Norman Kirk Memorial Pool – Nursery Building Detailed Engineering Evaluation
BU 3513-005 EQ2
Qualitative Report

Prepared for Christchurch City Council (CCC)

By Beca Carter Hollings & Ferner Ltd (Beca)

14 June 2013

Revision History

Revision Nº	Prepared By	Description	Date
A	Andrew Franklin	Draft for CCC review	11 October 2012
B	Andrew Franklin	Final	14 June 2013

Document Acceptance

Action	Name	Signed	Date
Prepared by	Andrew Franklin		14 June 2013
Reviewed by	Nicholas Charman		14 June 2013
Approved by	David Whittaker		14 June 2013
on behalf of	Beca Carter Hollings & Ferner Ltd		

Norman Kirk Memorial Pool
Nursery Building
BU 3513-005 EQ2

Detailed Engineering Evaluation
Qualitative Report – SUMMARY
Version 1

Address
54a Oxford St
Lyttelton

Background

This is a summary of the Qualitative report for the building structure, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

The Nursery Building is located at the Norman Kirk Memorial Pool at 54a Oxford St, Lyttelton. It was designed in 1976 and has an approximate floor area of 180m^2 internally. The primary structural system comprises concrete and concrete masonry block shear walls and in situ reinforced concrete beams and columns supporting a precast with in situ topping first floor. The roof consists of steel beams, timber purlins and lightweight metal sheeting. A set of structural drawings by Royds Sutherland & McLeay dated 1976 were made available, however no calculations were carried out.

The Norman Kirk Memorial Pool site has a number of concrete masonry block walls/fences and retaining walls of varying construction type.

The Nursery Building is on the eastern side of the Norman Kirk Memorial Pool site. It appears to have been constructed partially into the ground with its north and east walls retaining the surrounding ground and with an independent retaining wall to the south.

Key Damage Observed

Visual inspections on 7 August 2012 indicate the building has suffered minor earthquake damage. The key damage observed includes:

- Minor cracking to concrete masonry block work mortar.

Critical Structural Weaknesses (CSW)

The following potential Critical Structural Weaknesses have been identified for the Nursery Building structure during our inspection and review of structural drawings:

- Pounding from adjacent concrete retaining wall on southern side of building.
- Potential landslide due to site characteristics.

Indicative Building Strength (from Initial Evaluation Procedure and CSW assessment)

The building has been assessed to have a seismic capacity of 35%NBS using the NZSEE Initial Evaluation Procedure (IEP) and is therefore classified as potentially Earthquake Risk and Seismic Grade C.

Recommendations

In order that the owner can make an informed decision about the ongoing use and occupancy of their building the following information is presented in line with the Department of Building and Housing document '*Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch*', June 2012.

The building is considered to be potentially earthquake risk, having an assessed capacity of between 34% and 67%NBS. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads and therefore no restrictions on use or occupancy are recommended. However, access to the Nursery Building should be restricted to routes that do not require entering cordoned areas of the site.

It is recommended that:

- Barricades be installed to cordon off access to damaged structures on the western portion of the Norman Kirk Memorial Pool site including walls/fences and buildings. No occupancy restrictions exist for the Main Plant Room or the Nursery Building and we understand the Nursery is currently occupied. Access to these two building should be restricted to routes that do not require entering cordoned areas of the site.
- A quantitative %NBS analysis of the building should be completed.
- A level survey could be carried out to determine the level of possible settlement of the building for insurance purposes.
- An investigation is undertaken to determine the structural integrity of the adjacent concrete retaining wall to the south, and crib retaining wall and concrete retaining wall to the east.
- A geotechnical investigation is undertaken into the stability of the surrounding landscape and large retaining wall to the east of the site.
- Repairs that would bring the building back to an "as new" condition are typically entitled under typical replacement insurance policies. We suggest you consult with your insurance advisor as to how you wish to proceed.

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Appendices

1 Background

Beca Carter Hollings & Ferner Ltd (Beca) has been engaged by Christchurch City Council (CCC) to undertake a qualitative Detailed Engineering Evaluation (DEE) of the Nursery Building located at the Norman Kirk Memorial Pool at 54a Oxford St, Lyttelton.

This report is a Qualitative Assessment of the building structure, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

A qualitative assessment involves inspections of the building, a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available and an assessment of the level of seismic capacity against current code using the Initial Evaluation Procedure (IEP).

The purpose of the assessment is to determine the likely building performance and damage patterns, to identify any potential Critical Structural Weaknesses or collapse hazards, and to make an initial assessment of the likely building strength in terms of percentage of New Building Standard (%NBS).

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure has been carried out. Full structural drawings were made available and these have been considered in our evaluation of the building. The building description below is based on a review of the drawings and our visual inspections.

The format and content of this report follows a template provided by CCC, which is based on the EAG document.

2 Compliance

This section contains a brief summary of the requirements of the various statutes and authorities that control activities in relation to buildings in Christchurch at present.

2.1 Canterbury Earthquake Recovery Authority (CERA)

CERA was established on 28 March 2011 to take control of the recovery of Christchurch using powers established by the Canterbury Earthquake Recovery Act enacted on 18 April 2011. This act gives the Chief Executive Officer of CERA wide powers in relation to building safety, demolition and repair. Two relevant sections are:

Section 38 – Works

This section outlines a process in which the chief executive can give notice that a building is to be demolished and if the owner does not carry out the demolition, the chief executive can commission the demolition and recover the costs from the owner or by placing a charge on the owners' land.

Section 51 – Requiring Structural Survey

This section enables the chief executive to require a building owner, insurer or mortgagee carry out a full structural survey before the building is re-occupied.

We understand that CERA will require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). It is understood that CERA is adopting the Detailed Engineering Evaluation Procedure document (draft) issued by the Engineering Advisory Group on 19 July 2011, which sets out a methodology for both qualitative and quantitative assessments. We understand this report will be used in response to CERA Section 51.

The qualitative assessment includes a thorough visual inspection of the building coupled with a desktop review of available documentation such as drawings, specifications and IEP's. The quantitative assessment involves analytical calculation of the building's strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

It is anticipated that factors determining the extent of evaluation and strengthening level required will include:

- The importance level and occupancy of the building
- The placard status that was assigned during the state of emergency following the 22 February 2011 earthquake
- The age and structural type of the building
- Consideration of any Critical Structural Weaknesses
- The extent of any earthquake damage

2.2 Building Act

Several sections of the Building Act are relevant when considering structural requirements:

Section 112 – Alterations

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to any alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

Section 115 – Change of Use

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) be satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'. Regarding seismic capacity 'as near as reasonably practicable' has previously been interpreted by CCC as achieving a minimum of 67%NBS however where practical achieving 100%NBS is desirable. The New Zealand Society for Earthquake Engineering (NZSEE) recommend a minimum of 67%NBS.

Section 121 – Dangerous Buildings

The definition of dangerous building in the Act was extended by the Canterbury Earthquake (Building Act) Order 2010, and it now defines a building as dangerous if:

- In the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
- In the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or
- There is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a 'moderate earthquake' (refer to Section 122 below); or
- There is a risk that that other property could collapse or otherwise cause injury or death; or

- A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone if its ultimate capacity would be exceeded in a 'moderate earthquake' and it would be likely to collapse causing injury or death, or damage to other property. A moderate earthquake is defined by the building regulations as one that would generate ground shaking 33% of the shaking used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

This section gives the territorial authority the power to require strengthening work within specified timeframes or to close and prevent occupancy to any building defined as dangerous or earthquake prone.

Section 131 – Earthquake Prone Building Policy

This section requires the territorial authority to adopt a specific policy for earthquake prone, dangerous and insanitary buildings.

2.3 Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in 2006. This policy was amended immediately following the Darfield Earthquake of the 4th September 2010.

The 2010 amendment includes the following:

- A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
- A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- Repair works for buildings damaged by earthquakes will be required to comply with the above.

The council has stated their willingness to consider retrofit proposals on a case by case basis, considering the economic impact of such a retrofit.

It is understood that any building with a capacity of less than 33%NBS (including consideration of Critical Structural Weaknesses) will need to be strengthened to a target of 67%NBS of new building standard as recommended by the Policy.

If strengthening works are undertaken, a building consent will be required. A requirement of the consent will require upgrade of the building to comply 'as near as is reasonably practicable' with:

- The accessibility requirements of the Building Code.
- The fire requirements of the Building Code. This is likely to require a fire report to be submitted with the building consent application.

2.4 Building Code

The building code outlines performance standards for buildings and the Building Act requires that all new buildings comply with this code. Compliance Documents published by The Department of Building and Housing can be used to demonstrate compliance with the Building Code.

On 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

a. Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)
b. Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

The increase in the above factors has resulted in a reduction in the level of compliance of an existing building relative to a new building despite the capacity of the existing building not changing.

3 Earthquake Resistance Standards

For this assessment, the building's Ultimate Limit State 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 new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

No consideration has been given at this stage to checking the level of compliance against the increased Serviceability Limit State requirements.

The likely ultimate capacity of this building has been derived in accordance with the New Zealand Society for Earthquake Engineering (NZSEE) guidelines 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' (AISPBE), 2006. These guidelines provide an Initial Evaluation Procedure that assesses a building's capacity based on a comparison of loading codes from when the building was designed and currently. It is a quick high-level procedure that can be used when undertaking a Qualitative analysis of a building. The guidelines also provide guidance on calculating a modified Ultimate Limit State capacity of the building which is much more accurate and can be used when undertaking a Quantitative analysis.

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown in Figure 3.1 below.

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	Unacceptable	Unacceptable

Figure 3.1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 3.1 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. on average 0.2% in any year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

Table 3.1: %NBS compared to relative risk of failure

Building Grade	Percentage of New Building Standard (*%NBS*)	Approx. Risk Relative to a New Building
A+	>100	<1
A	80-100	1-2 times
B	67-80	2-5 times
C	33-67	5-10 times
D	20-33	10-25 times
E	<20	>25 times

4 Building Description

4.1 General

Summary information about the building is given in the following table.

Table 4.1: Building Summary Information

Item	Details	Comment
Building name	Norman Kirk Memorial Pool - Nursery Building.	
Street Address	54a Oxford St, Lyttelton.	
Age	36 years. 1976 design.	From drawings received.
Description	Two storey, stand-alone Nursery building.	
Building Footprint / Floor Area	Footprint ≈ 90m^2 Floor area ≈ 180m^2 Approximately 7.6m x 12.2m in plan.	
No. of storeys / basements	2 storeys / No basement.	
Occupancy / use	Nursery.	Importance Level 2.
Construction	Reinforced concrete (below first floor) and concrete masonry block (above first floor) shear walls. In situ reinforced concrete first floor beams and support columns. Precast Vibradec first floor with in situ topping. Timber and steel framed roof	Drawings indicate the masonry walls are reinforced. First floor topping appears to be mesh reinforced. The drawings indicate the precast floor units (first floor) have 40mm seating only.
Gravity load resisting system	Gravity loads from the roof structure are supported by the load bearing concrete masonry walls. These loads and first floor loads are supported by the concrete walls and beam/column framing below and then transferred into the foundations and to the ground.	The north and east walls of the building also support earth pressures/loads.

Item	Details	Comment
	There is also a small internal wall of concrete masonry block construction on the ground floor acting as an additional gravity support. The ground floor is slab on grade with strip foundations.	
Seismic load resisting system	Lateral loads above the first floor are resisted by concrete masonry block shear walls in both directions. Lateral loads are then transferred through the first floor structure into the reinforced concrete shear walls below and then into the foundations. The structural drawings indicate rod cross bracing in the roof.	The north and east walls of the building also resist earthquake earth pressures from the external ground.
Foundation system	Slab on grade with strip footings.	
Stair system	Internal cast in situ concrete stairs. External steel stairs to access first floor.	External steel stairs are not shown on structural drawings – connection to building is unknown. The internal concrete stairs appear to be rigidly connected top and bottom.
Other notable features	A 3m high crib retaining wall located 1m from the east wall of the building, with a 1 in 2 slope above. Concrete retaining wall adjacent to the south	
External works	A large concrete retaining wall approximately 8m to the east of the site. In ground concrete swimming pool located in the centre of the site.	
Construction information	Full structural drawings. Site inspection.	
Likely design standard	Conservatively assumed to be NZS 1900 Chapter 8: 1965 (could have been designed to NZS 4203:1976).	Inferred from age of building.
Heritage status	No heritage status.	
Other		

4.2 Structural 'Hot-spots'

- Connections between walls, floor and roof typically.
- Connection between the upper storey concrete masonry walls and the ground floor shear walls / precast floor.
- Pounding from adjacent concrete retaining wall to the south.
- Retaining wall on eastern side surcharged by 3m high crib wall.
- Precast floor unit seating.
- Stair support details.
- Non-ductile mesh reinforcement in first floor topping.

5 Site Investigations

5.1 Previous Assessments

The building had a level 2 rapid assessment undertaken following the February 2011 and June 2011 earthquake events (refer to Appendix D). It is believed that the rapid assessment form in our possession is incorrectly titled however, and the Nursery Building has its own rapid assessment form. The rapid assessment form indicates all buildings on the Norman Kirk Memorial Pool site (excluding the Main Plant Room (refer BU 3512-001 EQ2 Qualitative DEE)) have a red placard status, however the Nursery Building is currently occupied, indicating a green placard status.

5.2 Level 4 Damage Inspection

Visual inspections as part of the level 4 damage assessment were undertaken on 7 August 2012.

6 Damage Assessment

6.1 Damage Summary

The table below provides a summary of damage observed during our inspection. Refer to Appendix A for photographs of the observed damage.

Table 6.1: Damage Summary

Damage type	Unknown	Minor	Moderate	Major	Comment
settlement of foundations	✓				None observed during visual inspection. Level survey may be required to confirm.
tilt of building	✓				None observed during visual inspection. Vertical survey may be required to confirm.
liquefaction					None observed during visual inspection.
settlement of external ground			✓		Some differential settlement noted. Pavement slopes from the pool to the south.
lateral spread / ground cracks		✓			None observed during visual inspection in immediate proximity of Nursery Building.

Damage type	Unknown	Minor	Moderate	Major	Comment
					Some ground cracks observed on southern side of pool and adjacent to Change Rooms.
frame					No damage observed to concrete frame portion of building during inspection.
concrete and masonry walls		✓			Hairline cracking observed in concrete masonry block work mortar.
cracking to concrete floors					No damage observed during visual inspection.
bracing	✓				Unknown, no bracing observed during visual inspection due to linings in place.
precast flooring seating					No damage observed during visual inspection.
stairs					No damage observed during visual inspection.
cladding /envelope					No damage observed during visual inspection. Refer above for concrete masonry block walls.
internal fit out					No damage observed during visual inspection.
building services	✓				No inspection of services was carried out.
other					

6.2 Surrounding Buildings

The Nursery Building is a stand-alone building, however it is located (and was constructed) immediately adjacent to a concrete retaining wall to the south. The retaining wall varies in height consistent with the natural slope of the site. At the south-west corner of the Nursery Building the top of the wall is approximately level with the first floor, and increases in height to around roof level at the south-eastern corner. The pounding potential from the retaining wall has been included in the calculation of the seismic capacity using the Initial Evaluation Procedure. No damage to the retaining wall was visible, however no formal inspection was carried out as it is considered outside the scope of this DEE.

A crib retaining wall exists to the east of the Nursery Building with a retaining height that extends above the roof level of the building. Although no damage was noted, there is a potential landslide risk (for the Nursery Building) and this has been included in the calculation of the seismic capacity using the Initial Evaluation Procedure.

To the north side of the pool is a concrete retaining wall approximately 2m high with a 2m high concrete masonry block fence on top that is significantly damaged (refer Photo 6 and Photo 7 in Appendix A). The block fence section appears to be very lightly reinforced and has minimal fill. It appears likely that the block fence will need to be demolished and reconstructed with an appropriately engineered replacement.

6.3 Residual Displacements and General Observations

No evidence of permanent settlement and displacements to the Nursery Building structure was observed during our visual inspection. Some evidence of permanent settlement and displacements was observed in other areas of the site however. A global settlement survey may reveal movement that could be described as damage under insurance entitlement.

6.4 Implication of Damage

The structure has suffered only minor visible structural damage and therefore we believe the structural capacity has not been affected.

7 Generic Issues

The following generic issues referred to in Appendix A of the EAG guideline document have been identified as applicable to the Nursery Building:

Concrete Shear Wall Structures and Fully Filled Concrete Masonry

- Inadequate shear strength.
- Inadequate seismic separation.

Precast Concrete Floor System

- Inadequate support of precast units.

8 Critical Structural Weaknesses

8.1 Pounding Potential

Pounding from the adjacent retaining wall to the south of the Nursery Building could potentially induce additional seismic forces due to the very small separation and misalignment of floor heights. Further details of the retaining wall and its implications are outlined in Section 6.2. This has been included in the IEP by including a ‘Pounding Effect‘ factor of 0.7. This is considered conservative and would be better addressed should a quantitative assessment be undertaken.

8.2 Site Characteristics

The Nursery Building is situated on a slope with a gradient of approximately 1:2.5 sloping to the west and south. As mentioned in Section 6.2, a crib wall retains roof-high soil immediately adjacent to the east, while a larger concrete retaining wall is situated a further 8m east of the Nursery Building. The Nursery building is deemed to have ‘potential for site instability’ and ‘landslide from above’ as outlined in NZSEE IEP Table 3.4 and hence a reduction factor of 0.7 has been included in the IEP.

9 Geotechnical Consideration

No geotechnical information was available for this site. During the inspection, any damage to the surrounding pavement was noted and any affect to the structure was considered.

It is recommended that further geotechnical studies are performed, in particular to investigate the stability of the surrounding landscape and large retaining wall to the east of the site. Investigations into the differential settlement across the site are also recommended.

10 Survey

There was some evidence of settlement and lateral spread across the site that was observed during our inspection however no level or vertical surveys were carried out. CCC may wish to undertake level and verticality surveys as part of insurance entitlement considerations.

11 Initial Capacity Assessment

11.1 %NBS Assessment

The building has had its seismic capacity assessed using the Initial Evaluation Procedure based on the information available. The building's capacity is expressed as a percentage of New Building Standard (%NBS) and is in the order of that shown below in Table 11.1. These capacities are subject to confirmation by a quantitative analysis which is more detailed. The post-damage capacity is considered to be the same as the original capacity.

Table 11.1: Indicative Building Capacities

System	Direction	Seismic Performance in *%NBS*	Notes
Concrete and concrete masonry shear walls	Longitudinal	35%	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.
Concrete and concrete masonry shear walls	Transverse	35%	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.

11.2 Seismic Parameters

The seismic design parameters based on current design requirements from NZS1170:2004 and the NZBC clause B1 for this building are:

- Site soil class C – NZS 1170.5:2004, Clause 3.1.3.
- Site hazard factor, Z = 0.3 – NZBC, Clause B1 Structure, Amendment 11 effective from 19 May 2011.
- Return period factor Ru = 1 – NZS 1170.5:2004, Table 3.5, Importance level 2 structure with a 50 year design life.
- Near fault factor N(T,D) = 1 – NZS 1170.5:2004, Clause 3.1.6, Distance more than 20 km from fault line.

11.3 Expected Structural Ductility Factor

The concrete shear walls and fully filled concrete masonry unit (CMU) walls in both directions have been assumed to have a ductility factor of 2.0 for the IEP assessment.

11.4 Discussion of results

Based on the IEP results, the Nursery Building is considered potentially Earthquake Risk and seismic grade C as the IEP result is greater than 33%NBS but less than 67%NBS. This assessment is qualitative and based on the NZSEE IEP only.

12 Initial Conclusions

- Minor earthquake damage was observed.
- The building has been assessed to have a seismic capacity of 35%NBS and is therefore potentially Earthquake Risk.
- Critical Structural Weaknesses have been identified.
- Collapse hazards have been identified at the Norman Kirk Memorial Pool site and these require cordoning off.

13 Recommendations

13.1 Occupancy

In order that the owner can make an informed decision about the ongoing use and occupancy of their building the following information is presented in line with the Department of Building and Housing document '*Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch*', June 2012.

The building is considered to be potentially earthquake risk, having an assessed capacity of between 34% and 67%NBS. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads and therefore no restrictions on use or occupancy are recommended. However, access to the Nursery Building should be restricted to routes that do not require entering cordoned areas of the site.

13.2 Further Investigations, Survey or Geotechnical Work

It is recommended that:

- Barricades be installed to cordon off access to damaged structures on the western portion of the Norman Kirk Memorial Pool site including walls/fences and buildings. No occupancy restrictions exist for the Main Plant Room or the Nursery Building and we understand the Nursery is currently occupied. Access to these two building should be restricted to routes that do not require entering cordoned areas of the site.
- A quantitative %NBS analysis of the building should be completed.
- A level survey could be carried out to determine the level of possible settlement of the building for insurance purposes.
- An investigation is undertaken to determine the structural integrity of the adjacent concrete retaining wall to the south, and crib retaining wall and concrete retaining wall to the east.
- A geotechnical investigation is undertaken into the stability of the surrounding landscape and large retaining wall to the east of the site.

13.3 Damage Reinstatement

Repairs that would bring the building back to an "as new" condition are typically entitled under typical replacement insurance policies. We suggest you consult with your insurance advisor as to how you wish to proceed.

14 Design Features Report

Repairs will be required to reinstate the existing structural system. No additional load paths are expected. A repair methodology has not been prepared at this stage.

15 Limitations

The following limitations apply to this engagement:

- Beca and its employees and agents are not able to give any warranty or guarantee that all defects, damage, conditions or qualities have been identified.
- Inspections are primarily limited to visible structural components. Appropriate locations for invasive inspection, if required, will be based on damage patterns observed in visible elements, and review of the construction drawings and structural system. As such, there will be concealed structural elements that will not be directly inspected.
- The inspections are limited to building structural components only.
- Inspection of building services, pipework, pavement, and fire safety systems is excluded from the scope of this report.
- Inspection of the glazing system, linings, carpets, claddings, finishes, suspended ceilings, partitions, tenant fit-out, or the general water tightness envelope is excluded from the scope of this report.
- The preliminary assessment of the lateral load capacity of the building is limited by the completeness and accuracy of the drawings provided. Assumptions have been made in respect of the geotechnical conditions at the site and any aspects or material properties not clear on the drawings. Where these assumptions are considered material to the outcome further investigations may be recommended. It is noted the assessment has not been exhaustive, our analysis and calculations have focused on representative areas only to determine the level of provision made. At this stage we have not undertaken any checks of the gravity system, wind load capacity, or foundations.
- The information in this report provides a snapshot of building damage at the time the detailed inspection was carried out. Additional inspections required as a result of significant aftershocks are outside the scope of this work.

This report is of defined scope and is for reliance by CCC only, and only for this commission. Beca should be consulted where any question regarding the interpretation or completeness of our inspection or reporting arises.

Appendix A

Photographs

Figure 1: Site Layout.

Photo 1: External view of Nursery Building (in background).

Photo 2: Crib Wall (left) to the east of Nursery Building (note: this is at first floor level).

Photo 3: Retaining wall with pounding potential to the south of the Nursery Building.

Photo 4: External view from the west, with concrete retaining walls to east and south shown. Source: Google Maps.

Photo 5: Internal concrete masonry block wall.

Damage Description: Cracking in concrete masonry block mortar.

Photo 6: Concrete retaining wall and concrete masonry block fence to the north of the pool (view from south-east).

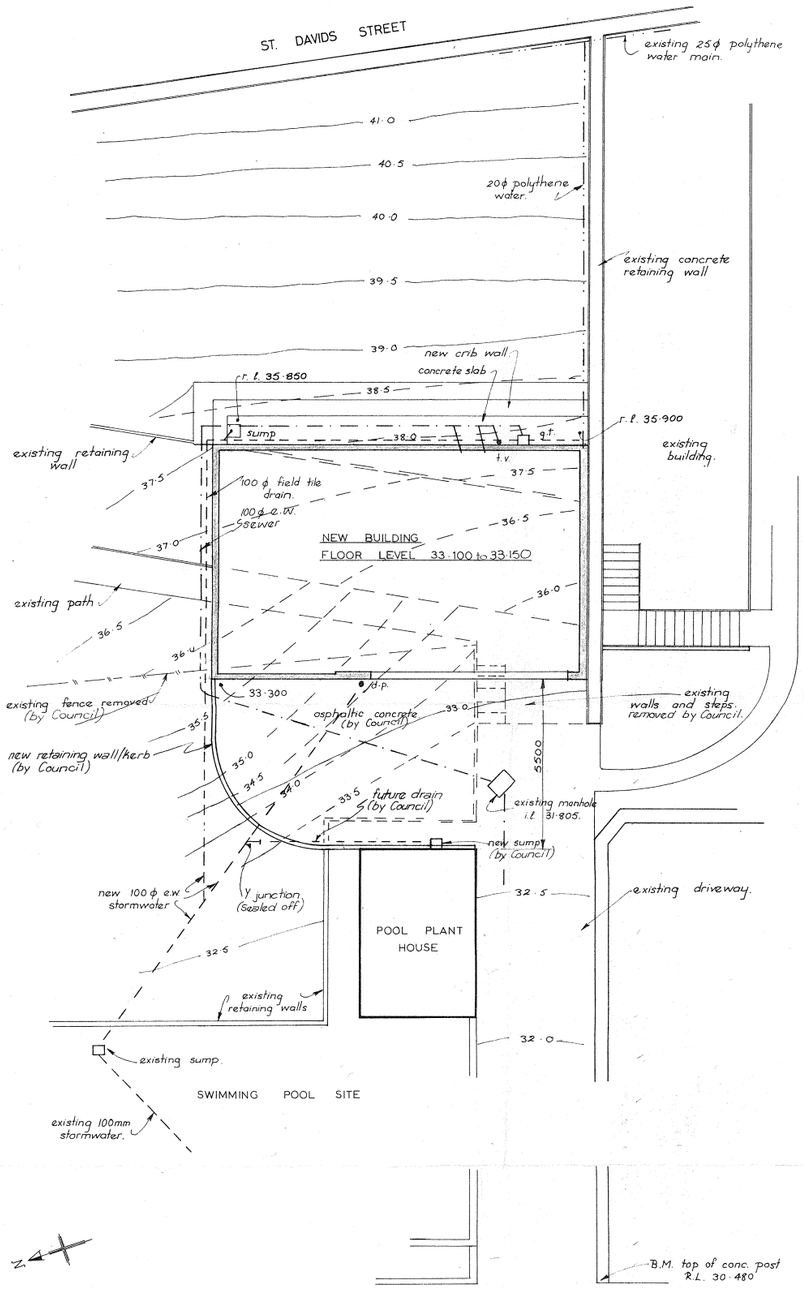
Damage Description: Cracking and differential settlement of concrete masonry block wall.

Photo 7: Concrete masonry fence to the north of the pool.

Damage Description: Cracked and dislodged concrete masonry units.

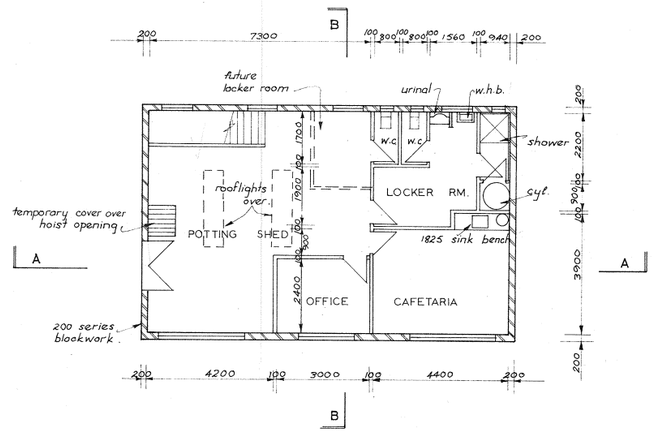
Appendix B

Existing Drawings

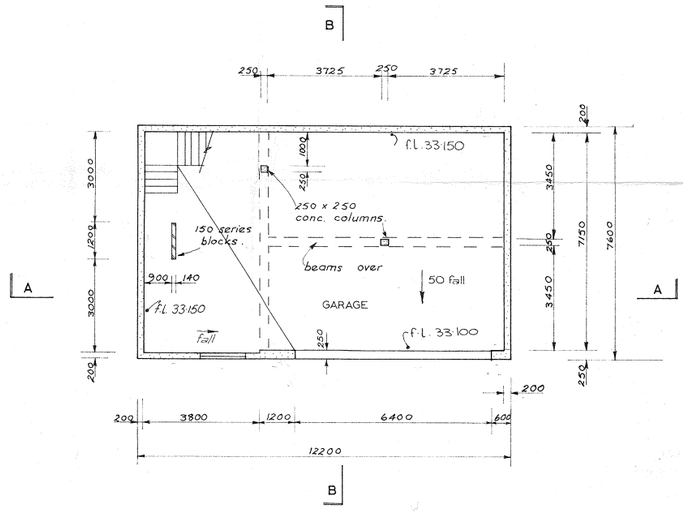


SITE PLAN

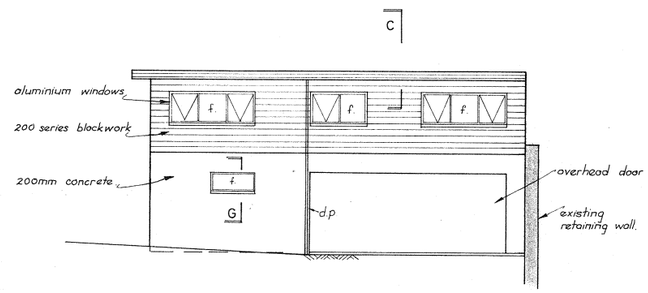
existing contours – – –
proposed contours ——
levels in metres



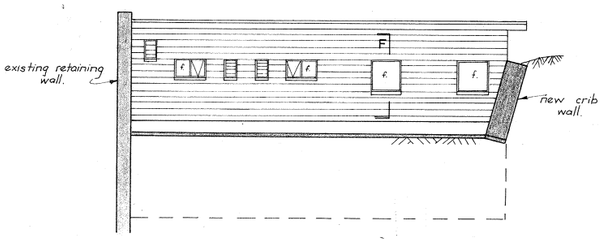
FIRST FLOOR PLAN



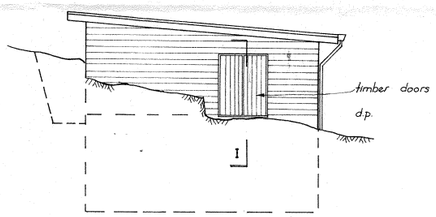
GROUND FLOOR PLAN



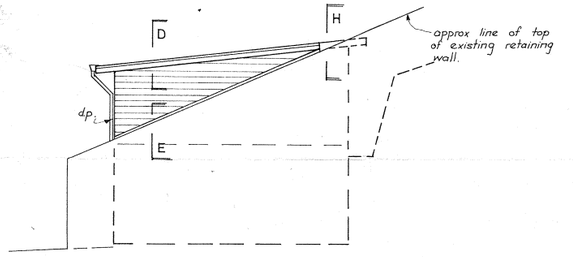
WEST ELEVATION



EAST ELEVATION



NORTH ELEVATION



SOUTH ELEVATION

see dwg 5 for details.

No	DATE	AMENDMENT	INITIAL
A	17.8.76	Details added	M.W.

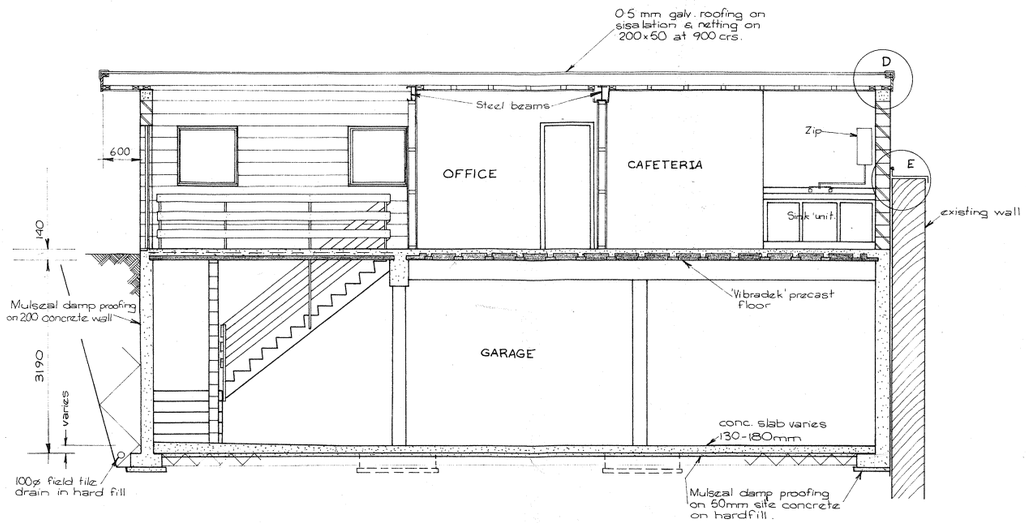
F.B.	INITIALS	DATE
SURV.		
DGN.	I.T	1/76
DR.	I.T	"
TR.	A.C.N	2/76
CH.		
APP.		

LYTTELTON BOROUGH COUNCIL
RESERVES DEPARTMENT BUILDING
PLANS AND ELEVATIONS

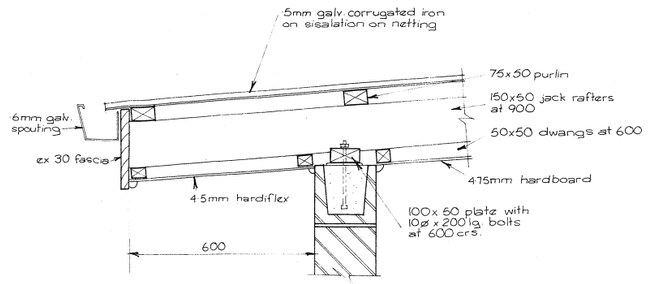
ROYDS SUTHERLAND & McLEAY
CONSULTING ENGINEERS
71 ARMAGH ST.
CHRISTCHURCH
NEW ZEALAND
CIVIL
STRUCTURAL
SURVEYING
TOWN PLANNING

SCALE: 1 : 100

2385/4A



SECTION A-A
Scale 1:50



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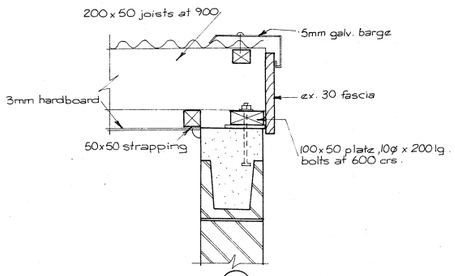

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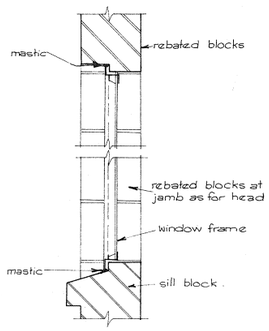

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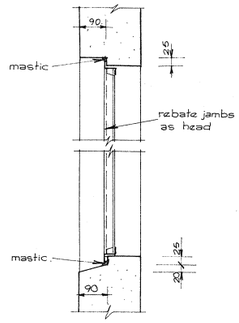

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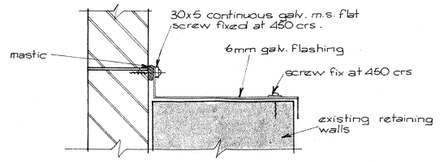

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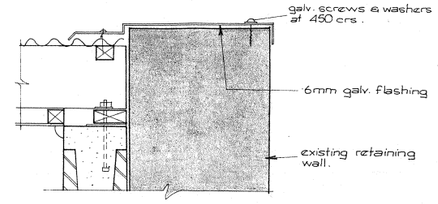

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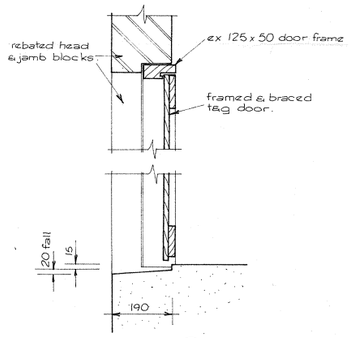
DETAILS
Scale 1:10



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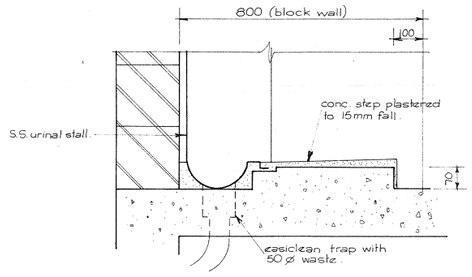

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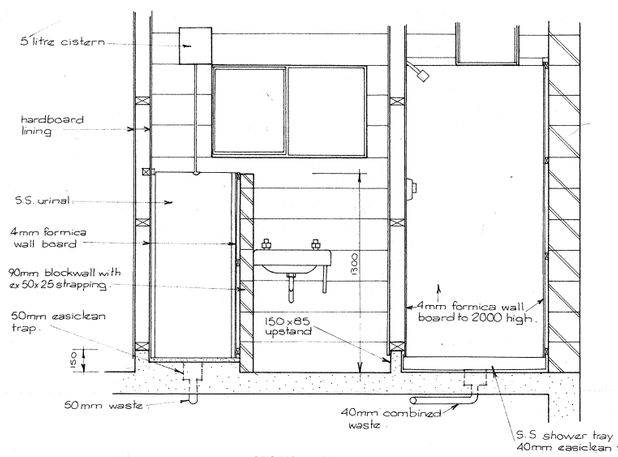
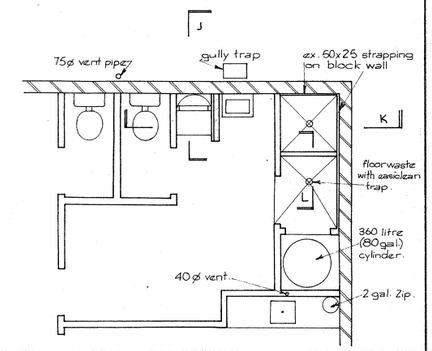
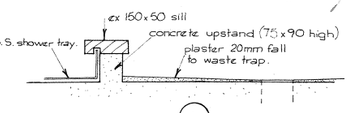


SECTION K-K
Scale 1:20



PLAN OF LOCKER ROOM
Scale 1:50



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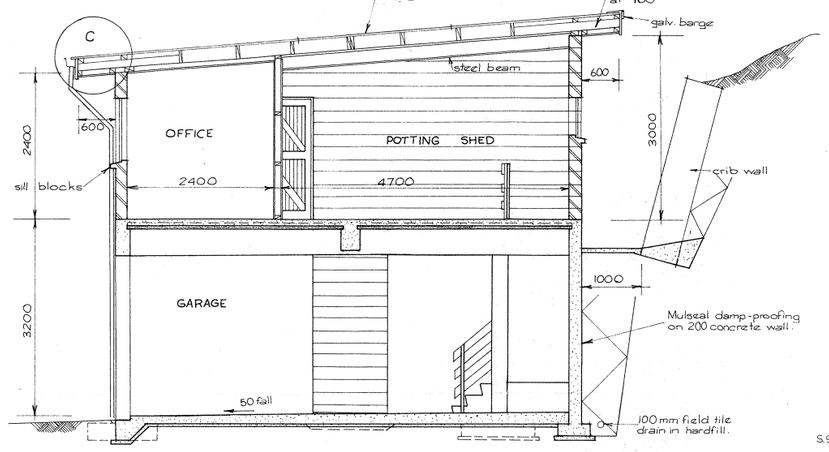


SECTION B-B
Scale 1:50

No.	DATE	AMENDMENT	INITIAL
1	17.8.76	Details added	M.W.

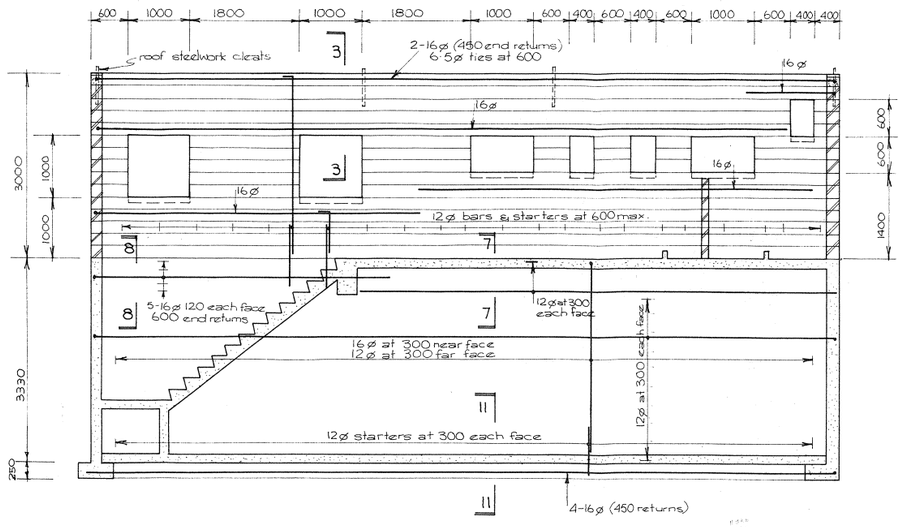
F.B.	INITIALS	DATE
SURV.		
DGN.		
DR.	J.T.	'75
TR.	M.W.	April '76
CH.		
APP.		

LYTTELTON BOROUGH COUNCIL
RESERVES DEPARTMENT BUILDING
SECTIONS AND DETAILS

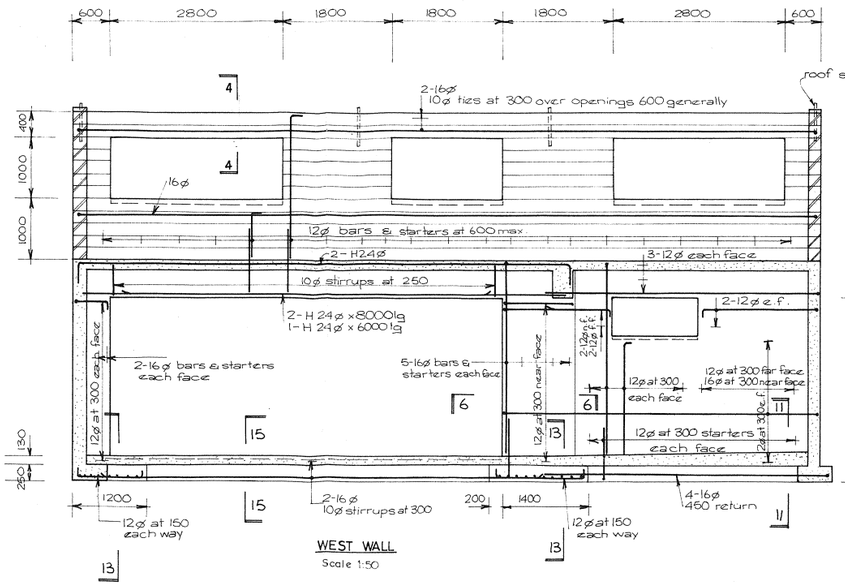
ROYDS SUTHERLAND & McLEAY
CONSULTING ENGINEERS
71 ARMAGH ST.
CHRISTCHURCH
NEW ZEALAND
CIVIL
STRUCTURAL
SURVEYING
TOWN PLANNING

SCALE: As shown

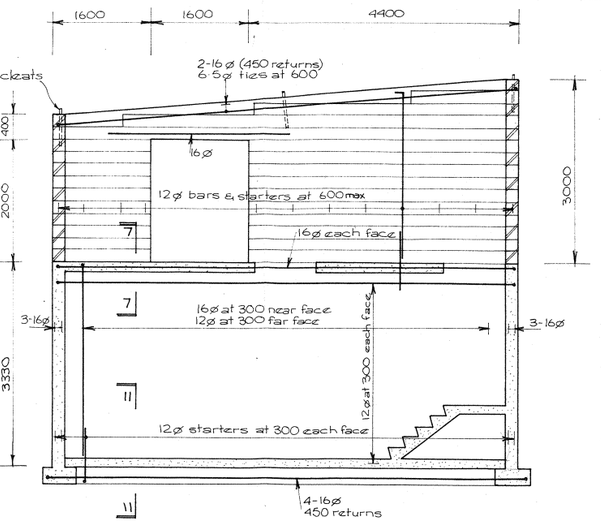
2385/5 A



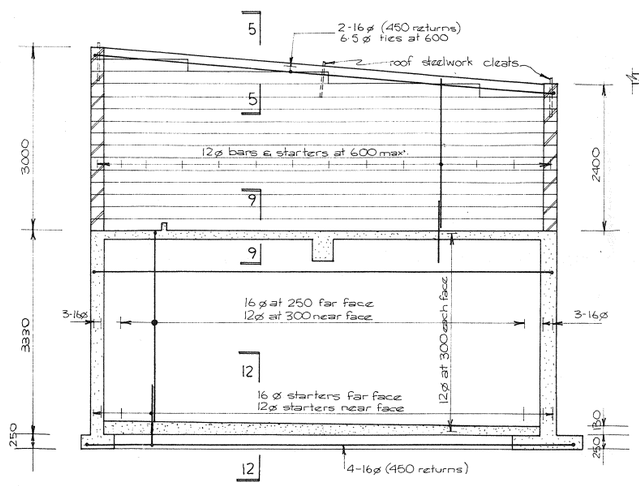
EAST WALL
Scale 1:50



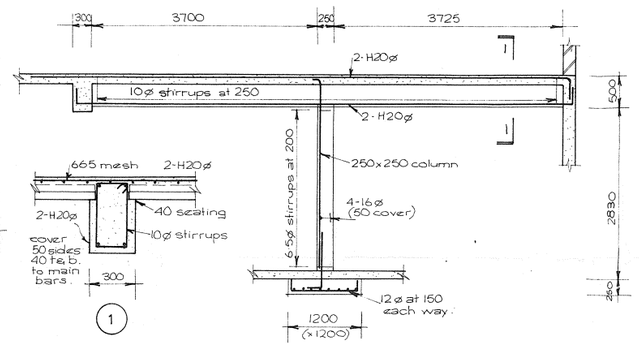
WEST WALL
Scale 1:50



NORTH WALL
Scale 1:50



SOUTH WALL
Scale 1:50



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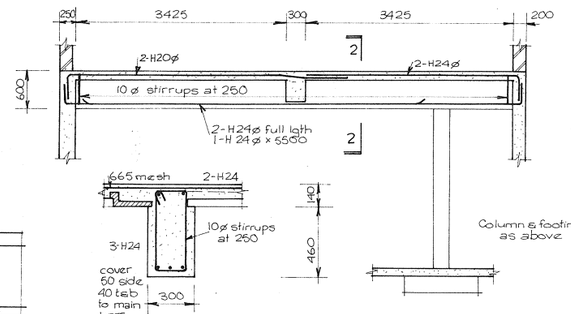
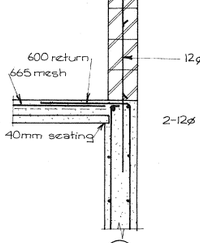


2

FLOOR BEAMS AND COLUMNS
Scale 1:50



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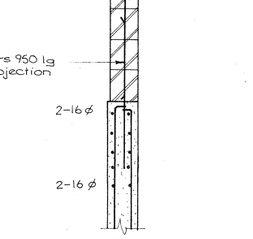

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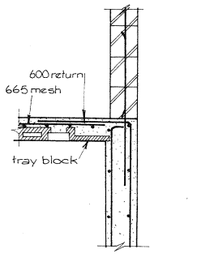

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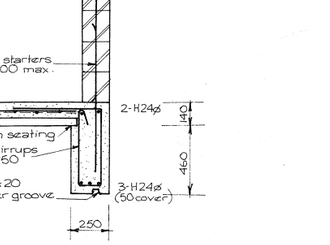

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9

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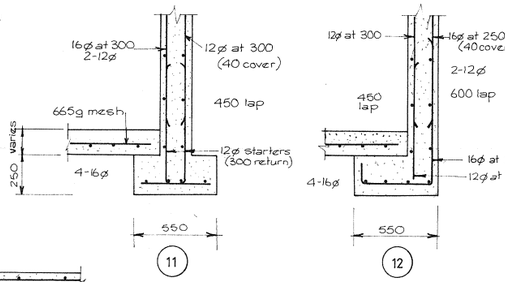

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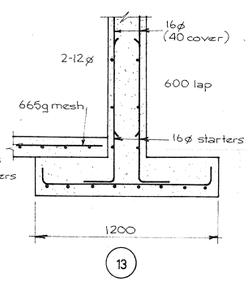

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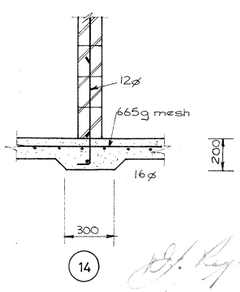
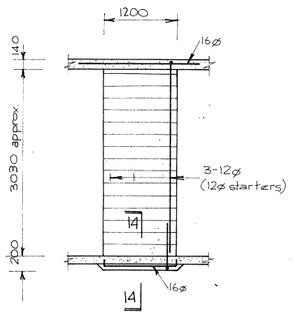
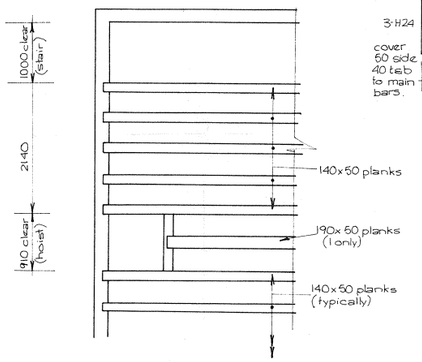


14

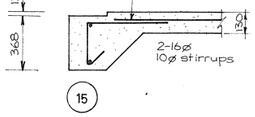
DETAILS
Scale 1:20



HOIST WALL
Scale 1:50



SET-OUT OF PRECAST FLOOR AT HOIST AND STAIRWAY



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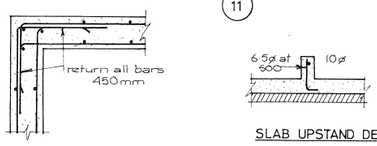


WALL CORNER DETAIL

SLAB UPSTAND DETAIL

NOTES

- First floor slab to be Vibradec precast system with 140x50 planks, V2 fillers, & 50mm topping reinforced with 665 mesh.
- Reinforcing bars prefixed H are to be high yield bar, grade 380 to NZS 3402:1973.
- Refer to drg. 2385/7 for roof beam cleats and fixings for roof bracing

No.	DATE	AMENDMENT	INITIAL
A	17.8.76	Details added	M.W.

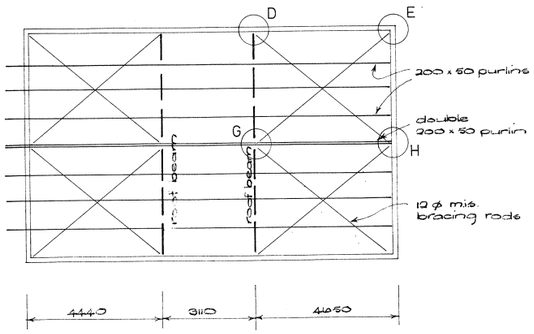
F.B.	INITIALS	DATE
SURV.		
DGN.		
DR.	J.T.	
TR.	M.W.	May '76
CH.		
APP.		

LYTTELTON BOROUGH COUNCIL
RESERVES DEPARTMENT BUILDING
WALLS & BEAMS

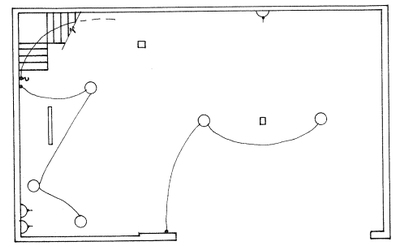
ROYDS SUTHERLAND & McLEAY
CONSULTING ENGINEERS
71 ARMAGH ST.
CHRISTCHURCH
NEW ZEALAND
CIVIL
STRUCTURAL
SURVEYING
TOWN PLANNING

SCALE: As shown

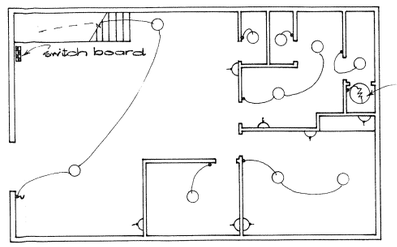
2385/6 A



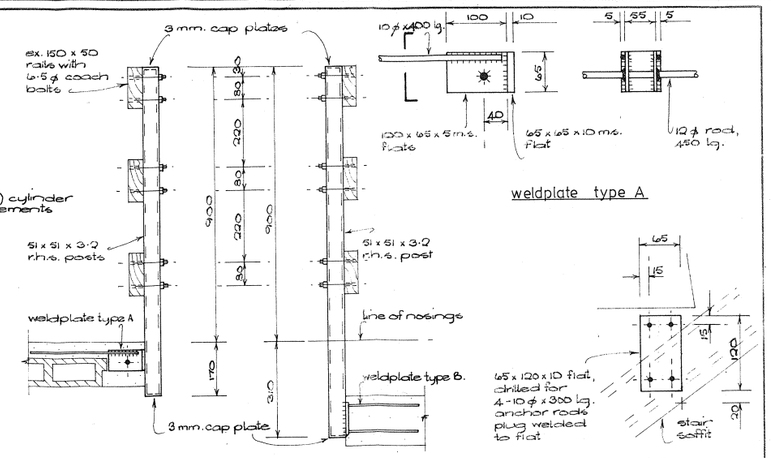
FRAMING PLAN



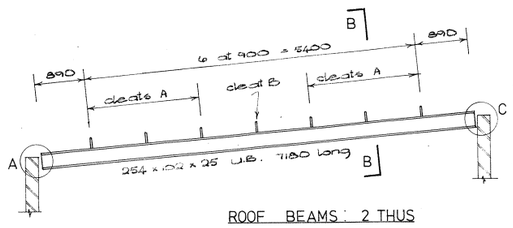
key to symbols :
- ceiling mounted incandescent light
- single socket outlet with switch
- 1 way switch
- 2 way switch



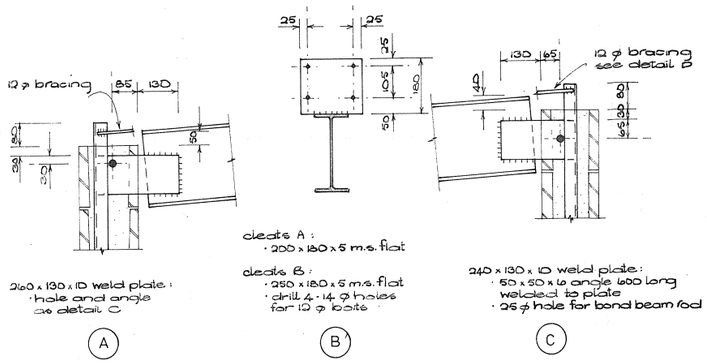
ELECTRICAL LAYOUT
Scale 1:100

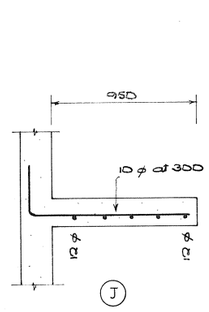


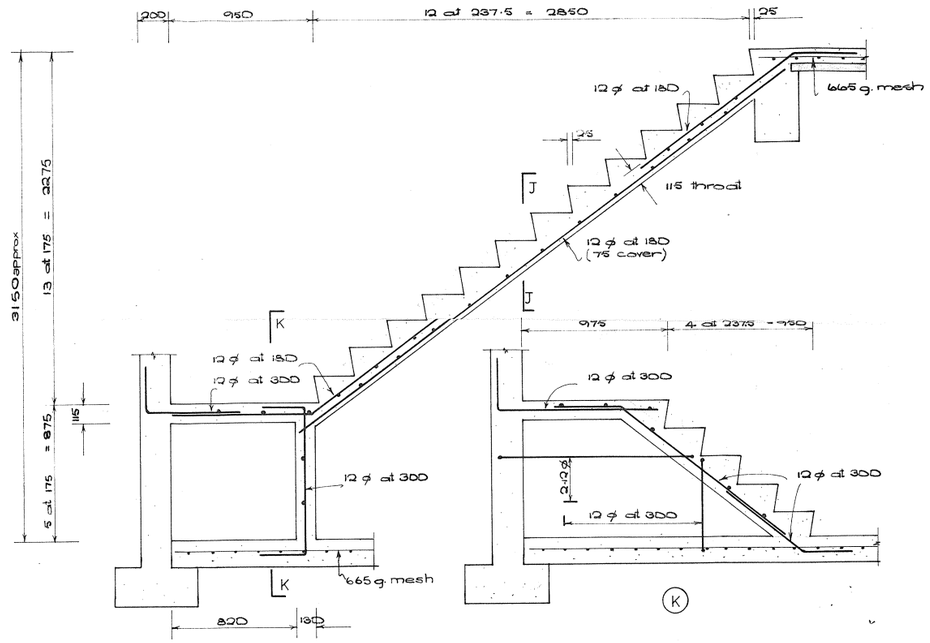
BALUSTRADE DETAILS
Scale 1:10



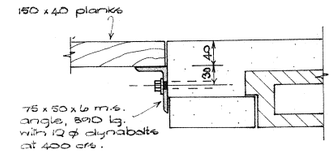
ROOF BEAMS : 2 THUS
Scale 1:50



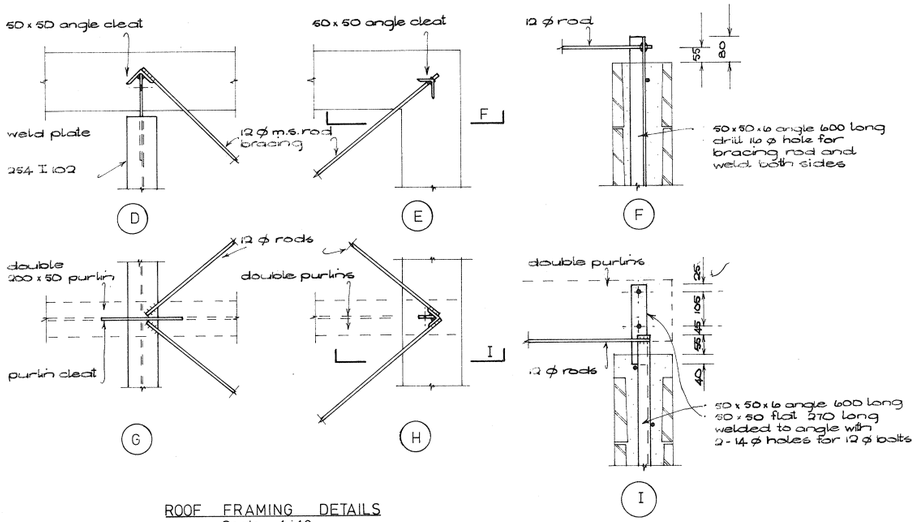




STAIR DETAILS
Scale 1:20



DETAIL OF COVER TO HOIST OPENING
Scale 1:5



ROOF FRAMING DETAILS
Scale 1:10

No	DATE	AMENDMENT	INITIAL
A	17.8.76	Details amended	M.W.

	INITIALS	DATE
F.B.		
SURV.		
DGN.		
DR.	J.T.	May '76
TR.	I.N.	May '76
CH.		
APP.		

LYTTELTON BOROUGH COUNCIL
RESERVES DEPARTMENT BUILDING
ROOF FRAMING, STAIRS AND ELECTRICAL

ROYDS SUTHERLAND & McLEAY
CONSULTING ENGINEERS
71 ARMAGH ST.
CHRISTCHURCH
NEW ZEALAND
CIVIL
STRUCTURAL
SURVEYING
TOWN PLANNING

SCALE: As Shown

2385/7A

Appendix C

CERA DEE Summary Data

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Nursery Building			Reviewer:	David Whittaker
	Unit	No:	Street	CPEng No:	123089
Building Address:	Norman Kirk Memorial Pool	54a	Oxford St, Lyttelton	Company:	Beca
Legal Description:				Company project number:	5323355
				Company phone number:	643663521
	Degrees	Min	Sec		
GPS south:				Date of submission:	14/06/2013
GPS east:				Inspection Date:	7/08/2012
				Revision:	Final
Building Unique Identifier (CCC):	BU 3513-005 EQ2			Is there a full report with this summary?	Yes

Site

Site slope:	slope >1 in 5	Max retaining height (m):	3
Soil type:		Soil Profile (if available):	
Site Class (to NZS1170.5):	C		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):	10	Approx site elevation (m):	36.00

Building

No. of storeys above ground:	2	single storey = 1	Ground floor elevation (Absolute) (m):	36.00
Ground floor split?	no		Ground floor elevation above ground (m):	0.00
Storeys below ground	0			
Foundation type:	strip footings		if Foundation type is other, describe:	
Building height (m):	6.30		height from ground to level of uppermost seismic mass (for IEP only) (m):	6.3
Floor footprint area (approx):	93			
Age of Building (years):	36		Date of design:	1965-1976
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	other (specify)		Brief strengthening description:	
Use (upper floors):	other (specify)			
Use notes (if required):	Nursery			
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	other (note)	describe system	lightweight metal sheeting on timber purlins, steel beam
Floors:	other (note)	describe sytem	Vibradec precast first floor. Slab on grade ground floor
Beams:	cast-insitu concrete	overall depth x width (mm x mm)	500 x 300
Columns:	cast-insitu concrete	typical dimensions (mm x mm)	250 x 250
Walls:	load bearing concrete	#N/A	

Lateral load resisting structure

			Note: Define along and across in detailed report!		
Lateral system along:	other (note)			describe system	Concrete wall ground floor with fully filled CMU first floor. Bracing in roof
Ductility assumed, μ:	2.00				
Period along:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	
Lateral system across:	other (note)			describe system	Concrete wall ground floor, fully filled CMU first floor. Bracing in roof
Ductility assumed, μ:	2.00				
Period across:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	

Separations:

north (mm):		leave blank if not relevant
east (mm):		
south (mm):		
west (mm):		

Non-structural elements

Stairs:	cast insitu	notes	Concrete internal stairs. Steel external stairs
Wall cladding:	exposed structure	describe	No cladding
Roof Cladding:	Metal	describe	Lightweight metal sheeting
Glazing:	aluminium frames		
Ceilings:	fibrous plaster, fixed		
Services(list):	Water, Electricity		

Available documentation

Architectural	none	original designer name/date	
Structural	full	original designer name/date	Royds Sutherland & McLeay, 1976
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site:	Site performance:	Ground cracks and differential settlement	Describe damage:	Ground, mortar and blockwork cracking, settlement
(refer DEE Table 4-2)				
	Settlement:	none observed	notes (if applicable):	
	Differential settlement:	0-1:350	notes (if applicable):	Ground around pool slopes to the south
	Liquefaction:	none apparent	notes (if applicable):	
	Lateral Spread:	none apparent	notes (if applicable):	
	Differential lateral spread:	none apparent	notes (if applicable):	
	Ground cracks:	0-20mm/20m	notes (if applicable):	Pavement cracks throughout site
	Damage to area:	slight	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	No significant structural damage
	Describe (summary):			
Across	Damage ratio:	0%	$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$	
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

Recommendations

	Level of repair/strengthening required:	minor structural		Describe:	Mortar cracking.
	Building Consent required:	no		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	Access to avoid cordoned areas of the site.
Along	Assessed %NBS before:	35%	35% %NBS from IEP below	If IEP not used, please detail assessment methodology:	
	Assessed %NBS after:	35%			
Across	Assessed %NBS before:	35%	35% %NBS from IEP below		
	Assessed %NBS after:	35%			

IEP **Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.**

Period of design of building (from above): 1965-1976

h_n from above: 6.3m

Seismic Zone, if designed between 1965 and 1992: B

not required for this age of building
not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:	6.3%	6.3%

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0	1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2	1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)	1.0

	along	across
Final (%NBS)$_{nom}$:	**6%**	**6%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:	0.30
Z_{1992}, from NZS4203:1992	0.7
Hazard scaling factor, **Factor B:**	3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above):	2
Return Period Scaling factor from Table 3.1, **Factor C**:	1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	2.00	2.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:	1.57	1.57
Ductiity Scaling Factor, **Factor D**:	1.57	1.57

2.6 Structural Performance Scaling Factor:

Sp:	0.700	0.700
Structural Performance Scaling Factor **Factor E**:	1.428571429	1.428571429

2.7 Baseline %NBS, (NBS%)$_b$ = (%NBS)$_{nom}$ x A x B x C x D x E

%NBS$_b$:	**47%**	**47%**

Global Critical Structural Weaknesses: (refer to NZSEE IEP Table 3.4)

3.1. Plan Irregularity, factor A:	insignificant	1
3.2. Vertical irregularity, Factor B:	insignificant	1
3.3. Short columns, Factor C:	insignificant	1

3.4. Pounding potential

Pounding effect D1, from Table to right	0.7
Height Difference effect D2, from Table to right	1.0
Therefore, Factor D:	0.7

3.5. Site Characteristics significant 0.7

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Alignment of floors within 20% of H	**0.7**	**0.8**	**1**
Alignment of floors not within 20% of H	**0.4**	**0.7**	**0.8**

Table for Selection of D2	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Height difference > 4 storeys	0.4	0.7	1
Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	1.5	1.5
Rationale for choice of F factor, if not 1	Landslide CSW only acts across building.	Pounding CSW only acts along building.

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)

List any: Pounding potential, landslide. Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR)	**0.74**	**0.74**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**35%**	**35%**
4.4 Percentage New Building Standard (%NBS), (before)		**35%**

Official Use only:

Accepted By
Date:

Appendix D

Previous Reports and Assessments

(1)

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	M W F	Date	21-6-11	Final Posting (e.g. UNSAFE)	UNsafe
Territorial Authority	Christchurch City	Time	11:00		

Building Name: Norman Kirk Main Pool Ladies, Mens, Nursery + Lean to Bldg
Short Name:
Address: 54 Oxford St Lyttelton
GPS Co-ordinates: S° E°
Contact Name: Bruce Thompson
Contact Phone: 027 449 2937

Storeys at and above ground level: 1
Below ground level: N/A
Total gross floor area (m²):
Year built:
No of residential Units:

Photo Taken: Yes (No)

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☑ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☐ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☑ Other Pool Bldgs

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☐	☐	☑	Block walls will require partial/ complete demolition. Floor
Building or storey leaning	☑	☐	☐	sunk. Slab moved 20mm
Wall or other structural damage	☐	☐	☐	from pool. Significant
Overhead falling hazard	☐	☐	☑	damage
Ground movement, settlement, slips	☐	☑	☐	
Neighbouring building hazard	☐	☐	☑	On to driveway - south side from
Electrical, gas, sewerage, water, hazmats	☐	☐	☐	Not known lean to. This drive gives access to 54a Oxford St

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE): Unsafe

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED			RESTRICTED USE			UNSAFE			
GREEN	G1	G2	YELLOW	Y1	Y2	RED	R1	R2	R3

Record any restriction on use or entry:

Further Action Recommended:

Need to design/detail new walls & investigate foundation conditions

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☑ Detailed engineering evaluation recommended
  - ☑ Structural
  - ☑ Geotechnical
  - ☐ Other:
- ☐ Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☐	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☑	100 %	☐

Sign here on completion

Date & Time: 21-6-11 12:00

ID: Murray Frost SKM 021 403 180

PROPT:

Inspection ID: _____ *(Office Use Only)*

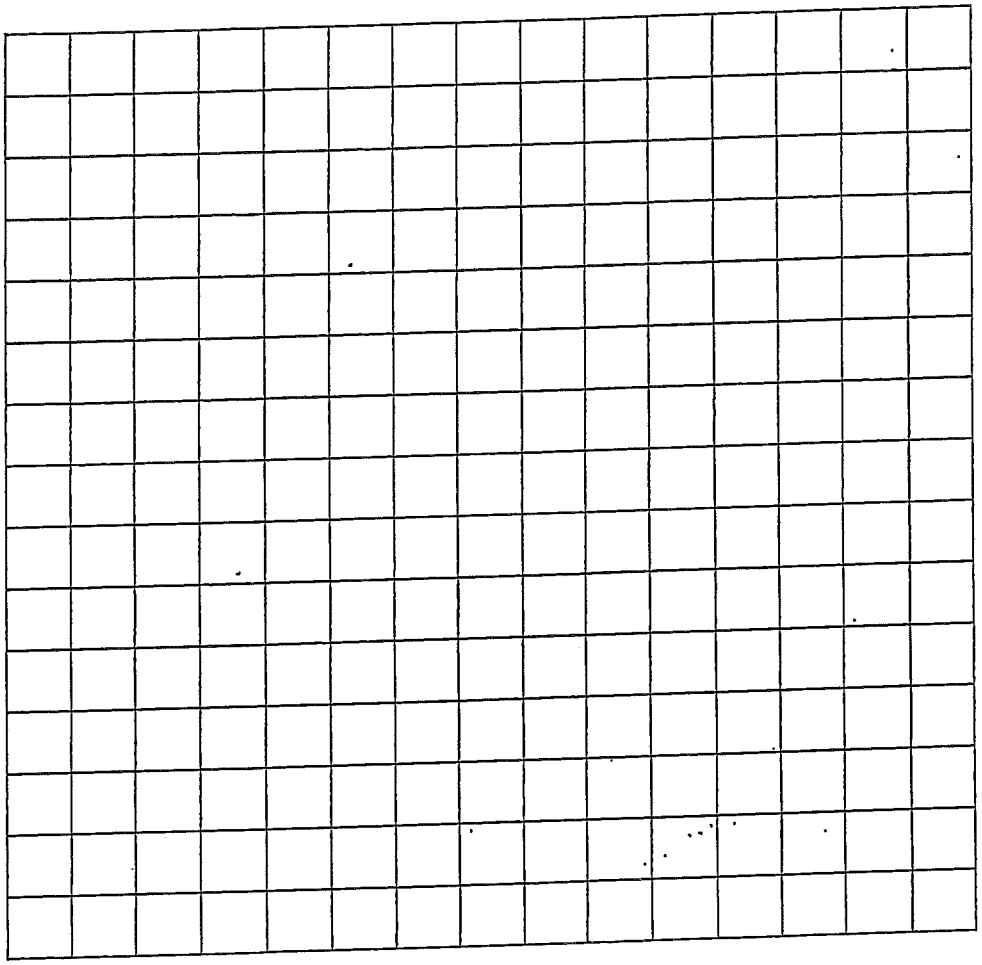
Structural Hazards/ Damage	Minor/None	Moderate	Severe	Comments
Foundations	☐	☑	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☐	☐	☐	
Pre-cast connections	☐	☐	☐	
Beam	☐	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☐	☐	☐	
Cladding, glazing	☐	☐	☑	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☐	☐	☑	
Elevators	☐	☐	☐	N/A
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☐	☐	☐	Not Known
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	None
Ground movement, fissures	☑	☑	☐	Minor
Soil bulging, liquefaction	☑	☐	☐	None

General Comment ______________________________

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	Put danger tape along Wall of Ikon to (along drive to
		R2. Severe damage: demolition likely	54a Oxford St) & across all access to other areas.
		R3. At risk from adjacent premises or from ground failure	Walls cracked (5mm) & Walls badly damaged. south Block wing

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

Detailed investigation & inspection required.

This could be a significant claim for CCC to the Insurance Company although danger to public is limited due to the security arrangements around the pool.

Ring Tin Driver – Removed to stop gas bottles from cabinet – wall in danger of collapse. City care to called. Two cylinders lying flat on ground by childs paddling pool.

 Inspection ID: _____ *(Office Use Only)*