

# 10 Limitations

(a) The cost and time estimates provided above are approximations only. Industry advice has been sort for the specialist items (demolition and ground improvement), although no Quantity Surveyor advice has been gained. The other cost and time estimates provided are based on internal knowledge sort from within the Opus International Consultants organisation.

(b) Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at the time;

(c) This report is based on an inspection of the building structure with a focus on the damage sustained from the 22 February Canterbury Earthquake and aftershocks only. Some non-structural damage is mentioned but this is not intended to be a comprehensive list of non-structural items;

(d) Our inspections have been visual and non-intrusive, no linings or finishes were removed to expose structural elements. Calculations have been limited to simple assessments and comparisons of seismic coefficients. No other analyses have been performed;

(e) This report is prepared for the Ministry of Education to assist with assessing remedial works required for the Christchurch Girls' High School Main Block. It is not intended for any other party or purpose.

# Appendix A:

# Repair Sequence Drawings

**Tech Block Link** covered by stand alone report.
For the purpose of this excercise assumed to be demolished prior to these works.

Remove timber framed awning

Remove external cladding

Remove and store external cladding

Construct new temporary Level 2 access

Install new temporary elevator to Level 2

Relocate electrical services to concrete wall

Main switch board to be replaced after new fit-out installed

Hydraulic services to be re-directed at high level

Relocate electrical services to concrete wall

Hydraulic services to be re-directed at high level

Salvage existing Kitchen appliance and hardware and store for reinstatement

Construct new temporary Level 2 access

Relocate IT server

Remove and store external cladding

LINK

AUDITORIUM

**GENERAL NOTES :**
Strip out all partition walls and floor linings of the entire Level 1 area. Remove and store all doors for reinstatement as part of new fit out.

**Auditorium** covered by stand alone report.
For the purpose of this excercise assumed to be demolished prior to these works.

EXTENT OF STRIP OUT WORKS

EXTENT OF DEMOLITION PRIOR TO THESE WORKS





| Revision | Amendment | Approved | Revision Date |
|---|---|---|---|

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CHRISTCHURCH GIRLS' HIGH SCHOOL

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| Drawn | Designed | Approved | Revision Date |
|---|---|---|---|
| JS | JN | AB | 16/7/2012 |

Project
MOE - Christchurch Girls High School
Matai Street
Main Block Repair Phase Planning

Title
Level 1 Soft Strip Out Plan - STAGE 1

| Project No | Scale | Drawing No | Sheet No | Revision |
|---|---|---|---|---|
| 6-DP109.00 | As indicated | 6/695/13/ 7601 | 101 | RB |

1 Level 1 Soft Strip Out Plan - STAGE 1
1 : 200

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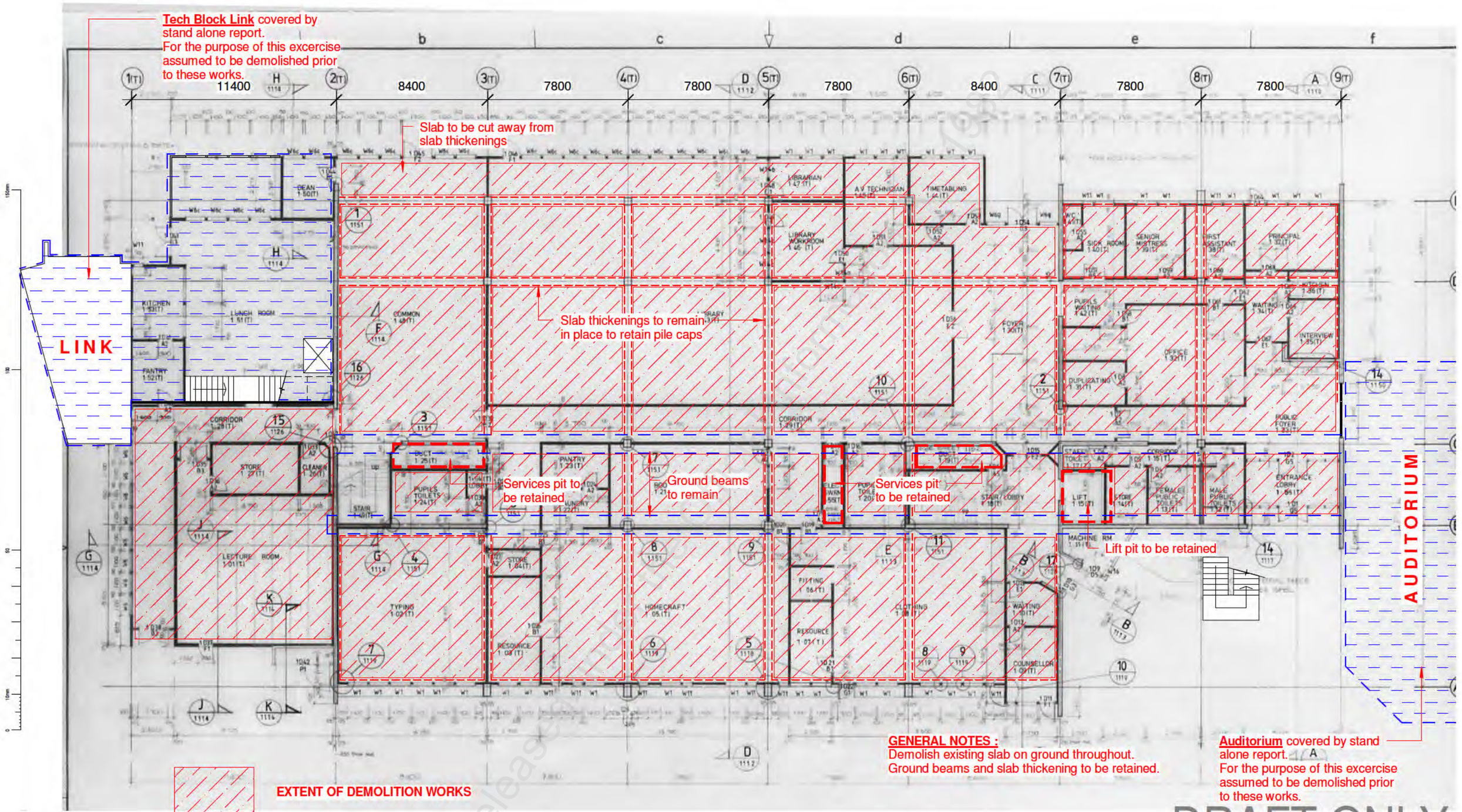


2 Level 1 Demolition Plan - STAGE 2

1 : 200

| Revision | Amendment | Approved | Revision Date |
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|---|---|---|---|
| JS | JN | AB | 16/7/2012 |

Project
MOE - Christchurch Girls High School
Matai Street
Main Block Repair Phase Planning

Title
Level 1 Demolition Plan - STAGE 2

| Project No | Scale | Drawing No | Sheet No | Revision |
|---|---|---|---|---|
| 6-DP109.00 | As indicated | 6/695/13/ 7601 | 102 | RB |

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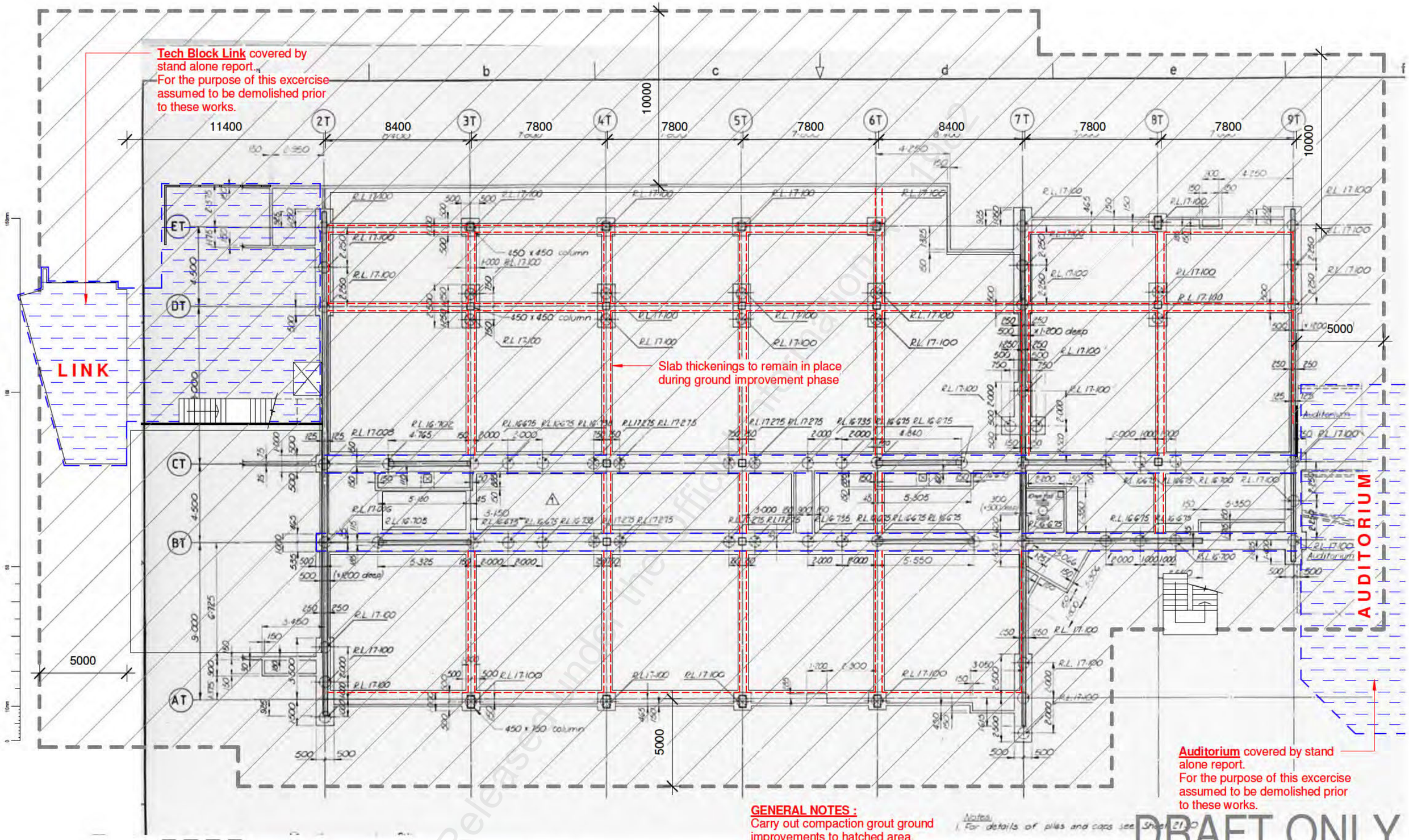


**GENERAL NOTES :**
Carry out compaction grout ground improvements to hatched area.

Notes:
1. For details of piles and caps see Sheet 21 etc

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EXTENT OF GROUND IMPROVEMENT WORKS

3 Ground Improvement Plan - STAGE 3
1 : 200

| Revision | Amendment | Approved | Revision Date |
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Project
MOE - Christchurch Girls High School
Matai Street
Main Block Repair Phase Planning

Title
Ground Improvement Plan - STAGE 3

| Drawn | Designed | Approved | Revision Date |
|---|---|---|---|
| JS | JN | AB | 16/7/2012 |

| Project No | Scale | Drawing No | Sheet No | Revision |
|---|---|---|---|---|
| 6-DP109.00 | As indicated | 6/695/13/ 7601 | 103 | RB |

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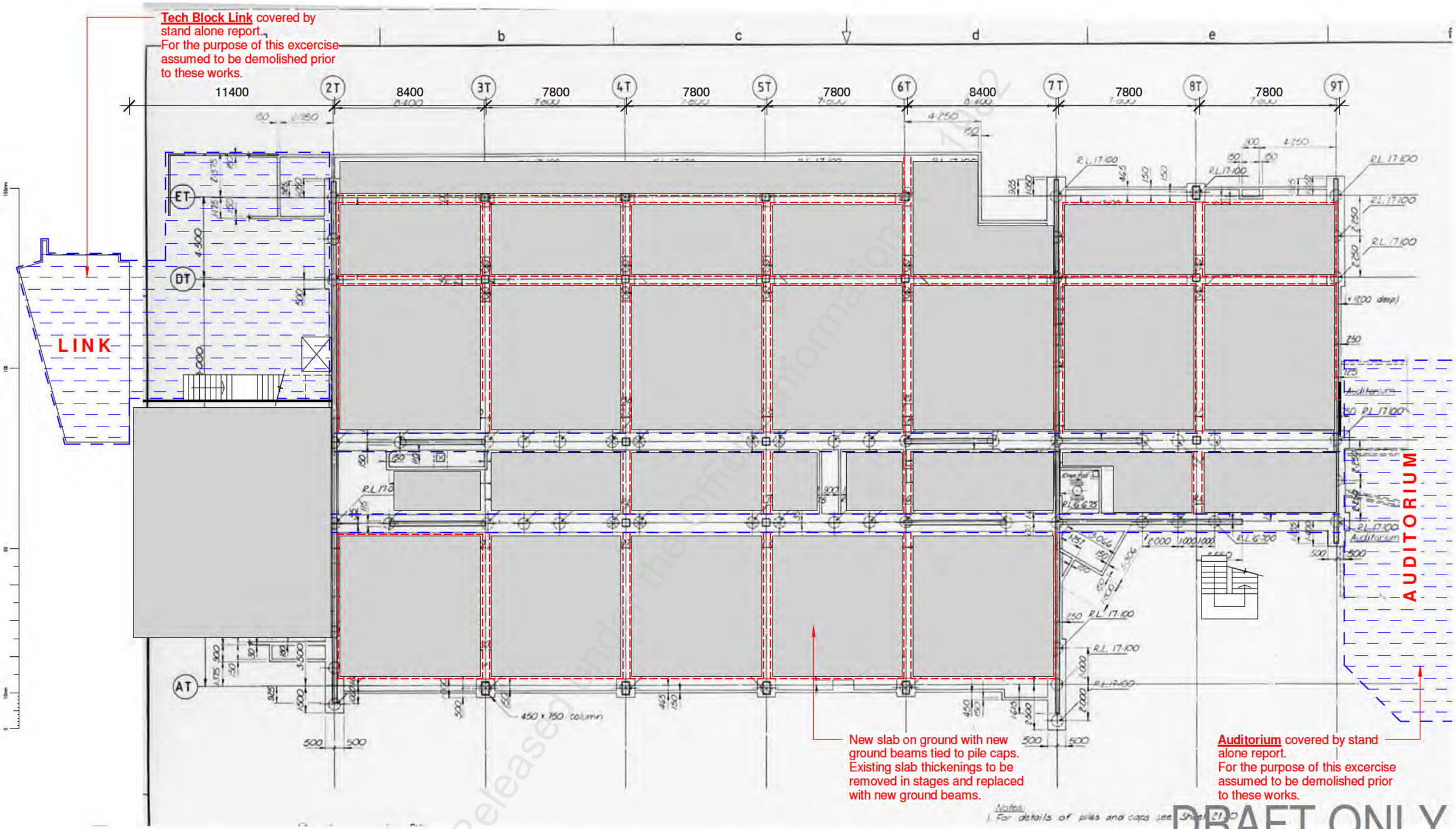




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| Project No | Scale | Drawing No | Sheet No | Revision |
|---|---|---|---|---|
| 6-DP109.00 | 1 : 200 | 6/695/13/ 7601 | 104 | RB |

Project
MOE - Christchurch Girls High School
Matai Street
Main Block Repair Phase Planning

Title
Slab Reinstatement Plan - STAGE 4

4 Slab Reinstatement Plan - STAGE 4
1 : 200

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**Tech Block Link** covered by stand alone report.
For the purpose of this excercise assumed to be demolished prior to these works.

LINK

Reinstate internal fit-out as per original layout

**Auditorium** covered by stand alone report.
For the purpose of this excercise assumed to be demolished prior to these works.

AUDITORIUM



DRAFT ONLY

| Revision | Amendment | Approved | Revision Date |
|---|---|---|---|

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Project
MOE - Christchurch Girls High School
Matai Street
Main Block Repair Phase Planning

Title
Internal Fit-out Plan - STAGE 5

| Drawn | Designed | Approved | Revision Date |
|---|---|---|---|
| JS | JN | AB | 16/7/2012 |

| Project No | Scale | Drawing No | Sheet No | Revision |
|---|---|---|---|---|
| 6-DP109.00 | 1 : 200 | 6/695/13/ 7601 | 105 | RB |

5 Proposed Floor Plan - STAGE 5
1 : 200

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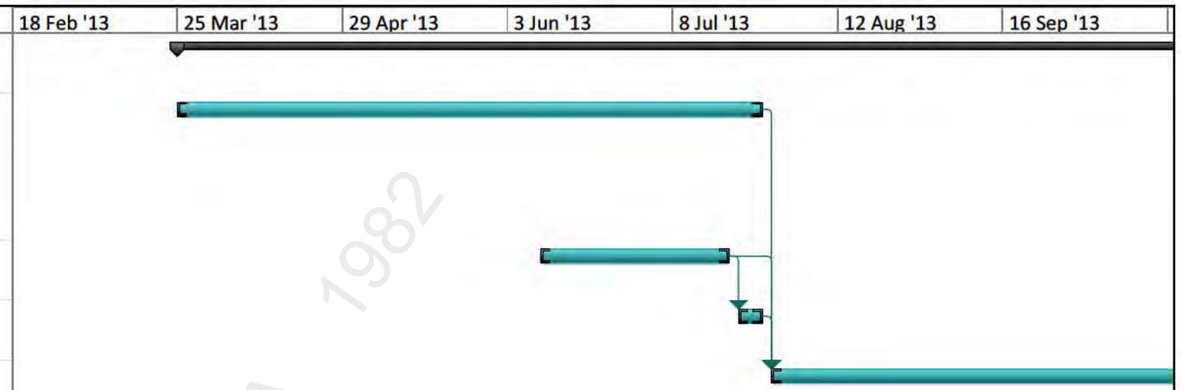
# Appendix B:

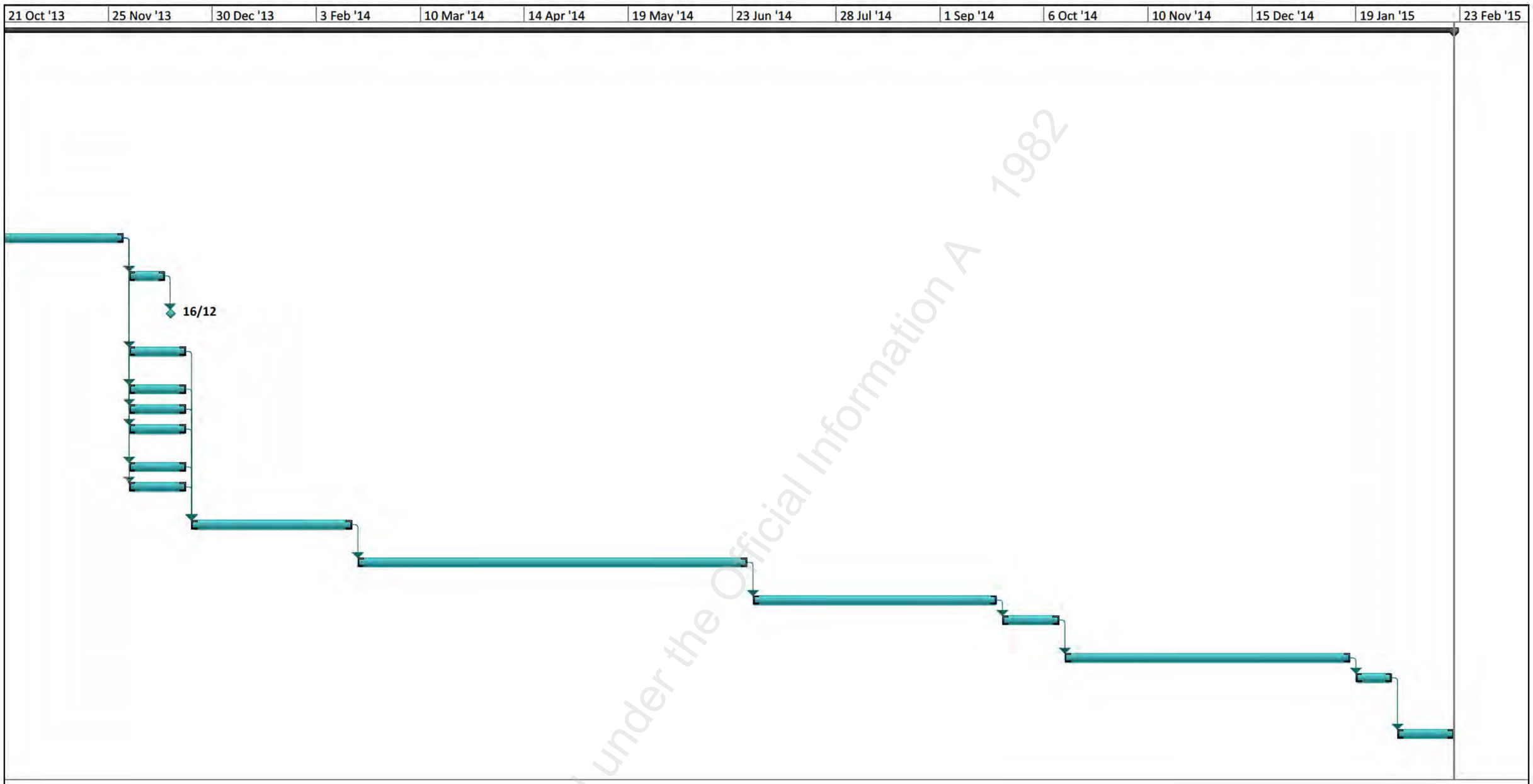
# Repair Sequence Programme

| ID | Task | Task Name | Duration | Start | Finish | Predecessors | Resource Names |
|---|---|---|---|---|---|---|---|
| 1 | | **Main Block Level 1 Slab Repair** | **500 days** | **Mon 25/03/13** | **Fri 20/02/15** | | |
| 2 | | Design and document temporary and perments items. Peer review and Building Consent required. | 90 days | Mon 25/03/13 | Fri 26/07/13 | | |
| 3 | | Demolish Auditorium and Tech Block Link | 30 days | Mon 10/06/13 | Fri 19/07/13 | | |
| 4 | | Contractor site occupation and set up | 5 days | Mon 22/07/13 | Fri 26/07/13 | 3 | |
| 5 | | Construction of temporary facilities | 90 days | Mon 29/07/13 | Fri 29/11/13 | 3,4,2 | |
| 6 | | Relocate Level 1 functions | 10 days | Mon 2/12/13 | Fri 13/12/13 | 5 | |
| 7 | | Occupy new temporary facilities | 0 days | Mon 16/12/13 | Mon 16/12/13 | 6 | |
| 8 | | Construc temporary access to Level 2 | 15 days | Mon 2/12/13 | Fri 20/12/13 | 5 | |
| 9 | | Move switchboard | 15 days | Mon 2/12/13 | Fri 20/12/13 | 5 | |
| 10 | | Relocate IT server | 15 days | Mon 2/12/13 | Fri 20/12/13 | 5 | |
| 11 | | Temporary divert and cut off other services | 15 days | Mon 2/12/13 | Fri 20/12/13 | 5 | |
| 12 | | Soft strip out | 15 days | Mon 2/12/13 | Fri 20/12/13 | 5 | |
| 13 | | Remove Level 1 external cladding | 15 days | Mon 2/12/13 | Fri 20/12/13 | 5 | |
| 14 | | Demolish Level 1 slab on ground | 40 days | Mon 23/12/13 | Fri 14/02/14 | 8,9,10,11,12,13 | |
| 15 | | Carry out ground improvement | 95 days | Mon 17/02/14 | Fri 27/06/14 | 14 | |
| 16 | | Install new internal slab | 60 days | Mon 30/06/14 | Fri 19/09/14 | 15 | |
| 17 | | Re-install external cladding | 15 days | Mon 22/09/14 | Fri 10/10/14 | 16 | |
| 18 | | Refit Level 1 | 70 days | Mon 13/10/14 | Fri 16/01/15 | 17 | |
| 19 | | Move all items back into Main Block Level 1 | 10 days | Mon 19/01/15 | Fri 30/01/15 | 18 | |
| 20 | | Remove temporary access and accommodation | 15 days | Mon 2/02/15 | Fri 20/02/15 | 19 | |




Project: Main Block Repair Phase
Date: Mon 16/07/12

Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress






Project: Main Block Repair Phase
Date: Mon 16/07/12

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Task | Project Summary | Inactive Milestone | Manual Summary Rollup | Deadline |
| Split | External Tasks | Inactive Summary | Manual Summary | Progress |
| Milestone | External Milestone | Manual Task | Start-only | |
| Summary | Inactive Task | Duration-only | Finish-only | |

# MEMO

MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

**To:** 9(2)(a) – Group Manager Service Delivery Manager, EIS
**From:** David Hobern – Programme Manager, CSR Programme
**CC:** Peter Fenwick SPA, Andrew Smith - CSR Programme

**Date:** 10 April 2014
**Subject:** Christchurch Girls High School – Auditorium

**Introduction**

This memo seeks your approval to proceed with the demolition of the Auditorium at Christchurch Girls High School (CGHS). In addition it seeks approval to bring forward the replacement of auditorium and associated master planning services for the site.

**Purpose**

To outline the rationale for replacement versus repair and the reason to bring forward the master planning to enable the replacement to be planned in line with the site wide development.

**Background**

The Auditorium (included in Block A in PMIS) was severely damaged during the earthquakes events of 2010 and 2011 and has been isolated since the February 2011 earthquake. The auditorium has been isolated and the school has not had access to these facilities. This has the potential to compromise student learning opportunities, with school unable to access the facility and major redevelopment work is not programmed for completion until 2020 there is a real risk student learning and opportunities will be compromised.

The Auditorium consists of a number of adjoining buildings collectively are considered a single area for the purpose of this study. The Auditorium buildings comprise:

- Music Rooms 1 & 2 (north east area, adjacent to river): demolished in 2011 due to severe damage
- Main Auditorium: this is heavily damaged
- Link Area (north west area): the connection and approach from the Main Block. This area is heavily damaged
- Two storey Music Practice Rooms (south east area): no apparent damage

This Auditorium has been scrutinised intensively by both the Ministry and its Insurer's engineering team. It is considered a flag ship building for engineering solutions, consequently the information we have obtained is thorough and comprehensive.

Engineers Lewis Bradford and quantity surveyors Davis Langdon were engaged to prepare a final costed options analysis to allow the Ministry to make an informed decision on whether the building should be repaired or demolished.

The School are in favour of demolition, but accept that a repair option may be the most economical solution.

A similar situation existed for the nearby Christchurch Boys High School, where the Ministry has given an undertaking to repair the Hall and Library after exploring the feasibility of repairing versus demolition.

**Proposal**

The proposal is to demolish the Auditorium and advance the replacement of the new facility through the engagement of master planners. The decision to commence master planning will ensure a well planned site.

A one page summary of the advantages and disadvantages of both the options is appended to this memo. Essentially a 'repair' provides the lowest cost option with higher risk, whilst a 'rebuild' is a higher cost option with a lower risk.

Table. 1

| | Estimated Cost | Percentage ratio repair / rebuild | NBS of completed building |
|---|---|---|---|
| Repair | $4,700,000 | 86.7% | 67% |
| Replacement | $5,420,000 | | 100% |

The informal advice gathered from our engineering team (not in print) is as follows:

- Davis Langdon (QS): recommending a rebuild
- Lewis Bradford (Structural Engineer): in favour of proceeding with a repair option, but concede this carries a higher risk
- Tonkin & Taylor (Geotechnical Engineer): would prefer the building was relocated to the eastern side of the playing fields (near to tennis courts) where the asset will be better placed to withstand a major seismic event

**Rationale**

The rationale for recommending demolition and rebuilding of the auditorium is as follows:

1. With repair currently estimated at 86.7% of a rebuild cost, the Ministry's normal methodology is to default to a rebuild
2. The demolition & rebuild option appears to provide an approach with a lower risk profile
3. The Main Block (four storey) building has recently been identified as repairable - this has resulted in budgetary savings for the school
4. The school is strongly in favour of a demolition and rebuild approach

**Moving Forward/Programme Impact**

If demolition is agreed the school has requested the Auditorium be replaced immediately. The current timeframe for CGHS to enter the programme is the first quarter 2018. Acceptance of the replacement option does not necessarily mean the auditorium would be rebuilt in the same configuration on the same location. The Ministry would work with the School's board to determine size (based on entitlement), configuration and location.

To undertake this work efficiently, it is proposed the master planning of the development is brought forward and commenced immediately with appointment of the master planners through the Master Planning Panel.

The rebuild of the auditorium (and adjoining buildings) allows for a like-for-like replacement of the areas currently affected. The CSR programme determines the entitlement (or amount to be rebuilt) usually on the higher of the current roll or the projected roll. The Ministry has no intention to build facilities over entitlement. The school or the community may wish to add additional funding to a particular project but this would not be taken into account in the entitlement. The master planning process will be determined on the schools overall entitlement and will determine the scope of works.

**Budget Impact**

The overall planned investment at the school is $27 million -$15 million of which was initially assigned to development of the Main Block. Latest estimates include a revised figure of $12.5 million for the Main Block. This figure includes replacement of the Auditorium and the latest insurance claim figures, including a modernisation amount. The figures are summarized in the table below:

Table 2:

| Component | Business Case | Latest estimates |
|---|---|---|
| Block A estimate | $15 m | Auditorium: $5.4m<br>Main Block: $7.1m<br>Sub total: $12.5m |
| Additional School contingency | Included | $2.5 m |
| School budget | $27 m | $27 m |

A further submission will be made once the Master Planning has been completed and cost estimates updated. Until then it is proposed to retain the full school budget at $27m.

**Procurement**

Project management and master planning appointments will be made through the Ministry's existing panels. The design team and contractors will be appointed through the soon to be established Professional Services Panel and Contractors' Panel.

The appointments will be made in consultation with the Ministry Commercial Procurement team; the School's Board will also be given the opportunity to have a representative on the appointment panel.

A further memo will be produced to allow the standard process for the disposal of Ministry assets to be adhered to.

**Recommendations**

It is recommended that you:

a. **Approve** the demolition of the CGHS Auditorium.
b. **Agree** the master planning for CGHS commences in the immediate future.

~~Approved/Not Approved~~

9(2)(a) [redacted]

**Group Manager, Service Delivery Manager, EIS**

9(2)(a) [redacted]

Date: 11/4/2014

Attachments

Comparison Repair V rebuild

Davis Langdon Estimate

OPUS

*Ministry of Education*

# Christchurch Girls' High School Main Block

## Detailed Engineering Evaluation

## Quantitative Assessment Report

*Ministry of Education*

# Christchurch Girls' High School Main Block

# Quantitative Assessment Report

## 10 Matai Street, Riccarton, Christchurch


Prepared By s 9(2)(a) OIA
Structural Engineer

Reviewed By s 9(2)(a) OIA
Structural Engineer

Approved By s 9(2)(a) OIA
Principal Structural Engineer, CPEng

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PO Box 1482, Christchurch Mail Centre, Christchurch 8140
New Zealand

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Date: 10 July 2014
Reference: 6-DP109.00/005SC
Status: Revision 2

# Executive Summary

Opus International Consultants Limited has been engaged by the Ministry of Education to undertake a detailed seismic assessment of the Main Block at Christchurch Girls' High School located at 10 Matai Street in Christchurch following the recent earthquakes in Canterbury.

The purpose of this report is to determine the predicted seismic performance of the building, following our initial evaluation, which indicated the seismic capacity of the building was unlikely to be Earthquake Prone.

Following a quantitative engineering assessment of the building, our conclusions are:

a) Capacity of the superstructure is longitudinal direction is in excess of 55% NBS.

b) Capacity of the superstructure in the transverse direction is in excess of 38% NBS.

c) The building is not considered Earthquake Prone.

d) The capacity of the building is governed by the performance of the foundation system, particularly lateral spreading of material beneath the buildings toward the river.

e) The building has sustained severe damage to ground floor slabs and foundation elements, including the piles. The superstructure is largely undamaged.

f) Significant repairs are required to the foundation and ground floor levels.

g) This repair will cause considerable disruption to the normal operation of the buildings.

h) Further detailed assessment of the foundation system is required to more precisely determine the overall performance of the building.

We consider that the Main Block in all its parts remains suitable for occupancy by students and staff. This is based on our assessment that the building has no CSW's, is not an Earthquake Prone Building, has suffered moderate structural damage to the superstructure in the recent earthquake sequence and, by our estimation, has a reasonable margin between the collapse limit state and our calculated % NBS at ultimate limit state.

It is our recommendation that the following work be undertaken:

a) Damage Assessment report be completed.

b) Feasibility of Repair report be completed to determine likely programme and cost of repair.

c) If it is concluded that it is practicable to repair the building within budget and programme constraints, then undertake a detailed assessment of the foundation system and soil-structure interaction to inform potential repair solutions.

# Contents

# 1 Introduction

Following the February 2011 Christchurch Earthquake, Opus International Consultants Limited (Opus) were engaged by the Ministry of Education (the Ministry) to inspect all of the buildings comprising Christchurch Girls' High School (CGHS) campus at 10 Matai Street, Riccarton, Christchurch.

This report focuses on the assessment of the Main Block structure (refer Figure 1.1 ) and is intended to provide an interim assessment of the seismic performance of the building relative to current new building standards (%NBS), recommendations for further assessment, options for remediation of earthquake induced damage, and recommendations for repair.

For the purposes of this report the Main Block is considered to comprise the four storey block designed by the Ministry of Works in 1982. The Auditorium and Link Block, which are connected to the east and west of the Main block respectively, are addressed in separate reports.


Figure 1.1: CGHS Main Block – Image courtesy Google Earth

# 2 Earthquake Resistance Standards and Compliance Requirements

For this assessment, the building's earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The loadings are in accordance with the current earthquake loading standard NZS1170.5 [1].

A generally accepted classification of earthquake risk for existing buildings in terms of %NBS that has been proposed by the NZSEE 2006 [2] is presented in Figure 2.1.

| Description | Grade | Risk | %NBS | Existing Building Structural Performance | Improvement of Structural Performance | |
|---|---|---|---|---|---|---|
| | | | | | Legal Requirement | NZSEE Recommendation |
| Low Risk Building | A or B | Low | Above 67 | Acceptable (improvement may be desirable) | The Building Act sets no required level of structural improvement (unless change in use) This is for each TA to decide. Improvement is not limited to 34%NBS. | 100%NBS desirable. Improvement should achieve at least 67%NBS |
| Moderate Risk Building | B or C | Moderate | 34 to 66 | Acceptable legally. Improvement recommended | | Not recommended. Acceptable only in exceptional circumstances |
| High Risk Building | D or E | High | 33 or lower | Unacceptable (Improvement required under Act) | Unacceptable | Unacceptable |

Figure 2.1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 2.1 compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. 0.2% in the next year).

Table 2.1: %NBS compared to relative risk of failure

| Percentage of New Building Standard (%NBS) | Relative Risk (Approximate) |
|---|---|
| >100 | <1 time |
| 80-100 | 1-2 times |
| 67-80 | 2-5 times |
| 33-67 | 5-10 times |
| 20-33 | 10-25 times |
| <20 | >25 times |

## 2.1 Minimum and Recommended Standards

Based on governing policy and recent observations, Opus makes the following general recommendations:

### 2.1.1 Occupancy

The Canterbury Earthquake Order in Council[1] 16 September 2010, modified the meaning of "dangerous building" to include buildings that were identified as being EPB's. As a result of this, we would expect such a building would be issued with a Section 124 notice, by the Territorial Authority, or CERA acting on their behalf, once they are made aware of our assessment. Based on information received from CERA to date, this notice is likely to prohibit occupancy of the building (or parts thereof), until its seismic capacity is improved to the point that it is no longer considered an EPB.

### 2.1.2 Cordoning

Where there is an overhead falling hazard, or potential collapse hazard of the building, the areas of concern should be cordoned off in accordance with current CERA/Christchurch City Council guidelines.

### 2.1.3 Strengthening

Industry guidelines (NZSEE 2006 [2]) strongly recommend that every effort be made to achieve improvement to at least 67%NBS. A strengthening solution to anything less than 67%NBS would not provide an adequate reduction to the level of risk.

It should be noted that full compliance with the current building code requires building strength of 100%NBS.

### 2.1.4 Our Ethical Obligation

In accordance with the IPENZ code of ethics, we have a duty of care to the public. This obligation requires us to identify and inform CERA of potentially dangerous buildings; this would include earthquake prone buildings.

## 2.2 Compliance

A brief summary of the requirements of the various statutes and authorities that control activities in relation to building in Canterbury is included as Appendix 1.

[1] This Order only applies to buildings within the Christchurch City, Selwyn District and Waimakariri District Councils authority

# 3 Background Information

## 3.1 Building Description

The Main Block of the CGHS campus was constructed in 1983 when the school was relocated to its current site. The Main Block is a four storey (three suspended levels) building and includes teaching spaces on the upper levels and food preparation, library and administration areas on the ground floor. The building is approximately 60m long and 29m wide. The upper levels are serviced by a stairwell at both the western and eastern ends, along with an elevator at the eastern end.

Table 3.1: Gravity and Lateral Force Resisting Systems

| Structural System | Description |
|---|---|
| Gravity | Precast double tee floors spanning onto reinforced concrete beams, which span onto reinforced concrete columns and walls |
| Lateral – (North – South / transverse direction) | 250mm thick reinforced concrete shear walls |
| Lateral – (East – West / longitudinal direction) | 300mm thick reinforced concrete shear walls |
| Foundations | Insitu reinforced concrete circular piles to a depth of 12.5m below building floor level, with a combination of ground beams beneath shear walls and isolated pile caps below gravity columns. |

## 3.2 Gravity System

The Main Block is a concrete structure with a gravity system including precast double Tee floor units supported by the web onto precast concrete beams with corbels. The floor units span in the transverse direction to beams that are supported on concrete columns and walls.

The roof structure is a series of steel portal frames.

## 3.3 Lateral System

The lateral load resisting system in the transverse direction includes full height shear walls at the ends of the four storey sections and at the eastern end of the administration area. In the longitudinal direction the lateral load resisting system relies on the stair and elevator core walls along with a full height shear wall on the southern side at the eastern end. Refer Figure 3.1.

As these lateral load resisting elements are located more towards the southern side of the building, some moment frame action may be utilised on the northern side of the building.


Figure 3.1: Ground Floor Plan

## 3.4 Foundation system

The in ground structure includes 12.5m deep in situ concrete piles under either deep ground beams under the concrete walls, or pile caps under the concrete columns. The piles penetrate through the upper layers of sand and silty soils to found onto a gravel layer. The ground floor slab is typically a 100mm thick slab on ground with slab thickenings on the column lines.

Seismic base shear is assumed to be transferred to the ground via lateral resistance of the piles, passive resistance of the ground against the foundation beams and friction beneath the ground bearing floor slab. The original designer, and the high-level verification undertaken during the preliminary design process, confirm that the base shear capacity was dependant on these three mechanisms, as the piles alone could only provide approximately half of the based shear demand (calculated using NZS4203:1984).

Seismic overturning loads are transferred to the ground via axial loads (tension and compression) in the piles. Some piles are specifically noted on the foundation plan as being tension piles, and these are typically located beneath the end regions of the shear walls, where the overturning forces will be transferred to the foundation structure.

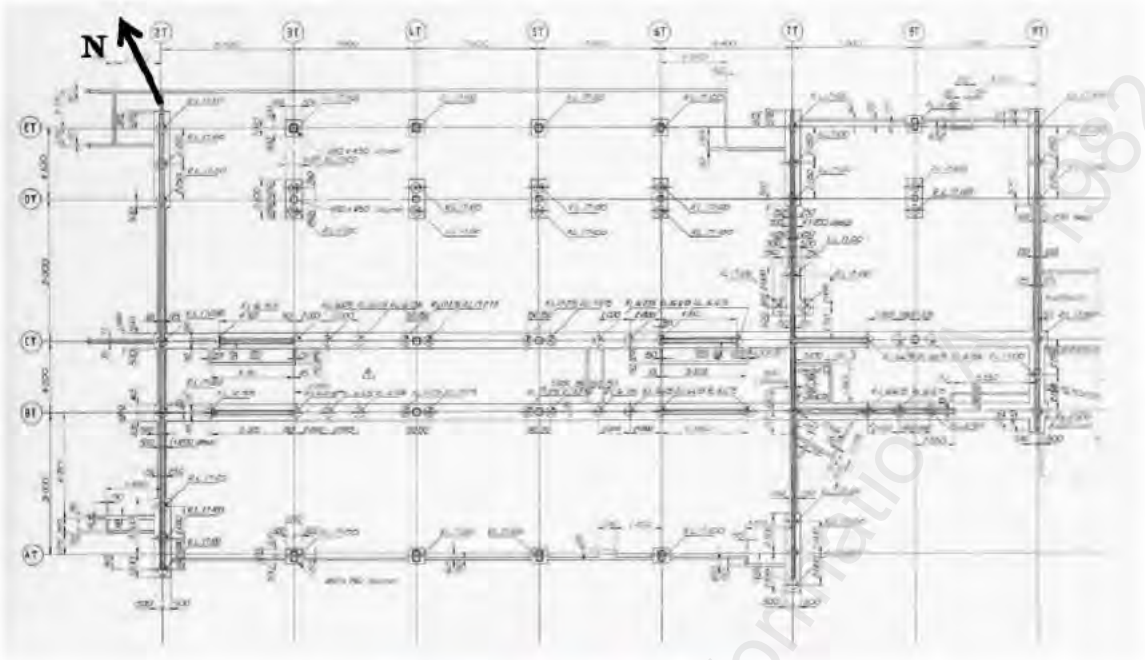


Figure 3.2: Foundation Layout Plan

# 4 Building Survey

## 4.1 Field Inspections

Various inspections of the site have been carried out by s 9(2)(a) OIA (Opus), s 9(2)(a) OIA (Opus) and s 9(2)(a) OIA (Opus) since 4 September 2010. Floor linings have been removed in some areas to inspect the floor slab, and an inspection pit has been established to inspect the top of the southernmost pile beneath the transverse wall on Gridline 7T/AT.

A level survey was carried out by Opus on the 8th of December 2011. This was done using equipment that can determine spot heights taken throughout the building. The general findings of the levels survey include:

- The ground floor slab on ground has slumped at locations away from the pile caps and ground beams where the slab was supported by the ground only. These settlements were as much as 65mm.
- The levels survey of the upper levels of the building show that the building is generally level, with a maximum variation of ± 20mm, with some of this variation being attributed to the deflection of the floor units and the beams.

The results of the level survey are included as Appendix 4.

## 4.2 Original Documentation

A full set of structural drawings by the Ministry of Works, dated 1983, have been obtained and are included in Appendix 2. Architectural drawings are also available, but have not been included in this report at this stage.

The available drawings are a construction issue set. An as-built record, which would contain valuable information about the pile construction, has not been located.

The original design calculations for the building could not been obtained, although some preliminary design check calculations have been located, which indicate the calculated base shear is consistent with our calculation using the design standards in force at the time of the design.

The available information has been used to confirm the structural systems, investigate potential critical structural weaknesses (CSW's) and undertake an analysis of the building.

## 4.3 Observed Damage

The Main Block suffered significant damage during the February Earthquake, which has worsened slightly in the subsequent aftershocks. Various site inspections have been undertaken since this time, including some intrusive inspection of critical areas. A selection of photographs showing some of the damage is included as Appendix 3.

### 4.3.1 Primary Structure Damage

The main areas of structural damage are:

- The sub soil to the northern side of the building and under the whole foot print of the building has subsided and spread towards the adjacent stream. This subsidence has caused the ground bearing floor slab to settle. This is most noticeable in the food tech room and sewing room on the southern side of the building along with areas within the library on the northern side of the building. This settlement is up to approximately 60-100mm in some areas and has caused damage, including vertical displacement across cracks in the slab on grade. The slab settlement is most pronounced at the mid span points between the columns and walls. It is expected that the foundation beams have also settled, but to a lesser extent than the slab.

- There is also damage to the in ground perimeter beam on the northern side of the building, which has cracked and displaced horizontally, most noticeably at the base of the beam mid-span between the return beams. This appears to be due to the beam providing restraint to soil behind that has spread towards the river.

- Cracks in concrete shear walls, most obvious at elevator core wall on ground floor (approx. 0.5mm crack).

- Non-structural damage to concrete walls adjacent to joints where the mastic joint sealant has pulled cover concrete from the walls. Most notable on the upper levels at eastern end.

- Fine cracks at some beam column joints on the ground floor on the northern side of the building.

- Fine cracks to some beams and columns, particularly on the ground floor level.

- The restraint cable fixings for the extractor fans on the roof failed and one of the extractor fans had fallen onto the roof.

- Damage to awning structure on the northern side of the building due to ground subsidence.

- Damage to the Principal's Office, due to loss of support to the foundation as a result of liquefaction.

### 4.3.2 Non Structural Elements

Damage has been observed to non-structural elements such as doors, windows and internal non-load bearing walls. This damage includes cracking to plaster board linings to partition walls and other damage associated with the above mentioned ground damage and subsidence.

## 4.4 Remedial Works to Date

In the immediate aftermath of the February 2011 seismic event a series of temporary works and access restrictions were put in place. The main items being:

- No access to the approx. 1.5m wide section of the library on the northern side of the building at ground floor. This was due to the loss of substrate support below the slab and perimeter foundation beam.

- No access to the food technology rooms and cafe on the southern side of the building at ground floor. This was due to the loss of substrate support below the slab. This has now been mitigated by the installation of the raised timber floor that does rely on only partial support from the existing slab on grade.
- The restraint of various non-structural walls. Where the slab on grade has slumped and the bottom plate of the timber frame walls has in some places lost its connection to the slab. In order to stabilise the walls, new fastenings were placed here.
- Replacing and re-fastening the air intake stacks on the roof.

# 5 Detailed Seismic Assessment

The detailed seismic assessment has been based on the NZSEE 2006 [2] guidelines for the "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes" together with the "Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure" [3] draft document prepared by the Engineering Advisory Group on 19 July 2011, and the SESOC guidelines "Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes" [4] issued on 21 December 2011.

An initial qualitative assessment as outlined in the DEEP guidelines was not undertaken on this building prior to completing a detailed quantitative analysis. Identification of load paths, critical structural weaknesses and a collapse hazards has been completed as part of the detailed quantitative analysis.

## 5.1 Critical Structural Weaknesses

The term Critical Structural Weakness (CSW) refers to a component of a building that could contribute to increased levels of damage or cause premature collapse of a building.

The following potential CSW's have been identified during the assessment of the building:

- Inadequate shear reinforcing in the link beams between the longitudinal and transverse shear walls. These beams are expected to experience high shear demand when there is high ductility demand on the longitudinal shear walls. This is due to their relatively short span and the displacement demand on the beams due to the coupling action between the two perpendicular shear walls. There is currently no evidence of damage occurring in these areas due the February 2011 Earthquake and aftershocks, and damage is only expected during high levels of displacement in the longitudinal walls. Further review of these beams is required to determine the expected displacement capacity compared to the displacement demand occurring when a plastic hinge forms at the wall base.

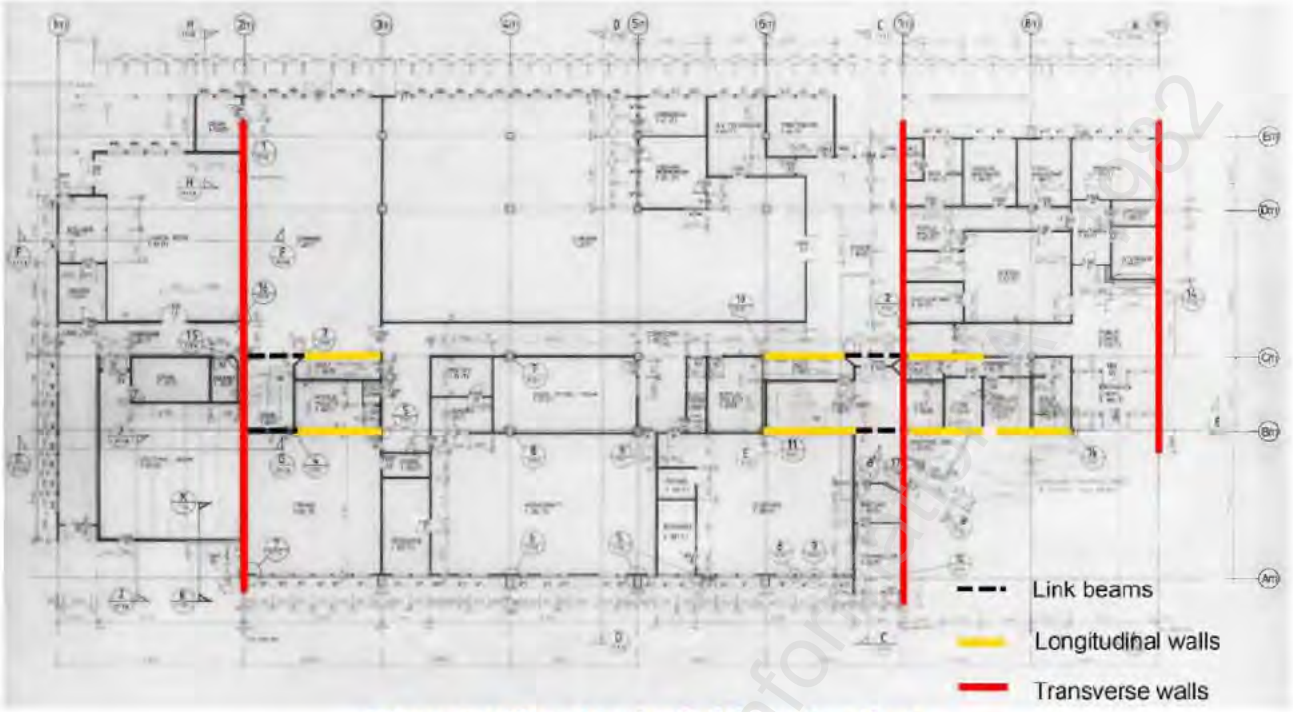


Figure 5.1: Plan showing link beam locations

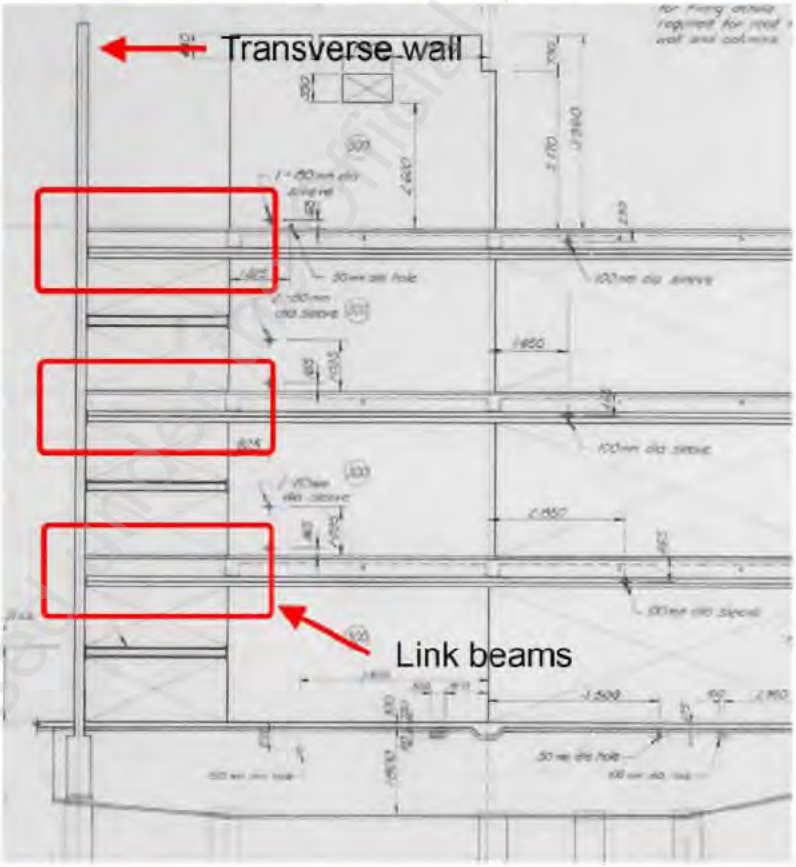


Figure 5.2: Longitudinal wall elevation showing link beams

- Tortuous diaphragm load path to the south east end shear walls around the lift well. This is unlikely to lead to premature collapse, so is not considered to be a CSW, but could result in increased levels of damage locally. Further review of this is required to ensure adequate performance of the floor diaphragm.

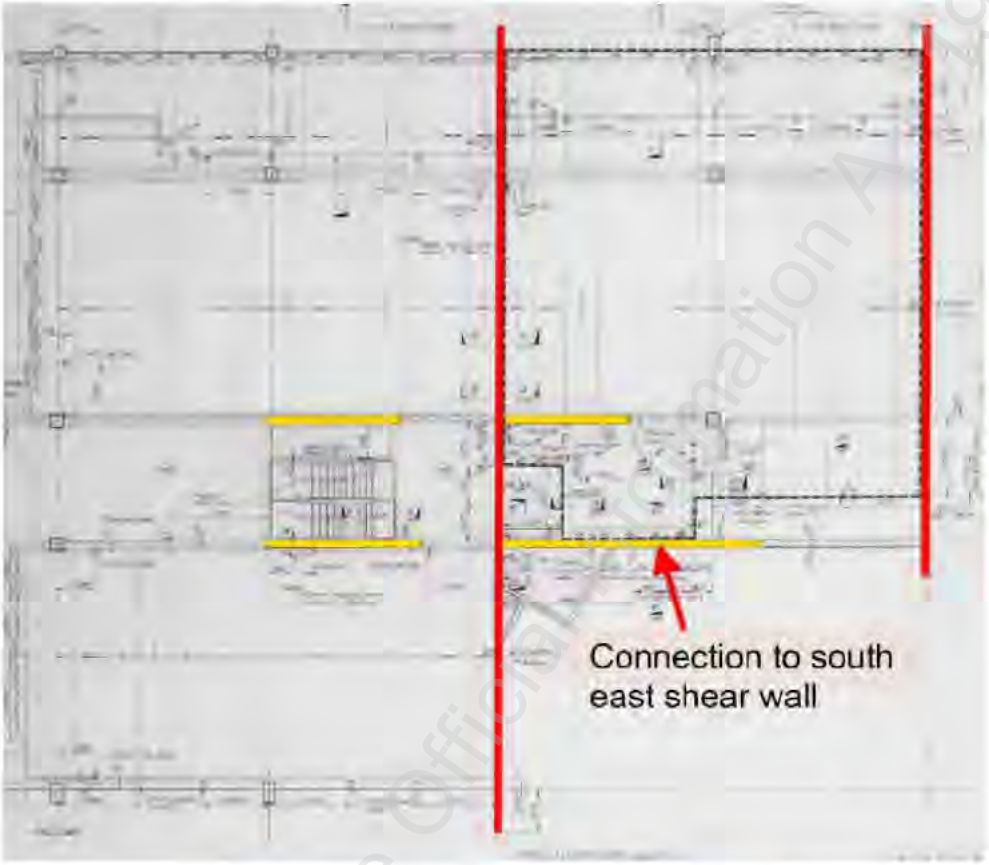


Figure 5.3: Floor plan at east end of building

## 5.2 Quantitative Assessment Methodology

The assessment assumptions and methodology have been included in Appendix 5 of the report due to the technical nature of the content. A brief summary follows:

1. The building, including pile foundations, was analysed using an elastic response spectrum analysis (ERSA) method, as the building superstructure was expected to exhibit a predominantly elastic response. To allow for non-linear behaviour that was expected in some of the main structural members, increased ductility factors were used for these elements in accordance with NZS1170.5 (for example the longitudinal shear walls). The soil foundation interaction will be a key factor in determining the actual response of the building, therefore complex non-linear time history analysis (NLTHA) would not necessarily improve the of the modelling precision unless the soil interaction effects were analysed and accurately modelled. To achieve this would require a significantly greater analytical input.
2. The building was analysed using a 3-D model created using ETABS analysis software.
3. The base shear was calculated from the seismic weight of the building using the spectral values established from NZS1170.5, with an updated Z factor of 0.3 (B1/VM1).

4. The building was assessed as Importance Level 3.

5. The building superstructure has been assessed with a number of simplifying assumptions about the soil structure interaction and flexibility of the foundations. These assumptions are likely to lead to a conservative assessment of the seismic force applied to the superstructure, but a low estimate of the seismic deformations, particularly in the piles and foundation beams. This is particularly relevant for long duration shaking events, such as an Alpine Fault event (M8.0), where liquefaction may occur to the supporting soils part way through an event, which will significantly reduce the stiffness of the upper soils at the same time that lateral spreading is initiated to towards the river. This will materially alter the response of the building from the non-liquefied soil response, as well as significantly reducing the capacity of the soil to resist base shear load and overturning loads from the superstructure. Refer Appendix 5 for a fuller description of these assumptions and effects on our analysis.

## 5.3 Limitations and Assumptions in Results

Our analysis and assessment is based on an assessment of the building in its undamaged state. Therefore the current capacity of the building may be slightly lower than that stated.

The results have been reported as a %NBS and the stated value is that obtained from our analysis and assessment. Despite the use of best national and international practice in this analysis and assessment, this value contains uncertainty due to the many assumptions and simplifications which are made during the assessment. These include:

- Simplifications made in the analysis, including boundary conditions such as foundation fixity.
- Assessments of material strengths based on limited drawings, specifications and site inspections
- The normal variation in material properties which change from batch to batch.
- Approximations made in the assessment of the capacity of each element, especially when considering the post-yield behaviour.

## 5.4 Quantitative Assessment

A summary of the structural performance of the building is shown in Table 5.1: Summary of Seismic Performance. Note that the values given represent the critical elements in the building, as these effectively define the buildings capacity. As noted in Appendix A.2 Analysis parameters, the building was analysed using a displacement ductility factor ($\mu$) equal to 1.25 in the transverse direction, and 2.5 in the longitudinal direction, due the ductile detailing of the concrete shear walls.

Modes of failure that do not govern the building's performance are not included in the table, except as noted for cases where higher ductility factors have led to the component being classified as non-critical.

Table 5.1: Summary of Seismic Performance

| Structural Element/System | Failure Mode or description of limiting criteria based on displacement capacity of critical element. | Critical Structural Weakness and Collapse Hazard | % NBS based on assumed capacity |
|---|---|---|---|
| Concrete shear walls: Transverse direction | Concrete walls in the transverse direction are squat walls (typically their length is greater than their height). One is located at the west end of the building and two are located towards the east end of the building. The walls are typically 250mm thick, with 2 layers of 12mm diameter vertical bars at 450mm centres, and 2 layers of 16mm diameter horizontal bars at between 150 - 250mm centres. There are typically larger diameter vertical bars provided in the end regions of the walls and around openings. The failure mode is in shear. | No | 38% - >100% |
| Concrete shear walls: Longitudinal direction | Concrete walls in the longitudinal direction are isolated piers with an aspect ratio of approximately 2.5:1 (height to length ratio). The walls are located along two separate gridlines which are offset slightly toward the south end of the building. The walls are typically 300mm thick, with confined end regions containing between 12 – 16 no. 24mm diameter vertical bars in 2 layers, and 10mm diameter horizontal enclosed stirrups at 125mm centres. The central regions of the walls typically have 2 layers of 16mm diameter vertical bars at 450mm centres and 2 layers of 12 or 16mm diameter horizontal bars at between 125 – 200mm centres.<br><br>The south east most wall does not have confined end regions, and is reinforced with 12mm diameter bars at 450mm centres vertically and 300mm centres horizontally.<br><br>The demand to capacity ratio is governed by flexure, although the shear capacity of the wall has not been checked for the demand associated with flexural over-strength. | No | 55% - >100% |
| Link beams | These beams span in the longitudinal (east – west) direction of the building, and are expected to be subject to high displacement demand and therefore high shear demand due to coupling action when there is high displacement of the shear walls in the longitudinal direction. The failure mode is in shear. | No | 63% - 94% |
| Pile foundations: Pile Group | Assuming that the concrete slab and foundation beams have the capability to distribute the base shear between the piles then shear capacity of the entire pile group varies from 55%NBS in the transverse direction, and 100% in the longitudinal direction; the difference in capacity being related to the different ductility in each direction. This is ignoring any contribution provided by the passive resistance of the soil on the foundation beams, and shear friction of the soil on the underside of the slab, as the reliable capacity of this mechanism is questionable unless the susceptibility of the underlying soil is adequately mitigated. | No | 55% (N-S direction)<br><br>100%(E-W direction) |

## 5.5 Discussion

Based on our quantitative assessment, the Main Block superstructure ignoring foundations has a computed strength in the overall lateral load resisting system that exceeds 33% NBS.

The building's calculated strength is limited by the shear walls in the transverse direction, which have computed strengths in the range of 38% to greater than 100% NBS. 38% NBS represents the failure of the first transverse wall element, but does not represent failure of the building as a whole. This is discussed further below.

Our assessment of the pile foundations has assumed that ground improvements will be undertaken to mitigate liquefaction and lateral spreading, and that the pile capacity will govern. This is not the current state of the building, where weak upper layers of the soils govern the lateral load capacity of the foundation system.

### 5.5.1 Transverse Shear Walls

The transverse shear walls are large squat walls, which are likely to fail in shear, and appear to be designed for this. Due to this, these walls have been assessed as being nominally ductile ($\mu = 1.25$), which in turn corresponds to a higher level of design loading.

There are three of these walls in the transverse direction, one each at the west and east ends of the building, on gridlines 2 and 9, respectively, and one between these on gridline 7, which is also located towards to east end of the building.

Due to the layout of the building, the walls on gridlines 2 and 7 attract over 90% of the lateral load in the transverse direction, and therefore govern the building capacity in this direction. The governing element in this direction is the central pier of the gridline 7 wall, which has a capacity of 38 %NBS. The other two piers of the wall have a capacity greater than 100 %NBS, and it is expected that once failure of the central pier occurs, lateral loads would be shed to the other piers with remaining capacity. Therefore, the overall capacity of the gridline 7 wall is likely to be in excess of 38 %NBS.

The wall located on gridline 2 has a capacity in the order of 94 %NBS, while the wall on gridline 9 has capacity in excess of 100 %NBS. Therefore, the overall building superstructure capacity in the transverse direction is governed by the shear walls, and is expected to be greater than 38 %NBS, but less than 94 %NBS.

### 5.5.2 Longitudinal Shear Walls

The longitudinal shear walls are typically isolated slender piers, which are likely to develop a ductile flexural failure mode, and are reasonably well detailed for this. These walls have been assessed as having limited ductility ($\mu = 2.5$). The walls typically have well reinforced confined end regions at both ends, with minimal steel in the centre regions of the wall, therefore they were down rated to a ductility of 2.5, to ensure dependable performance of the mid zone of the walls under higher compression loads, rather than the value of 3.0 which is typically available for walls classified as having limited ductility (Cl. 2.6, NZS 3101:2006 [5]). The limited ductility classification of the walls corresponds to a lower level of loading than that used in the transverse direction.

There are longitudinal walls located on both gridlines B and C, and the overall centre of rigidity of these walls is offset slightly towards the south end of the building. On gridline B there are three independent walls which extend to the roof level, and one further wall which extends two levels above ground. Along gridline C, there are two independent walls which extend to the roof level, and one further wall which extends to the top floor, level four.

With the exception of the short wall on gridline B, the longitudinal walls typically have a flexural capacity greater than 80 %NBS, with some exceeding 100 %NBS. The short wall on gridline B is lightly reinforced when compared to the other longitudinal walls, and does not have confined end regions. Due to this, it appears this wall was not originally designed to be part of the lateral load resisting system. This wall is expected to fail in shear and it has a capacity in the order of 55 %NBS. It is expected that once failure of this wall occurs, lateral loads would be shed to the other walls along gridline B which have greater capacity. However, as this wall provides gravity support to parts of the first and second suspended floors, loss of support to the floor slabs may result from failure of the wall.

If the potential loss of gravity support at the short wall on gridline B can be addressed, it is expected that the overall capacity in the longitudinal direction will be greater than 55 %NBS, but less than 80 %NBS.

### 5.5.3 Link Beams

The link beams span a relatively short distance along gridlines B and C, between the longitudinal shear walls and the transverse shear walls located on gridlines 2 and 7. Due to this these beams are expected to experience displacement demand and therefore high shear demand when there is high ductility demand on the longitudinal shear walls.

The shear capacity of these beams is in the range of 63 – 94% NBS.

### 5.5.4 Pile Foundations

Assessment of the shear capacity of the pile foundations was undertaken assuming good ground conditions to determine whether it was worthwhile undertaking ground improvements to the current foundation system. The insitu piles are typically capped by isolated pile caps underneath the gravity columns, and by continuous ground beams underneath the lines of the shear walls. The current foundation system does not rigidly constrain all the piles together as one group.

Shear demand on individual piles was determined from the ETABS analysis. As noted above, the design loading in the transverse direction was significantly higher than that in the longitudinal direction, and therefore this governed the demand on the piles. From the individual pile assessment it was found that the pile capacity varied greatly from 11 %NBS to greater than 100 %NBS. This capacity was determined using a simplifying assumption to determine pile loads, which will tend to overstate the demand on some piles.

A simplified assessment of the piles acting as a group was made, assuming that rigidly constraining the piles as a group is achievable. This assessment was carried out to determine whether it is feasible to achieve acceptable performance of the pile group if ground improvements are undertaken and the ground floor foundation system can be improved to rigidly constrain the piles as one group. The group capacity was in the order of 55 %NBS in the transverse direction and greater than 100 %NBS in the longitudinal direction.

# 6 Summary of Geotechnical Appraisal

## 6.1 General

A geotechnical investigation and assessment for the site has been completed by Opus; refer Christchurch Girls High School, Volume 2 - Geotechnical Assessment Report. This report includes site investigation records, factual report, interpretative report and predictions on lateral spread and differential settlements in future earthquake events.

Based on construction drawings the Main Building is founded on typically 12.5m deep, 450mm to 500mm diameter concrete piles. The piles have been designed to perform in both tension and compression.

## 6.2 Geotechnical Investigation

Site investigations were carried out by Opus in August and September 2011. The site wide investigations consisted of three boreholes and twelve Cone Penetration Tests. One Borehole and three CPT's were conducted in the vicinity of the Main Building (Block A).

The results of the 2011 investigations were interpreted in conjunction with two historical borehole logs retrieved from archives for the Main Building.

Ground conditions are variable across the school site. The interpreted ground conditions beneath the Main Building (Block A) are represented by Figure 5 (Cross Section C-C), refer Geotechnical Assessment Report.

## 6.3 Liquefaction Analysis

Records from the CPT testing in the vicinity of the building have been analysed using LiquefyPro. The liquefaction analysis has indicated the soils in the top 10m of the ground profile are susceptible to liquefaction in both the ultimate limit state (ULS) and serviceability limit state (SLS) design level earthquakes.

Ground settlement and lateral spreading has been observed on the northern side of the Main Building.

Actual lateral spreading measured adjacent to the Main Building has been of the same order of magnitude as the lateral spread predicted by analysis of the CPT data for a Local Fault earthquake event.

Negligible lateral spreading (less than 50mm) was observed on the southern side of the Main Building.

# 7 Conclusions

Following our detailed assessment we concluded that:

a) Capacity of the superstructure is longitudinal direction is in excess of 55% NBS.

b) Capacity of the superstructure in the transverse direction is in excess of 38% NBS.

c) The building is not considered Earthquake Prone.

d) The capacity of the building is governed by the performance of the foundation system, particularly lateral spreading of material beneath the buildings toward the river.

e) The building has sustained severe damage to ground floor slabs and foundation, including the piles. The superstructure is largely undamaged.

f) Significant repairs are required to the foundation and ground floor levels.

g) This repair will cause considerable disruption to the normal operation of the buildings.

h) Further detailed assessment of the foundation system and soil-structure interaction is required to more precisely determine the overall performance of the building.

i) We consider that the Main Block in remains suitable for occupancy by students and staff. This is based on our assessment that the building has no CSW's, is not an Earthquake Prone Building, has suffered moderate structural damage to the superstructure in the recent earthquake sequence and, by our estimation, has a reasonable margin between the collapse limit state and our calculated % NBS at ultimate limit state.

# 8 Recommendations

We recommend;

a) A Damage assessment report be completed.

b) A Feasibility of Repair report be completed to determine likely programme and cost of repair.

c) If it shows it is feasible to repair the building - undertake a detailed assessment of the foundation system and soil-structure interaction to inform potential repair solutions.

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13 March 2015

Ministry of Education
PO Box 2552
Christchurch 8140

ATTENTION: Peter Fenwick

Dear Peter

**Christchurch Girls High School – Master Planning**
**Main Block Assessment**

Further to our email to David Hobern dated 2 March 2015, setting out the process we have adopted for identifying the costs of upgrading the Main Block versus the cost of replacement, we have evaluated the following options:

a. Replace with a new Main Block on area of existing tennis courts
b. Repair the Main Block – Worst case
c. Repair the Main Block – Best case

For the repair options above, the difference between worst case and best case is with the proposed solution to remediate the foundations.

The worst case is based on what the Structural and Geotechnical consultants believe has occurred with the ground conditions under the building, the effect this has had on the piles and the likely remediation to repair and protect against future similar seismic events.

The best case is based on the best possible outcome of damage that would have occurred to the piles during the earthquakes. To determine if the best case can be achieved, further invasive testing is required which will be highly disruptive to the school operation. Work involves evacuating the building for an estimated six weeks, bringing machinery into the building, breaking up the concrete slab to expose the pile caps and drilling into the piles for a depth of at least four meters to see what damage has occured to the length of the piles. This would then all need to be reinstated to allow re occupation of the spaces.

The cost estimates for each option are summarised as follows:

a. Replace with new Main Block
b. Repair Main Block – Worst Case
c. Repair Main Block – Best Case

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**Replace Main Block (Option a)**

This cost estimate allows for a new building of the same area constructed on the existing tennis courts which has better ground conditions than the current location. This estimate also includes the cost of demolishing the existing building, making good the surrounding area and constructing new tennis courts in a new location.

**Repair Main Block – Worst Case (Option b)**

The extent of work to repair the existing building is summarised as follows:

1. Foundation repairs to a minimum 67% NBS
2. Seismic Strengthening of structure to a minimum 67% NBS
3. Removal and reinstatement of partitions, floor coverings, ceilings, etc for 1 & 2 above
4. Repairs to surroundings of building
5. Address weathertightness Issues
6. MLE improvements to the basic level (acoustics, data, lighting, power, etc)
7. Asbestos issues allowance
8. Building services/infrastructure upgrades to minimum acceptable level
9. Temporary facilities (decanting)
10 Professional Fees

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**TOTAL**

**Repair Main Block – Best Case (Option c)**

The extent of work to repair the existing building is the same for all aspects above except for item 1 above for the foundation repairs. The best case scenario is expected to yield a saving of s 9(2)(b)(ii) from the worst case option making a total cost for this option at s 9(2)(b)(ii) OIA

Please refer to the attached cost estimates and letter from Davis Langdon which provides a more detailed breakdown of the high level costs relating to each option. Note that the above costs are based on current rates and do not allow for escalation.

Should you wish to discuss any aspect of the above please feel free to contact the writer.

Yours faithfully
**RDT PACIFIC**
s 9(2)(a) OIA

Director

# Memo

| | | | |
|---|---|---|---|
| **To:** | s 9(2)(a) OIA - Jasmax | **Job No:** | 53612.301 |
| **From:** | s 9(2)(a) OIA | **Date:** | 6 March 2015 |
| **cc:** | s 9(2)(a) OIA (RDT Pacific Ltd)<br>s 9(2)(a) OIA (Lewis Bradford Consulting Engineers) | | |
| **Subject:** | Christchurch Girls High School - Block A: Conceptual repairs to foundations based on existing information | | |

Dear 9(2)(a)

As requested, Tonkin & Taylor Ltd (T&T) has undertaken preliminary geotechnical analyses to assist in the development of conceptual repair solutions for Block A (Main Block) at the Christchurch Girls High School (CGHS) site in Christchurch. The work described in this report was commissioned by Jasmax on behalf of the Ministry of Education (MoE).

The objective of our work was to develop '*best*' and '*worst*' case concept level repair solutions to the piled foundations based on the limited information which is currently available. We understand that these conceptual repairs are to be used to support a high-level costing exercise for the Ministry of Education (MoE) during the Master Planning of the CGHS earthquake repair programme.

T&T have undertaken a desktop review of the ground conditions and the damage to each of the CGHS buildings as documented by Opus International Engineers Ltd (Opus) as part of our Master Plan Report[1]. This memo should be read in conjunction with our Master Planning Report.

We have undertaken the above scope of work in conjunction with Lewis Bradford Consulting Engineers (LBA). This memo should be read in conjunction with their drawings which describe a high level assessment of the strengthening required to achieve 67% of New Building Standard (NBS)[2].

## 1 Block A (Main Block) Foundation system

T&T understand that the foundation system of the existing Main Block building comprises 600mm diameter, 12m deep, reinforced concrete piles. The piles are connected to deep ground beams under the reinforced concrete walls, and pile caps under the reinforced concrete columns. The existing ground floor slab is typically a 100mm thick slab on ground with thickenings on the column lines.

In 2011, Opus undertook a number of site inspections and noted that the ground bearing floor slab had settled, with settlement up to approximately 60-100mm in some areas[3]. The building however, was generally level.

[1] Tonkin & Taylor Ltd (January 2015) Report prepared for Jasmax titled *Christchurch Girls High School Master Planning, Geotechnical Desktop Assessment*, T&T Ref 53612.301.

[2] Lewis Bradford Consulting Engineers (05/03/2015) Drawings titled *Christchurch Girls High School Master Planning Main Block High Level 67% NBS Seismic Strengthening*, Sheets SS-SK01 through SS-SK05, LBA Ref 114177.

[3] Opus International Consultants Limited 2014 (10 July 2014) Report prepared for the Ministry of Education titled *Christchurch Girls High School Main Block, Detailed Engineering Evaluation Quantitative Assessment Report*, Opus Reference 6-DP109.00 /005SC Revision 2.

# 2 Ground conditions

Ground conditions across the CGHS Campus are given in our Master Planning report[1]. The ground conditions for the Main block, located in the central portion of the site, are also summarised in Table 1. Existing information indicates the groundwater level is likely to be between 0.7 and 2.8m below the ground level (bgl).

**Table 1: Generalised geotechnical profile: CGHS Main Block**

| Layer number | Typical depth to top of layer (m) | Typical layer thickness (m) | Material description | Geological formation | Typical SPT N (uncorrected) | Typical qc (MPa) |
|---|---|---|---|---|---|---|
| 0 | 0 | 0.5 – 1.2 | Fill | - | - | - |
| 1 | 0.5 – 1.0 | 8.0 – 11.0 | Interbedded silt, silty sand, silty gravel, sandy gravel and gravel with some sand, firm to stiff, medium dense to very dense. | Yaldhurst member, Springston Group | 3 – 9 | 0.5 – 30.0+ |
| 2a | 11.0 - 12.0 | 5.0 – 8.0 | Interbedded silty sand and sand with some silt and gravelly lenses, dense to very dense. | Christchurch | 10 – 50+ | 5 – 25 |
| 2b | 18.0 – 20.5 | 0.5 - 2.0 | Interbedded silt to sandy silt, soft to stiff (aquaclude). | Christchurch | 11 – 16 | 2 - 10 |
| 3 | 21.0 + | Unconfirmed | Interbedded sands, sandy gravels and gravels, dense to very dense. | Riccarton | 50+ | 30.0+ |

It should be noted that the above ground model may be refined upon completion of additional machine drilled borehole and Cone Penetrometer Test (CPT) investigations. Similarly, laboratory testing on selected samples may indicate that some of the silt deposits identified in the existing investigations are unlikely to be susceptible to liquefaction. These uncertainties should be investigated as part of the detailed design and cost assessment process.

# 3 Seismic analysis

T&T has completed preliminary geotechnical analyses to assess the site liquefaction and lateral spread risk. The results of this work are presented in our Master Planning report[1].

In summary, the analyses indicated that for a design ULS event ($M_W$ = 7.5, $PGA_H$ = 0.35g), the potential liquefaction induced settlement at the location of the Main Block is expected to be in the order of 125-175mm. The preliminary lateral spreading analysis indicated lateral movement of more than 400mm may occur.

# 4 Remedial concepts for foundations

## 4.1 General

T&T have undertaken additional geotechnical modelling of the lateral soil displacement resulting from the Canterbury Earthquake Sequence and in design earthquake events. Preliminary lateral pile analysis was

undertaken to assess the likely magnitude of demand imposed on the piles by lateral soil displacement, and the demand imposed on the piles by the superstructure.

The concept remediation and/or mitigation solutions presented utilise jet grouting where grout is jetted out into the ground from a drilled hole to produce a grouted soil column. This solution creates a localised zone of improved material which is less likely to liquefy in a design ULS earthquake event and does not generally impose significant constraints on future development of the site. If the columns are constructed in a cellular arrangement, permanent mitigation of liquefaction risk over treated depth can be achieved.

T&T considered the use of fibre wrapping the top portion of the piles. This was discounted due to the construction challenges that are likely to be encountered (i.e. dewatering, time constraints).

## 4.2 Modelling

T&T have used Geostudio Slope/W software to undertake preliminary modelling of the ground conditions at the location of the Main Block. Our model included provision for liquefaction occurring in the underlying soils, resulting in lateral spreading of the ground towards the Avon River and Block B/S.

Modelling of the piles was undertaken using Ensoft LPile 2013 software. The original structural drawings provided the design reinforcing layout for the piles and LBA provided indicative piles loads based on their high level assessment.

We have developed '*best*' case and '*worst*' case repair options for the piled foundation based on the results of the above analysis.

## 4.3 *'Worst'* Case: Jet grout – cellular arrangement

For this scenario T&T have assumed that a significant portion of the underlying soils liquefied during the Canterbury Earthquake sequence. Such liquefaction of the underlying soils is assumed to have resulted in settlement of the ground beneath and around the structure and the lateral displacement of the soils towards the Avon River and B/S Blocks. Due to this movement, the piles are assumed to have cracked over the pile length.

Figure 1 attached shows jet grout columns in a cellular arrangement along all gridlines. The columns would be between 2 and 2.5m in diameter, and extend to a depth of approximately 13m below the ground level to key into the underlying dense sands/gravels (Layer 2a). The objective of this solution is to mitigate the liquefaction risk beneath the structure. Further analysis would be required during detailed design if this solution is constructed.

Discussions with Mainmark Ground Engineering Ltd[4] and Hiway Stabilisers Ltd[5] indicate that the cost to install the jet grout columns using this layout is likely to be between $4.0 Million and $10.5 Million NZD.

## 4.4 Best Case: Jet grout – surrounding piles

For the 'best' case scenario T&T have modelled co-seismic demands on the pile. We have assumed that:

- limited lateral and vertical ground movement occurred due to the liquefaction of a 3m thick zone of soil present directly below the water table in Layer 1,
- liquefaction of discrete lenses within Layer 1, and,
- the cumulative thickness of liquefiable deposits within this layer liquefied was significantly reduced when compared to the studies undertaken in 2011. (This key assumption must be confirmed following future laboratory testing of discrete soil samples.)

The soil movements induce both lateral and vertical loads on the pile.

[4] Email from Andrew Masterton (Mainmark Ground Engineering) to Kirsti Murahidy (Tonkin & Taylor), time stamped 5:11pm 23/02/2015 titled *Re: Jet grouting.*

[5] Email from Rob Whitfield (Hiway Stabilisers) to Kirsti Murahidy (Tonkin & Taylor), time stamped 11:14am 25/02/2015 titled *Re: Jet grouting.*

We also applied indicative structural shear and axial pile load demands provided by LBA that were developed as part of their high level assessment[6,7].

The above T&T analysis indicates that high stresses are likely to have been induced in the upper 2-3m of the piles due to the lateral movement of the soil and loads induced by the superstructure/pile interaction.

Figure 2 shows a jet grout column constructed either side of the pile. These columns should overlap providing an equivalent 2m diameter column surrounding the pile and extending to an approximate depth of 4m below the top of the pile.

The objective of this solution is to provide:

- additional shear and moment capacity over the grouted portion of the pile, and,
- enhanced durability around a section of the piles that is likely to have cracked.

As part of detailed design, the project Structural Engineer would need to confirm the magnitude of any such improvement.

## 4.5 Floor slab and ground beams

LBA have provided details for construction of additional ground beams and a replacement ground floor slab (Refer to Footnote 1). T&T are in general agreement that these elements should be constructed in conjunction with the jet grout works described in Section 4.3 and 4.4.



[6] Pers comm. between Scott Sutherland and Kirsti Murahidy (Tonkin & Taylor) and Ashley Wilson (Lewis Bradford Consulting Engineers), 05/03/2015

[7] Email from Robert Lane (Lewis Bradford Consulting Engineers) to Kirsti Murahidy (Tonkin & Taylor) time stamped 2:43pm 05/03/2105 titled *CGHS – Indicative Pile Axial Loadings*

# 5 Applicability

This report has been prepared for the benefit of Jasmax Ltd and the Ministry of Education with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

The conclusions and opinions contained herein are based upon data from investigations undertaken on the site and observations of surface features. The nature and continuity of the sub-surface conditions at the site are inferred and it must be appreciated that the actual conditions may vary from the assumed model.

The susceptibility analyses carried out represent probabilistic analyses of empirical liquefaction databases under various earthquakes. Earthquakes are unique and impose different levels of shaking in different directions on different sites. The results of the liquefaction susceptibility analyses and the estimates of consequences presented within this document are based on regional seismic demand and published analysis methods, but it is important to understand that the actual performance may vary from that calculated.

It is recommended that the final foundation design, drawings and specification are reviewed by an appropriately qualified and experienced Geotechnical Chartered Professional Engineer, who is familiar with the contents of this report, prior to the commencement of construction.

During construction, all earthworks and foundation excavations should be examined by an inspector who is competent to confirm that the subsurface conditions encountered are compatible with the inferred conditions on which this report is based and assess any additional undercut or support requirements.

Tonkin & Taylor Ltd must be immediately contacted if there is any variation in subsoil conditions from those which are described in this report.

Tonkin & Taylor LTD

Environmental and Engineering Consultants

Memo prepared by: Authorised for Tonkin & Taylor Ltd by:

s 9(2)(a) OIA

[redacted]

Geotechnical Engineer South Island Geotechnical Coordinator

CPEng, IntP.E. (NZ), MIPENZ CPEng, IntP.E. (NZ), MIPENZ

Attachments:

Figure 1: Jet Grout layout – Assumed worst case

Figure 2: Jet Grout layout – Assumed best case

Withheld in accordance with s9(2)(b)(ii) Official Information Act 1982

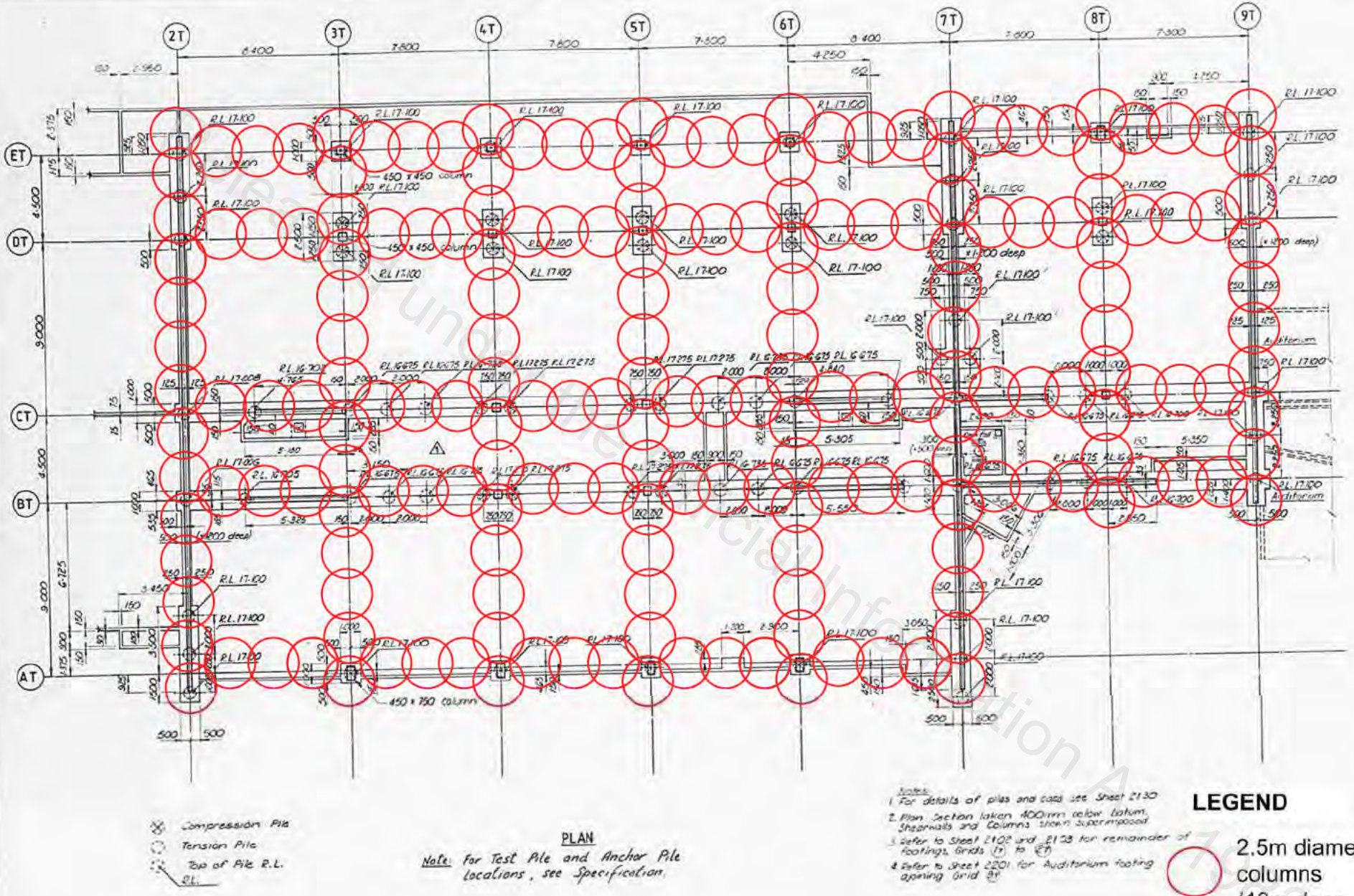


FIGURE 1: "WORST CASE" CONCEPT SKETCH:
Jet grout columns in cellular arrangement to reduce liquefaction potential and provide support to negate use of potentially damaged piles

PRELIMINARY
Tonkin & Taylor Ltd
23/02/2015

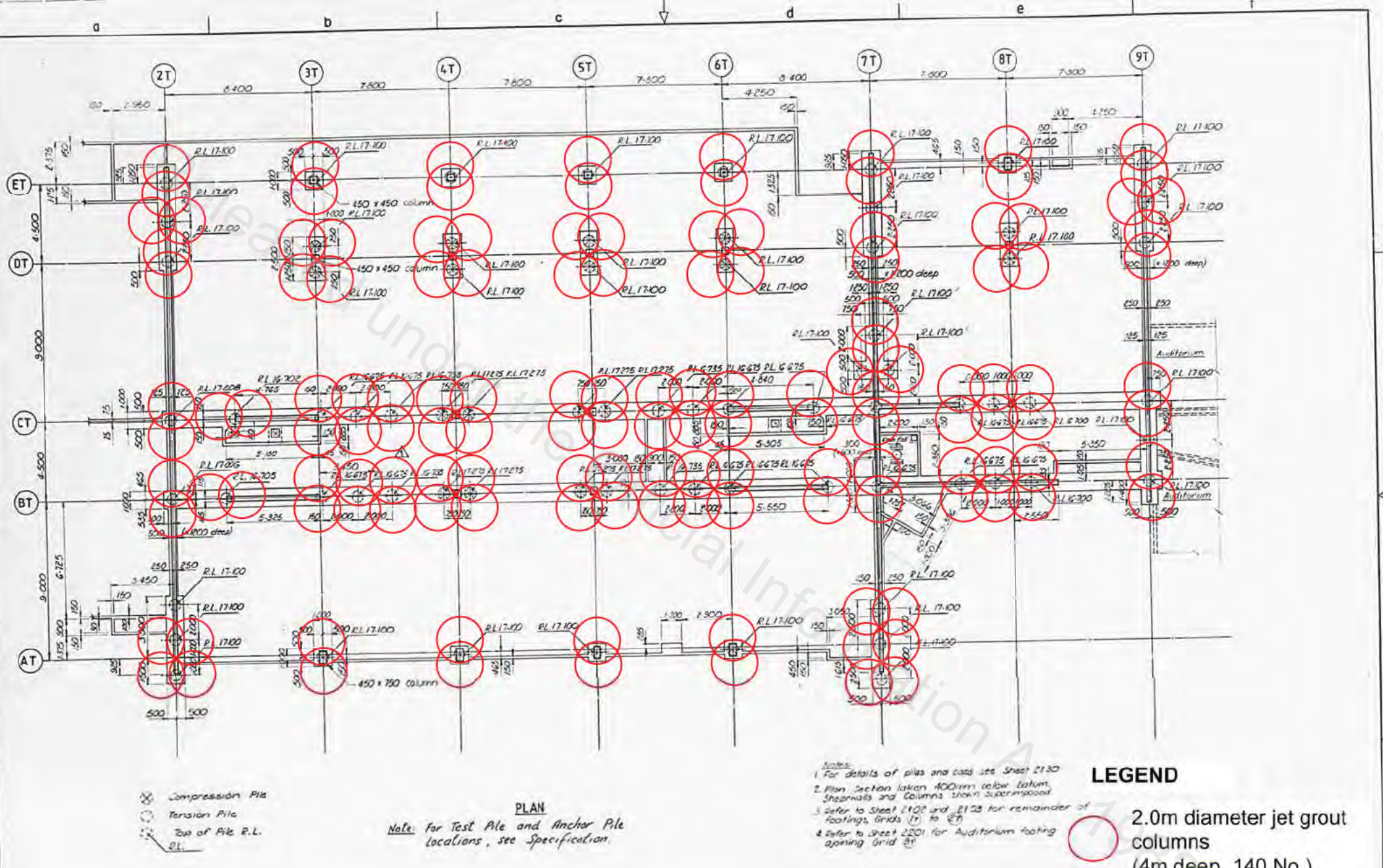


FIGURE 2: "BEST CASE" CONCEPT SKETCH:
Jet grout columns to support existing potentially damaged piles

PRELIMINARY
Tonkin & Taylor Ltd
05/03/2015

DRAFT

MEMORANDUM



| | | | |
|---|---|---|---|
| To: | David Hobern | | |
| Company: | Ministry of Education | | |
| Copy: | s 9(2)(a) OIA | MoE ESG | |
| From: | s 9(2)(a) | | |
| Date | 28 March 2015 | Project No: | 112103.01 |
| Subject: | CBHS AND CGHS – PRELIMINARY VIEWS | | |

As requested, s 9(2)(a) OIA and I met with s 9(2)(a) OIA of LBA and s 9(2)(a) OIA of Tonkin & Taylor, respectively the structural engineer and geotechnical engineer for these projects. Our initial thoughts are as follows:

**CGHS Main Block**

The main block suffered only moderate damage in the earthquakes, however there was considerable uncertainty over the possible extent of foundation damage. It was highlighted that further investigation was needed before work could be fully quantified. The required investigation was not completed before the DEE was finalised.

Subsequently LBA/T&T have been engaged to support the master planning. From this several things have eventuated:

- The proposed foundation repair is the most extreme case that could be foreseen, reflecting the need for further knowledge.
- The structural work comprises both repairs, and what might be required to bring the work up to 67%NBS as assumed for long-term compliance with the MoE target for existing buildings.
- A significant amount of the proposed work is consequential upgrade – for example the services upgrade. As a functioning facility, the existing building services are currently working adequately (although there is some question over this, apparently). However the work proposed represents what may be required to 'future-proof' the building on the basis that much of the plant is nearing the end of its economic life and it would be sensible to upgrade it while the other work is underway.
- The strengthening work is primarily in the floor diaphragms. It is relatively simple work, but disruptive. It may be relatively easily carried out if and when the building is being converted to MLE space.
- The decanting requirement is less clear, and depends on what work is done, and when. The main repair work is at the ground floor and could be done

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piecemeal, provided no other work to the piles is required. However this depends on the ground floor services being maintained. Repair work in stairwells could possibly be done one stair at a time, provided a suitable egress plan could be resolved and assuming that the school's security policies could tolerate construction workers in close proximity to pupils. Alternatively, work could be done after hours. Given the high cost of decanting, this is well worth considering.

- Even if there were some damage to the foundations from future earthquake, it was agreed that this is unlikely to present a significant collapse of loss of life hazard as foundation failure is unlikely to lead to collapse.

- The current capacity of the building is not clear, but it appears to be better than has been stated, on review of the the reports.

Conclusions:

1. The immediate need is to complete the investigations required, which appears to fall into three main parts (with appropriate analysis)

    a. Further geotechnical investigation to complete the geotechnical cross-section for the site.

    b. Excavation to expose the tops of potentially damaged piles, in one or two locations.

    c. Possibly not required, subject to the findings of the prior two, drill a core down one pile to verify its condition through the gravel layer interface.

2. Subject to the investigation, the budget for foundation repairs and strengthening can be confirmed. The most likely outcome is that no work is required to the piles, but there is a possibility that some repair will be needed, along the lines of what was proposed at the CEP stage.

3. The budget may be split into parts:

    a. Work required to repair the building, generally to its pre-earthquake condition, giving consideration to how the work may be staged to avoid decanting, if possible. This is primarily the crack repair to shear walls and ground floor replacement (in out of level areas).

    b. Work required to strengthen the building, over and above repair. This work would presumably be implemented in parallel with work required as an outcome of the master-planning study. Work at the upper levels

(and services replacement) could then be completed if and when the building is converted to MLE space.

Summary: The budget blow-out appears to be primarily a consequence of a mixed brief – containing both repair and strengthening components. If repair only is being completed, the scope of work is largely the same as previously contemplated, subject to the required further investigation being completed to finally confirm scope. Strengthening and replacement of services could be deferred until the MLE upgrades are implements, for the sake of efficiency.

Withheld in accordance with s9(2)(b)(ii) s9(j) and s9(2)(i) Official Information Act 1982

Withheld in accordance with s9(2)(b)(ii) s9(2)(j) and s9(2)(i)
Official Information Act 1982

Regards

s 9(2)(a)
DIRECTOR

113280ME2803 001 doc

## Jack Harrison

**From:** 9(2)(a)
**Sent:** Thursday, 30 April 2015 6:29 PM
**To:** 9(2)(a) ; David Hobern
**Cc:** 9(2)(a) @cghs.school.nz)
**Subject:** CGHS

Hi 9(2)(a) & David

Thanks for taking time to meet with the board yesterday.

I just thought I would bullet point a few of the outcomes of the meeting last night for your record.

- CGHS and MOE agree to proceed with the design and build of the Performing Arts Centre (PAC) on the proposed site as per Jasmax sketches provided.
- The appointment of the design team will begin immediately.
- That the scope of the PAC be increased to include space lost with the link block & replacement of prefab buildings currently on site (current proposal 2060 m2).
- That the planning and demolition of the Link Block proceed immediately
- That demolition of the pool be put on hold whilst costings for to reinstate are obtained (by CGHS) and that the $450,000 earmarked for the demolition of the pool be put toward the cost of possible re instatement.
- That repair (and modernisation to MLE standards) of the Arts Block begin immediately.
- That CGHS and the MOE both acknowledge that decanting should be avoided where at all possible and will work collectively to mitigate decanting requirements.
- That the proposed repair and upgrade of the Main Block be staged over three years with the first stage taking place over the Christmas Holidays of 2015 and the remaining stages over 2016 and 2017 holidays.

We feel what has been proposed is a sound and practical approach to achieving an outcome for the school and we appreciate your preparedness to consider all options. We do however have some concerns that we would like to note. Firstly, we still feel the estimated costs to repair and upgrade the Main Block are low based on previous reports and costings we have received from Engineers and Quantity Surveyors. With the estimated cost of the Main Block (based on MOE figures) increasing from $5,000,000 to $8,000,000 it has already effectively taken $3,000,000 from the budget for works on the rest of the school.

Furthermore we are somewhat skeptical about being able to replace the floor slab (in stages) over the 6 – 8 week window during the school holiday period and would require certainty regarding this. As this is critical to the school functionality we would like to meet with yourself, 9(2)(a), engineers and builders on site to gage their opinion and get some comfort around the practical implications. We acknowledge however that with the staged process beginning later this year, that planning and costings for this will be commencing immediately in which case we will have more certainty on these matters.

We will also need to think of the practicalities of housing students whilst the Arts Block is upgraded and how this may be achieved.

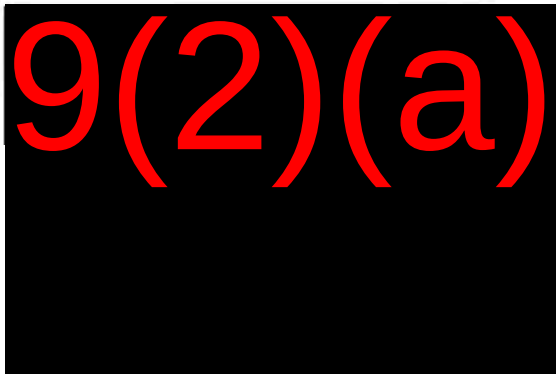
We still have some matters as part of the design phase that we would like to discuss with you (David) around PAC size and also possibilities regarding a solution in the Master Plan to include more Gym

space as our current Gym space is limited, particularly with the growing nature of PE as a curriculum subject.

Looking forward to working together in finding solutions, commencing the project and achieving a good outcome for the school.

Regards

[redacted]



## Jack Harrison

**From:** s 9(2)(a) OIA .co.nz>
**Sent:** Tuesday, 5 May 2015 4:49 PM
**To:** David Hobern
**Subject:** CGHS - Works to Proceed
**Attachments:** SC224EA620815050516430.pdf

Hi David

A summary of the meeting with Christchurch Girls High School where you, 9(2)(a) and I attended last week, I understand the following works are to proceed:

1. The Performing Arts Centre
2. Accomodation to replace the current temporary classrooms (ie Block J, Block 11,L4, Block E, Block F – refer attached drawing)
3. Total repair/upgrade of the Arts Block
4. Staged repair of the Main Block A, preferably starting works during the 2015/2016 school holidays.
5. Demolish or repair school pool.
6. Demolish the Tech Link

For item 4 above, we will need to undertake full design of the works to this block to be able to plan and tender the works in stages, ensuring we have a design that can be constructed in stages.

Therefore we will need to go out for design procurement for all 6 items above, noting that Block A will be constructed in stages of several years.

Can you please confirm that this is also your understanding before we proceed with the design procurement process.

Thanks and regards,

s 9(2)(a) OIA

Managing Director

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**From:** Scanner
**Sent:** 05 May, 2015 4:44 PM
**To:** 9(2)(a)
**Subject:** Message from KM_C224e

# SITE ANALYSIS

*existing built environment*




***AREAS OF CURRENT BUILDINGS USED FOR THIS DOCUMENT :***

***EXISTING BUILDINGS***

| | | |
|---|---|---|
| *MUSIC / AUDITORIUM* | | *970m²* |
| *BLOCK A* | *approx.* | *5583m²* |
| *TECH LINK* | *approx.* | *550m²* |
| *BLOCK J* | *approx.* | *167m²* |
| *BLOCK I I* | *approx.* | *88m²* |
| *BLOCK F (R4/6)* | | *BoT* |
| *BLOCK L4* | *approx.* | *135m²* |
| *BLOCK E* | *approx.* | *197m²* |
| *BLOCK H* | | *1,082m²* |
| *BLOCK C (GYM)* | | *1,188m²* |
| *BLOCK ARTS* | | *999m²* |
| *BLOCK S / B* | | *733m²* |

***SUBTOTAL:*** ***approx. 11,692m²***
*(INC CIRCULATION)*

***1,250 STUDENT PMIS :*** ***10,757m²***

*DEMOLISHED*

*EXISTING BUILDINGS*

**DRAFT**

1-1000
NOTE- CAD UNDERLAY OUT OF DATE

## Jack Harrison

**From:** David Hobern
**Sent:** Tuesday, 9 June 2015 1:17 PM
**To:** 9(2)(a) ; 9(2)(a)
**Subject:** FW: CGHS - Main block data

9(2)(a)

Latest info on the testing on the main block at CGHS.

Cheers

**David Hobern** | Programme Manager | CSR programme
DDI +64 3 378 7893 | Ext 47893 | Mobile s 9(2)(a) OIA

---

**From:** s 9(2)(a) OIA @rdtpacific.co.nz]
**Sent:** Tuesday, 9 June 2015 1:04 p.m.
**To:** David Hobern; Peter Fenwick
**Subject:** RE: CGHS - Main block data

Hi David and Peter

I have had a discussion with both 9(2)(a) and 9(2)(a) now and the verbal feedback on the testing done to date is the results look good and almost certainly confirms that Block A can be remediated. The extent of remediation required will depend on whether we design to the Ministry guidelines (ie 67% NBS) or whether the Ministry will accept a lower level (ie a minimum of say 34%). Either way further testing is still required on the set of piles below the shear wall that runs through the centre of the building before both Lewis Bradford and T&T will sign off on recommendations. We will also need this information before finalizing costs attached to the Master Planning.

With the Ministry approval, we are looking to finalise further tests to be undertaken over the next school holidays (July). T&T and LB are putting together a fee proposal to undertake this work together with a methodology to be discussed at a meeting I have set up for Monday at 1pm. I have invited Peter to this meeting but you are welcome to attend also David if required. The meeting will review results to date and agree plan to move forward.

The meeting could not be any earlier as T&T & LB are both busy putting together fee proposals for the CGHS design tender currently out, which closes this Friday.

Regards

s 9(2)(a) OIA
Managing Director

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**From:** David Hobern [mailto:David.Hobern@education.govt.nz]
**Sent:** 09 June, 2015 9:17 AM
**To:** Peter Fenwick; s 9(2)(a) OIA
**Subject:** CGHS - Main block data

Peter / s 9(2)(a) OIA

Can you please chase up the information on the testing of the main block. This has become very urgent now.

Cheers

**David Hobern** | Programme Manager | CSR programme
DDI +64 3 378 7893 Ext 47893 | Mobile s 9(2)(a) OIA
39 Princess Street, Christchurch

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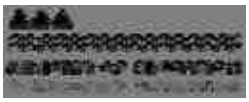
**We get the job done** *Ka oti i a mātou ngā mahi*
**We are respectful, we listen, we learn** *He rōpū manaaki, he rōpū whakarongo, he rōpū ako mātou*
**We back ourselves and others to win** *Ka manawanui ki a mātou, me ētahi ake kia wikitoria*
**We work together for maximum impact** *Ka mahi ngātahi mō te tukinga nui tonu*

**Great results are our bottom line** *Ko ngā huanga tino pai ā mātou whāinga mutunga*



s 9(2)(g)(i) OIA

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

14 December 2015

**FILE NOTE – Post Meeting Summary**

**328-Christchurch Girls' High School**

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**i. Seismic Strengthening**

The project team has assigned the development budget to seismic strengthening of the main block at Christchurch Girls' High School on the basis that at the completion of these strengthening works the building will have a capacity in the order of **35-45%NBS** (New Building Standard) and will be limited by the capacity of the upper level concrete floor diaphragms and/or roof bracing.

The scope of work is:

- Replace damaged ground floor slab with new rib raft type floor slab with spanning capability;
- Additional topping thickness to raft slab for enhanced strengthening works included in raft slab pricing;
- Installation of new foundation beams between all existing piles;
- Injection of minor cracking to existing structural walls (exterior walls only required);
- Local enhancement of existing roof steelwork connections.

Future Funding:
It is anticipated that the Ministry of Education will incorporate the following work items into a 10 YR Property Plan:

- Strengthening of existing floor to wall connections at levels 3 and 4
- Installation of a new plywood roof diaphragm to the entire roof area

Upon completion of these strengthening works the building will have a capacity in the order of **60-70%NBS** and will be limited by the capacity of a number of the main structural elements such as walls, foundations and piles.

Specifically (Per AECOM Sow):

- Floors 3 & 4: Break out 1000 wide strip of concrete topping slab, fix and tie in new steel including starters and lay new topping; Fibre reinforced plastic membrane 1000 wide to existing floors at Levels 3 and 4 including all necessary fixings and adhesive; New floor coverings and screeds; New internal partitions.

The approximate cost for these works is in the order of magnitude of Withheld in accordance with s9(2)(b)(ii) Official Information Act 1982

The option was provided to the school to fund these works from within the current development budget or to utilise the 10Yr Property Plan as the funding mechanism. The Board Chair has undertaken to seek confirmation from the school board as to which option will be selected.

**ii. Expended Funds**

Ministry has committed to fund the following expenditures over and above the project budget to be reinvested with the school.

- 150950 ATP#288 - Structural Damage Assessment Reports
- 160410 Approval#816 - CGHS - Acland House project management

Withheld in accordance with s9(2)(b)(ii) Official Information Act 1982

Change Management Request Memo is intended to draw the funding from programme contingency to increase the project budget accordingly.

### iii. Technology Block

If a 'build to' roll number is confirmed at 1100 students it will necessitate the demolition of 1,004 m2 of teaching space (over-entitlement). The Technology Building (block H) meets this requirement on the basis of size (1,082m2) and that a considerable amount of weather tightness repairs and some strengthening works are required to bring the building up to standard.

The sum(s) of has been assigned to the weather-tightness repairs and $100,000 for a new Link Bridge.

- This sum would be returned to the school redevelopment budget for utilising on other works should the demolition be required, less demolition costs.
- If the building is not to undergo demolition then another may be required to seismically strengthen to 67% NBS.

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

# Christchurch Schools Rebuild (CSR) Programme
# MINUTES

| | |
|---|---|
| **Subject** | Christchurch Girls' High School |
| **Date** | Friday, 11 December 2015 |
| **Time** | 10:30 am to 12:30 pm |
| **Venue** | St Paul's Square, RM SPS 8.4 |

| **Attendees** | | |
|---|---|---|
| **Name** | **Organisation** | **Initials** |
| 9(2)(a) | Christchurch Girls' High School | PD |
| Jill Forgie | Ministry of Education | JF |
| Simon Hampton | Ministry of Education | SH |
| 9(2)(a) | Ministry of Education | AH |
| 9(2)(a) | Christchurch Girls' High School | ML |
| 9(2)(a) | Ministry of Education | JS |
| **Recorded by** | | |
| Rachelle Lawrence | Ministry of Education | |



**INTRODUCTION**

» CGHS acknowledged progress had been made and they were appreciative of the team, but consider the overall redevelopment budget for the school inadequate.

» CGHS acknowledge that the Performance Arts Centre (PAC) project was going well and they were very happy with the current Ministry team.

**BUDGET**

» CGHS consider that the basis for original budget was flawed. The Ministry stated that the figures were based on the best available information in 2013 and were confident of the methodology applied across the CSR programme.

» **ACTION:** 9(2)(a) to provide breakdown of initial budget to CGHS.

» The Ministry was concerned that the request to "ring fence" the budget against certain buildings is not appropriate. Budgets for all CSR schools were set using the same methodology. In most school projects the full master plan will not be achieved within the CSR budget, and therefore projects are staged. The Ministry is putting in place a 20 year cohesive site plan (the master plan) for every school to reduce ad hoc projects occurring that do not connect the school. The master plans are staged, stage one is what can be achieved with the CSR budget. Subsequent stages would be completed as funding allowed. Schools therefore are prioritising build plans within the CSR budget. Funding priorities include addressing of structural strengthening, earthquake damage and weather tightness issues. I key goal is to ensure schools will have the planned network capacity.

» Ministry confirmed that when the CSR project is complete the school will return to the normal 5YA programme and a 10YPP will be developed. The first CSR schools are to exit the programme in the new year, and more information about the process will be confirmed at that stage.

» **ACTION:** 9(2)(a) to provide an estimate of the projected 5YA for CGHS once the CSR project is complete.

» CGHS advised that Minister Kaye recommended that they should put together a submission on their concerns about the budget. The Ministry confirmed that the school should contact them if there is additional information they need.

» As part of the submission process CGHS have been speaking to various parties who are not convinced the project to strengthen the main block can be achieved within budget and timeframes. The Ministry acknowledged the three month timeframe was a risk but steps are being made to mitigate this.

» CGHS referred to meeting minutes that included confirmation from Peter Fenwick that costs for structural damage assessment reports and Ackland House project management would be removed from the budget. The Ministry committed to fund the expenditures by adding those amounts to the budget. This amounts to **$324,193** that will be reinstated to the CSR CGHS budget

» **ACTION: CGHS** to provide a copy of the minutes to [redacted]

» CGHS was concerned that the budget will not allow for advanced ILE work to be done. The Ministry confirmed that a significant amount of the core ILE (heating, lighting, ventilation, acoustics) would be completed under CSR.

» CGHS were concerned that the gym is in a state of disrepair and it is too small. The board would like to see it expanded. It was noted that the current gym is slightly over entitlement. The Board have agreed to add circa $1m of funds to extend the gym - the Ministry have prepared to manage this construction work during the weather tightness and structural remediation works expected during next year 2016.

» CGHS suggested the Ministry review entitlement for gymnasiums as physical education programmes have changed over the years and are now taken across all school years.

**SEISMIC STRENGTHENING**

» CGHS were not happy with the decision not to strengthen the main building to circa 67% of the New Building Standard (NBS) in the short term. The Ministry noted, that whilst the current plan was to strengthen the building to c45% of the NBS, this would actually mean the building was structurally at a higher standard than pre-earthquakes due to the higher standards required under the new code. The Ministry stated that the strengthening in the short term to 45% addresses any life safety risks, is in line with the Ministry's earthquake upgrade policy, and frees up budget for other areas. Noting that the upgrade to circa 67% will be completed within a ten year timeframe, when other upgrades on the main block can take place.

» A decanting workshop was held in August 2015 where the decision was made to stage the strengthening work to allow funds to be allocated elsewhere. The initial CSR project would take the building to 45% NBS and the remainder of the strengthening work would be funded from 5YA allowance at a later date.

» CGHS did not consider they were made aware of that decision and reiterated that it was the board's firm requirement to have the buildings at 67% NBS. The Ministry acknowledged that the Board may not have been aware of that decision even though it was the topic of the discussion with the Principal and a staff member at the workshop noted above.

» The Ministry confirmed their policy is to bring schools above earthquake prone status in the short-term, and in the medium-term to bring them up to 67% NBS. [redacted] clarified that the short term solution would bring the building above where it was before the earthquakes.

» The Ministry reiterated their commitment to bringing the buildings to 67% NBS within the next ten years using 5YA and top up funding in line with policy, and would confirm this in writing. It was noted that if a project is over 50% of a school's 5YA, it will be topped up by the Ministry.

» Another option would be to complete the full strengthening to 67% NBS as part of the initial rebuild (now under CSR), but other aspects of the budget would need to be traded-off in order to fund this. CGHS expressed their dissatisfaction at this scenario.

» The Ministry reconfirmed there is a commitment to bring the school to 67% NBS, but it would be about timing. The two pieces of strengthening work are quite separate, so a staged approach is appropriate. (ie the roof structure can be done later (in the next ten years)

**TRADE OFFS**

» The Ministry must work within the mandated budget and entitlement restraints. An additional $1.6 million would be required to strengthen the buildings to 67% NBS and trade-offs would be required.

» There are three suggested areas we where approx $1.2 million savings could be achieved:

  – Reduce the extent of the landscaping around the PAC building This would save $350k.

  – Furniture and fittings saving $150k.

  – No work to the Tech block would save approx. $900k (note: that under the current projected build to roll of 1,100 the tech block could be demolished as the school would be over capacity by 1,800 (including the island block)

**BUILD ROLL**

» CGHS did not agree with the build roll of 1,100. They noted they were currently at 1,100 already.

» The Ministry noted they were managing rolls across the whole city and advised it had tried to reach agreement across the four single-sex state schools in Christchurch. Shirley Boys' and Avonside Girls' high schools have agreed to reduced rolls.

» CGHS consider the figures did not match their own research which shows the state integrated roll has gone up.

» **ACTION: CGHS** to provide roll information to JF.

» JF advised the Christchurch build and master plan rolls were determined by looking at the percentage of students at single-sex state integrated schools before the earthquake, then looking at the current network and determining what the rolls should be to maintain that percentage.

» The Ministry confirmed the CSR budget did not affect the discussion on roll.

» CGHS noted they had not seen the final decisions on the single sex roll. JF stated that the final numbers will only be sent to schools once they had confirmed their agreement to the roll decisions and that at this stage CGHS had not responded or agreed to the proposal.

» CGHS were concerned at the possibility of losing the Tech Block because the master plan had been developed based on the inclusion of the building. They had previously been assured that the build roll would not affect the Tech Block, and requested a meeting with Coralanne Child to discuss this further.

» **ACTION: JF** to organise meeting between CGHS and Coralanne Child.

MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

16 December 2015

Christchurch Girls' High School
10 Matai Street
Riccarton
Christchurch 8011

Attn: 9(2)(a) Board of Trustees Chair
9(2)(a), Principal
Board of Trustees members

Dear 9(2)(a) and Board

**Christchurch Girls' High School Redevelopment**

Thank you for meeting with us on Friday, 11 December 2015 to discuss your concerns around the redevelopment of Christchurch Girls' High School.

As promised, this letter sets out our position on key areas discussed.

**Seismic strengthening of the Main Block**

Following the decanting workshop with your school the plan was to strengthen the building to circa 45% of the New Building Standard (NBS). This would mean the building was structurally at a higher standard than pre-earthquakes. We are also confident that a short term goal of circa 45% is adequate for this building and would not pose any life safety issues given how well it performed in the Canterbury earthquakes.

The Ministry's policy is to bring schools above earthquake prone status in the short-term, and in the medium-term to bring them up to 67% of the NBS. This letter confirms our commitment to bringing the buildings to 67% of NBS within the next ten years using a combination of 5YA and top up funding, in line with current policy.

Alternatively, the Ministry can commit to remediating the main block to 67% NBS under the Christchurch Schools Rebuild (CSR) programme, which would have this complete by circa 2018/19. However, we are constrained by the CSR budget and therefore to accommodate this work (est $1.2 million) we will need to reduce the funding on landscaping, furniture fittings and equipment (FF&E) and not remediate the technology block.

The breakdown of the initial budget will be sent through shortly.

**Entitlement**

We note that based on your build roll of 1100, you would have approximately 1,800 $m^2$ more capacity than your school property guide entitlement. Our preferred option is to demolish the Technology Block, which is just over 1,000 $m^2$, as it requires significant investment to bring it up to a suitable standard. There is also the Island Block (circa 800$m^2$), which could either be demolished or potentially transferred into Board ownership.

Alternatively, there is the potential to re-design the new Performing Arts Centre (PAC) back down to 1,100 (currently designed to 1,250 with the schools concurrence) or demolishing the Arts Block. However, both of these are due to commence construction or remediation in the near future and we would prefer not to delay these projects.

**Redevelopment budget**

The funding allocation for the CGHS redevelopment budget $26.8 million was established in 2013 and the same methodology was used across all CSR schools. The purpose of the master planning process is to develop a 20 year cohesive site plan to reduce ad hoc projects occurring that do not connect the school. In general, master plans are staged; stage one is what can be achieved within the CSR budget. In the case of CGHS the school will be able to undertake a significant amount of works within its allocated budget and will able to address the specifics of seismic strengthening, weathertightness repairs, and including substantial modernisation. Subsequent stages are completed as funding allows. The detailed breakdown of the budget and methodology will be sent through shortly.

As previously agreed, $324,193 will be added to the schools CSR redevelopment budget allocation to cover the cost of structural damage assessment reports and the Ministry's support for your Acland House hostel project management fees.

**Future budgets**

The Ministry is currently working through the process that will apply to all schools in the CSR programme when they have completed their redevelopments. The planned process is that once a school has completed its redevelopment, a ten year property plan will be developed and the school will then return to the normal cycle of five year agreement funding allocations.

The base funding rate is currently $30/$m^2$. It is therefore anticipated that your budget will be:

| | |
|---|---|
| Gross area entitlement (1,100 students): | 9,790$m^2$ |
| Base rate: | $30/$m^2$ |
| Annual Budget: | $293,700 |
| Estimated 5YA Budget: | $1,468,500 |

Note: In line with current policy, if the school agrees to undertake the further strengthening as part of the first 5YA programme (est $1.2 million for getting it up to circa 67% NBS), then 50% of the 5YA allocation will be dedicated to the project with the Ministry allocating the balance from central funds.

**Next steps**

We would welcome further discussions with you on any of these matters and appreciate your time and effort in meeting with us in Wellington on Friday. We feel we have established good processes and governance structure with your school in the last few months and we are pleased with the progress we are making together on your school buildings.

Yours sincerely

9(2)(a)

Associate Deputy Secretary – Infrastructure Delivery
Education Infrastructure Service

CC: Coralanne Child
Director Education Canterbury
Ministry of Education

Jill Forgie
Manager Education Canterbury
Ministry of Education

9(2)(a)
Christchurch Schools Rebuild Programme Director
Education Infrastructure Service

Simon Hampson
Christchurch Schools Rebuild Delivery Manager
Education Infrastructure Service

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www.rdtpacific.co.nz



2 November 2017

Ministry of Education
48 Hereford Street
West End
Christchurch 8013

ATTENTION: Craig Morrison (letter by email)

Dear Craig

**Christchurch Girls' High School Main Block – Request for Approval to Proceed**

Background

The Christchurch Girls' High School Main Block Remediation & Arts Block Fit-out forms part of the overall Christchurch Girls' High School CSR Programme of Works. The overall budget allocated for these two projects is $9.4m and $770k respectively.

As part of the agreed ECI Sub-trade tendering process, Naylor Love have submitted a pricing proposal for $s 9(2)(j) OIA [redacted] which was not expected from an ECI process where transparency on budget and Contractor involvement at design meetings were encouraged.

Prior to sub-trade tendering of these projects it was believed that any small cost overruns could be dealt with through Value Engineering across the course of the circa 18-month programme, this was based on the developed design cost report.

At a meeting between RDT, Beca and MOE on 25th October 2017, it was agreed that the projects could not proceed to the value of $s 9(2)(j) OIA and that significant savings would need be realised to ensure the projects (specifically the Main Block project) were feasible before signing a lump sum contract for the works.

Prior to this meeting, RDT undertook an overview of the scope for the Main Block project and identified areas of scope creep, the scope has evolved significantly during the course of the project to incorporate requests and expectations presented by the school.

It was discussed that the likely budget for the Main Block with the evolved scope in mind was $s 9(2)(j) OIA and that as a minimum the project would need to meet a reduced scope and budget of $s 9(2)(j) OIA meeting the minimum obligations of 67% structural strengthening and Heating and Cooling. It was noted that this would take a number of weeks to work through with the Contractor and Design Team which would delay the start on site of both projects , currently planned for 6th Nov 2017 and that further savings to get the Main Block project below $s 9(2)(j) OIA would need to be investigated.

A number of Options have been reviewed on how to proceed given the current pricing proposal, the options make consideration of risks, budget, scope, school expectations, methodology and programme.

Option 1: Tender Project & Value Engineer Design

A number of items have been identified which are believed could be reduced given a more competitive tender environment and value engineering to the Main Block Design. Despite Naylor Love having tendered to 3-4 contractors per trade, in some of these scenarios only 1-2 prices were received.

However, given the time it would take to Tender both Projects to the open market (4-weeks) and a suitable evaluation period (3-weeks), this would mean that a new contractor would not be appointed until Jan 2018 which would create a year delay on the Main Block programme for the roof replacement and interference in the planned schedule of works for the interim levels due to essential services (HVAC, etc.) not being in place. This would also create delay to the Arts Block Project as any delay to the front end of this project would mean a delay in handing the building back over to the school for continuation of their Technology curriculum.

Given the expenditure by the MOE to make the Main Block building available early by arranging for CGHS exams to be undertaken off site, this would result in redundant cost expenditure in this endeavour and unnecessary disruption to regular school activities for no works to be undertaken in this period.

Though this is the preferred option from a procurement perspective, which provides the lowest risk associated with cost to the Ministry, we understand this is not considered to be a palatable option for the stakeholders involved.

Option 2: Rebuild and Demolish the Main Block, proceed with the Arts Block

Given the Pricing Proposal having been received at $s 9(2)(j) OIA for the Main Block, this pushes this project towards the threshold for rebuild, however $s 9(2)(j) OIA is not thought to be a true representation of the cost associated with the agreed scope. At $s 9(2)(j) OIA this does not meet the threshold for the rebuild option. In addition, the estimated sqm costs for a rebuild do not take into account additional consultant fees for a new design and potential decanting costs associated with this option. This option is not considered feasible from a cost or programme perspective at this stage.

Option 3: Reduce Scope & Budget on Main Block to Original, proceed with the Arts Block

Reduce the scope to the Original Main Block scope as it stood prior to Design Commencement and only undertake minimum works as required to meet the original budget of $7.6m.

Proceed with Arts Block fit-out and investigate value engineering options during construction.

This option is not feasible from the perspective of the Main Block project due to previous agreements with the school to provide minimum scope of structural upgrades to 67% and heating and cooling for the building.

Option 4: Value Engineer Main Block Design to $s 9(2)(j) OIA

This is the preferred option, however given time constraints to negotiate, value engineer and potentially re-tender, this option is not feasible within the time constraints, our recommendation is to proceed with this work stream whilst we commence with Option 5.

Option 5: Staged Approach (Recommendation)

In order to meet the Ministry requirement to commence Main Block works on site on 6th Nov 2017 and to enable us to spend time value engineering the project to $s 9(2)(j) OIA we believe a staged approached is the immediate recommendation.

This is thought to be a pragmatic solution to proceed with the Level 4 works to provide more time to refine cost savings and to review the design to bring it back in line with Ministry budget expectations.

Requirements to proceed with this recommendation include:

1. Issue a Letter of Intent to allow works to proceed on 6th November 2017
2. Agree costs of the Immediate scope of work with Naylor Love.

This option is detailed as follows, the expected costs associated with this have been estimated by Beca, please note these do not represent the confirmed costs with the Contractor as these will be negotiated and agreed in the coming weeks for the Immediate Works.

| Scope | Timeframe | Award to Contractor | Estimate |
|---|---|---|---|
| **Immediate Works** | | | |
| Main Block | | | s 9(2)(j) OIA |
| P&G | | Yes | |
| Upper Roof | | | |
| Temporary HVAC set-up to Levels 1-4 | Nov 2017 | Yes | |
| Roof Replacement (excluding mechanical) | Nov-May 2017/18 | Yes | |
| Roof Strengthening | Nov-Feb 2017/18 | Yes | |
| Level 4 | | | |
| Strengthening | Nov-Jan 2017/18 | Yes | |
| Fire Upgrades | Jan-Feb 2018 | Yes | |
| Fit-out (excluding mechanical) | Jan-May 2018 | Yes | |
| Lift | | | |
| Lift Replacement | Nov-Feb 2017/18 | Yes | |
| **Margin (s 9(2)(j) %)** | | | |
| **TOTAL** | | | |
| **Deferred Works** | | | |
| Arts Block Fit-out | Nov-Apr 2018/19 | No | TBA – subject to revised scope and negotiation |
| | | | |
| Server Relocation | Dec-Jan 2018/19 | No | |
| | | | |
| Main Block | | | |
| Mechanical Replacement/Upgrades (All Levels including Roof) | Nov-Jan 2018/19 | No | |
| Level 3 | | | |
| Strengthening | Nov-Jan 2018/19 | No | |
| Fire Upgrades | Jan-Feb 2019 | No | |
| Fit-out (excluding mechanical) | Jan-May 2019 | No | |
| Level 2 | | | |

| | | | |
|---|---|---|---|
| Minor Fit-out (excluding mechanical) | Nov-Jan 2018/19 | No | |
| Fire Upgrades | Jan-Feb 2019 | No | |
| Further Fit-out | TBA | No | |
| Level 1 | | | |
| Strengthening | Nov-Jan 2018/19 | No | |
| Fit-out | Feb-Jun 2019 | No | |
| | | | |
| Landscape | May-Sep 2019 | No | |

The initial proposal included in this recommendation was to proceed also with the Arts Block fit-out starting 6th November 2017, however based on confirmation provided by the school in a discussion with the MOE and RDT on 31st October 2017, the school does not want to proceed with the Arts Block project this year as they have already arranged to use this area for decanting of the Main Block. The above table has been adjusted in line with this.

In order to proceed with the deferred works, we need to look at key value engineering and agree with the school any changes to current agreements, the main one being the HVAC system where we can see we can make significant savings.

The indicative revised programme attached splits the work into two clear phases. Works to occur immediately from Nov 2017 – May 2018 and deferred works from Nov 2018 – Sep 2019 which will be subject to value engineering and scope revisions if required. Please note, ability to undertake these works in two stages as suggested in the attached programme will be determined based on whether structurally, the Level 3 floor strengthening works can be undertaken in tandem with the Level 1 slab replacement.

<u>Approval Sought</u>

Approval is sought to proceed with the Staged Approach of Immediate Works, scope as defined in the table above and cost estimate as presented by Beca.

Yours faithfully
**RDT PACIFIC**

s 9(2)(a) OIA

Project Manager

Copies To:

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| ID | Task Mode | Task Name | Duration | Start | Finish |
|---|---|---|---|---|---|
| 1 | | **Main Block Remediation** | **562 days** | **Mon 6/11/17** | **Fri 14/02/20** |
| 2 | | **Roof** | **114 days** | **Mon 6/11/17** | **Thu 3/05/18** |
| 3 | | Roof Minimum Stengthening | 49 days | Mon 6/11/17 | Fri 26/01/18 |
| 4 | | Roof Replacement | 114 days | Mon 6/11/17 | Thu 3/05/18 |
| 5 | | **Level 4** | **114 days** | **Mon 6/11/17** | **Thu 3/05/18** |
| 6 | | Strengthening | 39 days | Mon 6/11/17 | Fri 12/01/18 |
| 7 | | Fire Upgrades | 75 days | Mon 15/01/18 | Thu 3/05/18 |
| 8 | | Fit-out | 75 days | Mon 15/01/18 | Thu 3/05/18 |
| 9 | | **Level 3** | **124 days** | **Mon 5/11/18** | **Wed 15/05/19** |
| 10 | | Strengthening | 49 days | Mon 5/11/18 | Fri 25/01/19 |
| 11 | | Fire Upgrades | 20 days | Mon 28/01/19 | Mon 25/02/19 |
| 12 | | Fit-out | 75 days | Mon 28/01/19 | Wed 15/05/19 |
| 13 | | **Level 2** | **319 days** | **Mon 5/11/18** | **Fri 14/02/20** |
| 14 | | Fire Upgrades | 20 days | Mon 5/11/18 | Mon 3/12/18 |
| 15 | | Fit-out (TBA) | 75 days | Mon 4/11/19 | Fri 14/02/20 |
| 16 | | **Level 1** | **154 days** | **Mon 5/11/18** | **Thu 27/06/19** |
| 17 | | Strengthening | 49 days | Mon 5/11/18 | Fri 25/01/19 |
| 18 | | Fit-out | 105 days | Mon 28/01/19 | Thu 27/06/19 |
| 19 | | **Mechanical** | **292 days** | **Mon 6/11/17** | **Fri 25/01/19** |
| 20 | | Temporary Set-up | 10 days | Mon 6/11/17 | Mon 20/11/17 |
| 21 | | Mechanical Refurb (Levels 2- | 49 days | Mon 5/11/18 | Fri 25/01/19 |
| 22 | | **Lift** | **272 days** | **Mon 6/11/17** | **Fri 14/12/18** |
| 23 | | Structural Works | 42 days | Mon 6/11/17 | Wed 17/01/18 |
| 24 | | Lift Replacement | 49 days | Mon 6/11/17 | Fri 26/01/18 |
| 25 | | Fire Rating to Liftshaft | 29 days | Mon 5/11/18 | Fri 14/12/18 |
| 26 | | | | | |
| 27 | | **Arts Block Fit-out** | **93 days** | **Mon 5/11/18** | **Fri 29/03/19** |
| 28 | | | | | |
| 29 | | **Landscape** | **80 days** | **Tue 14/05/19** | **Tue 3/09/19** |
| 30 | | | | | |
| 31 | | **Server Relocation** | **21 days** | **Mon 17/12/18** | **Mon 28/01/19** |
| 32 | | Overall Works | 21 days | Mon 17/12/18 | Mon 28/01/19 |