Christchurch City Council

BE 0893 EQ2
Cuthberts Green Softball Complex
Pages Road, Wainoni

COMBINED QUALITATIVE AND QUANTITATIVE REPORT

FINAL

- 4
- 05 February 2013

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1. Executive summary

A Detailed Engineering Evaluation (DEE) was carried out for various structures at the Cuthberts Green Softball Facility in Wainoni (BU 0893-003 EQ2). This report contains the results of both the qualitative and the quantitative reports which were done as one report on the assumption that at least the Groundsmans Shed was an earthquake prone building and hence a quantitative report would have been recommended.

1.1. Key Damage Observed

The key damage observed during our inspections are summarised below:

- 5 of the 6 light towers are out of plumb.
- The modesty walls in the softball complex had collapsed and have subsequently been removed.
- The ground bearing floor slab in the softball complex had settled and cracked.
- Various other areas of minor structural damage such as concrete and block cracks.

1.2. Critical Structural Weaknesses

There were no critical structural weaknesses discovered that have not been accounted for in our quantitative assessment.

1.3. Indicative Building Strength

As described in the Engineering Advisory Group's "Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings" (from July 2011) we have assessed the percentage of new building standard seismic resistance using the quantitative method. Our assessment included consideration of geotechnical conditions, existing earthquake damage to the buildings and structural engineering calculations to assess both strength and ductility/resilience.

The assessments were based on the following:

- Detailed on-site investigation to assess the extent of existing earthquake damage including limited intrusive investigation.
- Qualitative assessment of critical structural weaknesses (CSWs) based on review of available structural drawings.
- Geotechnical investigation of the ground conditions on the site. The results of this investigation are summarised in this report and contained in the Geotechnical Assessment Report dated 8 December 2011.
- Assessment of the strength of the existing structures taking account of the current condition.

Any building that is found to have a seismic capacity less than 34% of the new building standard is required by the CCC Earthquake Prone Building policy (2010) to be strengthened up to a target strength of at least 67%NBS.

Based on the information available, and using the Quantitative Assessment Procedure, the original capacity and the post earthquake capacity have been calculated as below in Table 1.

- **Table 1: DEE results summary**

Description	Grade	Risk	%NBS Pre EQ	%NBS Post EQ	Structural performance
Softball complex (modesty walls in damaged condition)	E	High	26	<10%	Unacceptable. Improvement required.
Groundsmans shed	E	High	19	19	Unacceptable. Improvement required.
Canopy	D	Moderate	23	23	Unacceptable. Improvement required.
Softball complex (modesty wall demolished)	C	Moderate	39	39	Acceptable legally. Improvement recommended.
Grandstand	C	Moderate	52	52	Acceptable legally. Improvement recommended.
Light towers	A+	Low	>100	>100	Acceptable. Improvement may be desirable.
Dugouts	A+	Low	>100	>100	Acceptable. Improvement may be desirable.

As noted above the Softball Complex, Canopy and the Groundsmans shed have been assessed as potentially earthquake prone. The remaining buildings have been found to not be potentially earthquake prone.

Please note that structural strengthening is required by law for buildings that are confirmed to have a seismic capacity of less than 33% NBS.

1.4. Recommendations

It is recommended that:

a) The current placard statuses posted on the buildings of green remain as is, however refer to the recommendations below.

b) Due to the %NBS calculated, CCC may wish to vacate the earthquake prone buildings even though we are not aware of any legal obligation to do so.

c) We consider that barriers around the building are not necessary unless the buildings are vacated in which case barriers will be required to prevent access to the grandstand offices since access to these is under the Softball complex.

d) An options study is carried out providing solutions to strengthen the potentially earthquake prone buildings (Softball complex, Groundsmans Shed, and Canopy) to a target of 67% and 100% of New Building Standard

2. Introduction

Sinclair Knight Merz was engaged by Christchurch City Council to carry out a Quantitative Assessment of the seismic performance of buildings located at the Cuthberts Green Softball facility on Pages Road. The structures that this report covers are listed below:

- Softball complex
- Grandstand
- Groundsmans shed
- Light towers
- Dugouts
- Canopy between the Softball Complex and Cowles Stadium

The scope of this quantitative analysis includes the following:

- Analysis of the seismic load carrying capacity of the building compared to current seismic loading requirements or New Buildings Standard (NBS). It should be noted that this analysis considers the building in its damaged state where appropriate.
- Identification of any critical structural weaknesses which may exist in the building and include these in the assessed %NBS of the structure.
- Preparation of a summary report outlining the areas of concern in the building.

The recommendations from the Engineering Advisory Group[1] were followed to assess the likely performance of the structures in a seismic event relative to the New Building Standard (NBS). 100% NBS is equivalent to the strength of a building that fully complies with current codes. This includes a recent increase of the Christchurch seismic hazard factor from 0.22 to 0.3[2].

Construction drawings were made available, and these have been considered in our evaluation of the buildings. The buildings' description below is based on a review of the drawings and our visual inspections.

At the time of writing the buildings were thought to have an equivalent placard status of green.

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[1] EAG 2011, *Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury - Draft*, p 10
[2] http://www.dbh.govt.nz/seismicity-info

3. 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.

3.1. 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 anticipated that CERA will adopt the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This document sets out a methodology for both qualitative and quantitative assessments.

The qualitative assessment is a desk-top and site inspection assessment. It is based on a thorough visual inspection of the building coupled with a review of available documentation such as drawings and specifications. The quantitative assessment involves analytical calculation of the buildings 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 and amount of damage
- The age and structural type of the building

- Consideration of any critical structural weaknesses
- The extent of any earthquake damage

3.2. Building Act

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

3.2.1. 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).

3.2.2. 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.

3.2.3. 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.

3.2.4. 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.

3.2.5. 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.

3.2.6. Section 131 – Earthquake Prone Building Policy

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

3.3. 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. Council recognises that it may not be practicable for some repairs to meet that target. The council will work closely with building owners to achieve sensible, safe outcomes;
- 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.

We anticipate 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.

3.4. 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.

After the February Earthquake, 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.

4. Earthquake Resistance Standards

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 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).

The likely 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 buildings 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 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 1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines**

Figure 2 below 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). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

- **Table 2: %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

5. Building Details

5.1. Structure descriptions

5.1.1. Softball complex

The Softball Complex was designed in 1988 and is a two storey high structure with approximate plan dimensions of 28 x 14 m. It has reinforced block walls up to the first floor and steel portal frames forming the load resisting structure of the second storey. There are also changing block 'wings' of the building that are only one level which have block walls with steel portals to support the roof. The foundations of the building are constructed of strip footings below the block walls with 'floating' slabs between the walls which are not connected to the foundations. The first floor is in-situ reinforced concrete and the portals have lightweight steel cladding. The seismic load resisting structure incorporated steel portal frames above level 1 and reinforced concrete shear walls below level 1. The concrete block shear walls carry the lateral loads into the shallow strip foundations where the loads are resisted by friction.

5.1.2. Grandstand

The Grandstand was designed in 2009 and is a two storey building with approximate dimensions of 18 x 11 m. It consists of grandstand seating with a viewing deck above and various rooms below. The Grandstand is constructed from precast concrete shear wall panels and bleachers on top of a concrete floor with 1200 deep concrete 'posthole' foundations. The balcony floor is made of 75 mm precast floor units under 75 mm concrete topping.

5.1.3. Groundsmans Shed

No plans were available for the Groundsmans Shed and so all calculations were done on the basis of site visits and a reinforcing bar detection survey. The shed is constructed from lightly reinforced concrete block walls with a timber truss roof and profiled steel cladding and it has approximate plan dimensions of 9 x 6 m. The foundations for the shed are assumed to consist of the block walls extending below ground onto strip foundations with the slab 'floating' between walls. The block walls of the building act as shear walls to carry seismic loads down to shallow strip footings. The roof has not been detailed to act as a diaphragm.

5.1.4. Light towers

There are six light towers surrounding the softball pitch but structural information was available for only four of the towers. The two most recent towers were designed in 2003 and are made of steel octagonal sections of varying thicknesses and sizes with a total height of 25.7 m above ground. Two of the older light towers were retrofitted with new foundations in 2003 with a new reinforced concrete pile for each tower which extends six metres below ground. It has been assumed that the retrofitted towers are similar to the new ones and the new towers have similar foundations to the retrofitted towers. The light towers are cantilevered steel columns on piled foundations.

5.1.5. Dugouts

There are two dugouts adjacent to the softball pitch which each have plan dimensions of 11.5 x 3.8m. They were designed in 2003 and are made of steel portal frames with fibre cement board, Perspex and wire mesh to different parts of the walls and a profiled steel and Durolite roof. The foundations for the dugouts are made of a reinforced concrete slab with edge thickening.

5.1.6. Canopy between the Softball Complex and Cowles Stadium

No information was available for the canopy but an intrusive site visit found that it is constructed from steel portal frames in the transverse direction with support from Cowles Stadium entrance walls in the longitudinal direction. The walls are open and the roof is made of a membrane on plywood on timber framing with fibre cement board soffit cladding. It has approximate plan dimensions of 5.3 x 24 m. The connection detail between the Canopy and Cowles Stadium consists of the canopy end beam nailed to the side of a 70x85 timber which is then coach screwed from the underside to a 260x150 beam spanning above the entrance of Cowles Stadium.

5.2. Structural Damage

Below is an explanation of the damage noted to each structure. The damage described is from our inspections dated 21/10/2011, 2/11/2011 and a specific inspection of the Grandstand viewing deck on 01/02/2012.

5.2.1. Softball complex

The quantitative analysis has been preceded by a Level 2 Rapid Assessment undertaken by others dated 23/02/11. The rapid assessment found that a cantilever modesty wall in the south eastern end of the building had failed. In addition the rapid assessment noted other damage including cracking to some exterior block walls and differential settlement to some floors. Minor cracking to block walls is typical for this type and age of building.

Ground floor slab

The floor slab survey contained in Appendix 3 – Survey Results indicated significant settlement with around 100mm maximum variation in level at ground floor level. While this is not a residential property the guidance document titled “Guidance on house repairs and reconstruction following the Canterbury Earthquake” recommends that a house with Type C foundations (slab on grade) should have foundations completely rebuilt if the maximum variation in level exceeds 100mm; as noted above the maximum variation in level is approximately 100mm. The above levels would lead to the conclusion that the slab is significantly out of level and should be substantially replaced. We note that the slab is a floating slab on grade and the surrounding structures are not reliant on the slab for stability and so this repair could be undertaken relatively simply.

Superstructure Levels

The superstructure has been surveyed by taking levels of a consistent blockwork course which is assumed to have been level prior to the earthquake induced settlements evident on site having occurred. The survey results are contained in Appendix 3 – Survey Results.

The maximum differential between adjacent levels on the block wall course is 60mm over approximately 9.0m a slope of 1:150 or 0.67%. While this is not a residential property the guidance document titled "Guidance on house repairs and reconstruction following the Canterbury Earthquake" recommends that a house with Type C foundations (slab on grade) should have foundations completely rebuilt if the slope between two points greater than 2m apart is greater than 0.50%; as noted above the slope between points 3 and 4 is approximately 0.67%. These levels would lead to the conclusion that the building has settled and relevelling or demolition is required.

In addition the level 1 floor slab was surveyed, however these levels have been ignored since the block course survey should provide a more accurate indication of the superstructure settlement.

Superstructure Damage

Further investigation will be required for any blocks that are not to be demolished and have cracking greater than 1.0mm wide. This investigation will require removing the block faces off a select number of blocks so the concrete infill can be inspected for cracking and reinforcing samples taken if deemed necessary by the engineer.

The ground bearing concrete slab between the Grandstand and the Softball complex has sever cracking where the two structures have moved separately.

The two areas of concern which caused the building to be given a yellow placard have been addressed as follows:

- The minor block work cracking and differential settlement is not considered to have a significant impact on the load carrying capacity of the structure.
- In discussion with Christchurch City Council the cantilevered modesty walls at each end of the building have been demolished.

The above information should allow the existing placard to be removed in discussion with CERA.

5.2.2. Grandstand

Damage noted during an inspection of the building includes hairline cracks to the underside of the bleacher units, 0.6 mm wide cracking to cantilever part of the stairs and 'puckering' of the fibreglass topping of the viewing platform which appears to be at the joins of the precast floor units. One section of the ‘puckering’ was lifted and the concrete beneath inspected revealing 0.3mm cracks. The separation joint with the Softball Complex has been damaged and rainwater is now leaking into the walkway beneath. Some of the waterproofing seals on the structure has visible cracking and in some cases spalled plasterwork beneath.

The survey contained in Appendix 3 – Survey Results indicated a differential settlement of 35mm to the ground floor slab and 52mm to the viewing deck area. The settlement relative to the original building level has not been ascertained due to the survey using a different datum level when compared with the original construction drawings. The maximum slope of the viewing deck area is approximately 52mm over 10m or 0.52%. While this is not a residential property the guidance document titled “Guidance on house repairs and reconstruction following the Canterbury Earthquake” recommends that a house with Type C foundations (slab on grade) should have foundations completely rebuilt if the slope between two points greater than 2m apart is greater than 0.50%; as noted above the slope is approximately 0.52%. These levels would lead to the conclusion that the building has settled and relevelling or demolition is required.

5.2.3. Groundsmans Shed

Damage to the Groundsmans Shed consisted of hairline cracking to some of the blockwalls as well as substantial cracking to ground floor slab.

The building was not surveyed, however there was no evidence of settlement nor of any structural distress caused by settlement.

5.2.4. Dugouts

No damage or settlement issues were noted to the dugouts during the site inspection.

5.2.5. Canopy between the Softball Complex and Cowles Stadium

No damage to the canopy structure was discovered, an intrusive investigation was undertaken where the canopy connects to Cowles Stadium since this location will transfer all longitudinal loads from the canopy into Cowles Stadium and then into the foundations. The intrusive investigation showed that there was no damage in this connection.

5.2.6. Lighting Towers

No damage was noted to the light towers during the site inspection, however it was recommended that a verticality survey and a review of the bolt tensioning be carried out due to the critical nature of these elements of the structure. No intrusive investigations were undertaken to inspect the foundations although based on the detailed engineering calculations for these structures it is reasonable to assume that limited or no damage has occurred to the light tower structures.

The tension in the holding down bolts was reviewed against the methods of tensioning contained in NZS3404: Part 1:1997. It was discovered that 98% of the nuts had sufficient tension, 2% of the bolts were tensioned and all bolts held tension and so did not require replacement.

The verticality survey of the light towers which is attached at Appendix 3 – Survey Results has shown that the 5 of the 6 light towers were not vertical and exceeded the recommended column plumb tolerance. The recommended column plumb tolerance is 25mm for any point up to 60m in height and lights 1, 2, 3, 5 and 6 exceed this tolerance in one or both measured orthogonal directions and hence these light towers will need to be re-plumbed. The towers should be levelled by lifting them off the foundations, providing the necessary level of shims and then replacing the towers, tensioning the bolts using the methods contained in NZS3404 and the baseplates drypacked.

6. Foundation and Ground Conditions

Descriptions of ground conditions are based on boreholes and CPT's.

6.1. Ground

Investigation findings show that the materials are predominantly loose to dense medium to coarse sand. The sequence of materials typically comprised of an "upper" medium dense sand layer with occasional thin beds of silt. The thin beds of silt were identified at approximately 4.0 - 4.5m, 5.0 - 5.5m and 6.0 - 6.5m. A deeper 750mm thick silty layer was identified approximately 14.0 to 16.0m below ground level. Underlying this silt layer a "lower" dense medium sand layer was encountered.

Refer to the borehole logs presented in the Geotechnical report for more detailed interpretation.

The paleo-topography generally indicates that the underlying soil profile is near flat to gently sloping. Refer to Drawings ZP01185-001, 002 and 003 for the inferred geological long section and the estimated extent of the sand and silty layers. We have assumed a flat site at RL15m for the long sections as no detailed survey/level was undertaken.

6.2. Groundwater

Groundwater levels were measured at the completion of drilling and also undertaken the day after drilling in the open hole (no piezometer). These results are presented on the borehole logs in the Geotechnical report.

The groundwater table is estimated to be 2m below existing ground level based on measurements in the boreholes.

6.2.1. Bearing Capacity

Bearing capacity of the shallow foundations of Cuthberts Green Softball Pavilion and Grandstand were calculated in accordance with 'New Zealand Building Code Structure Clause B1/VM4, Foundations'.

This calculation assumed foundations of Cuthberts Green Softball Pavilion to be 600mm high, 270mm wide strip footing as per drawing D3479 and foundations of the Grandstand to be 1200mm deep, 600mm diameter circular concrete foundation as the worst case as per drawing S1.01. Design parameters were assumed based on borehole logs and CPT output and they are show in Table 4. The ground was pre-drilled to the depth of 1.2–1.8m so that the cone resistance value (q_c) was assumed to be the value at 1.2m bgl (below ground level).

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- **Table 3 Design Parameters**

Unit Weight, γ (kN/m^3)	18
Friction Angle, Φ (°)	35

- **Table 4 Bearing Capacity of Softball Pavilion and Grandstand**

	Softball Pavilion	Grandstand
Ultimate Bearing Capacity (kPa)	650	1700
Allowable Bearing Capacity (kPa)	215	550

6.3. Seismic Assessment

Seismic loading for geotechnical foundation assessment has been determined from NZS 1170.5:2004 Structural Design Actions Part 5: Earthquake Actions – New Zealand, with the following inputs:

- Site subsoil class: D (deep soil)
- Zone factor 0.3
- Structure design working life 50 years (this is the maximum design working life)
- Structural importance level 2
- Serviceability-level earthquake annual probability of exceedance (SLS) 1/25
- Ultimate limit state earthquake annual probability of exceedance (ULS) 1/500
- Maximum considered earthquake annual probability of exceedance (MCE) 1/2500

The Ultimate Limit State (ULS) and the Serviceability-level earthquake is Serviceability Limit State (SLS). The resulting design seismic loadings are peak ground acceleration (PGA) for:

- NZS1170 - 1/25 year return period (SLS) 0.084g
- NZS 1170 - 1/500 year return period (ULS) 0.336g
- NZS 1170 - 1/2500 year return period (MCE) 0.605g

6.4. Liquefaction

The susceptibility of a site to soil liquefaction is a function of particle size distribution, groundwater level and soil density. Liquefaction assessment has been carried for the soil profile of CPT02, CPT10 and CPT14 using the simplified procedure presented in the 1996 and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils. Data was analysed using CPT results from the investigation. Results of the liquefaction analysis are presented in the appendix to the Geotechnical report. By this method, the analyses indicate that there is a risk of liquefaction within the silty sand units under ULS acceleration. In this loading case, the liquefaction occurs only in the fully saturated, loose material of the upper sand layer from approximately 4m to 15m depth.

Due to the soils showing a high liquefaction potential under ULS accelerations, the soils are expected to be prone to liquefaction induced settlement under ULS loading and the bearing capacity of shallow foundations may be compromised. It is likely that this will manifest as some irregular settlement or tilting.

6.5. Possible Remedial Works

Results from the investigations (CPT02, CPT10 & CPT14) show zones of loose and medium dense sands in the upper 15m.

The existing pavilion structure and the grandstand both satisfy the static bearing capacity in accordance with 'New Zealand Building Code Structure Clause B1/VM4, Foundations'. However, under ULS earthquake loading we would anticipate liquefaction and associated settlement and ground deformation resulting in a loss of serviceability. The existing foundation would not be considered appropriate for the given ground conditions and applicable earthquake design criteria. Detailed design of the foundations has not been undertaken as part of this investigation, although it is concluded that remedial treatment is required to improve the seismic performance of the existing foundations. Examples and explanation of possible ground treatments options are as follows:

Vibro-compaction technique – This technique is used to densify granular soils using a deep vibrator. It involves vibrating a hollow steel probe into the soils to the required depth. Aggregate is then introduced down the probe to the base of the hole and is vibro-compacted whilst the probe is slowly withdrawn.

Vibro Replacement installed as a stone column – Similar in character to the vibro-compaction using top feed vibrators which are forced into the ground. The aggregates are then allowed to take the place of the displaced soil which exerts a pressure on the surrounding soil, hence helping to improve the soil's load-bearing capacity and liquefaction resistance.

Compaction grouting (Pressure / permeation grouting) involves injecting a grout material into the pore or void space of loose granular materials and is often referred to simply as *grouting*. The grout is usually a cementitious mix that is assumed to strengthen a formation. The risk in this technique is controlling the distribution of the injected materials and validating that sufficient material has been successfully placed in the required zones to achieve the desired result.

Deep Soil Mixing (DSM) is a soil improvement technology used to treat soils in situ to improve strength and stiffness thereby improving bearing capacity and reducing compressibility. The process involves mixing a grout or binder with the soil in reciprocating augers to create cemented column of improved soil.

Displacement Piles can be used to also improve the mass strength / stiffness of an extensive area of loose compressible or potentially liquefiable soils. The technique simply involves driving displacement piles at intervals across the required treatment to a pre-determined depth. The installation of the piles can densify loose sand deposits within the immediate influence zone of the pile and transfer structural loads to deeper more competent soils. Displacement piles can be driven pre-cast concrete or timber poles.

A Stiffened Raft is another treatment option that could be considered. This process would involve the mass excavation and replacement of loose / soft near surface soils to a pre-determined depth with an engineered / compacted fill material that may or may not be reinforced with geo-fabrics or grids. The stiffened raft provides a competent formation to above ground structures and mitigates the consequences of any liquefaction of materials at depth.

Structural Solutions for improving the seismic performance of the existing foundations would involve the installation / construction of underpinning piles. Underpinning piles may take the form of conventional screw piles installed in small groups immediately adjacent and structurally connected to existing shallow foundations. The piles would need to be installed to found in competent materials that are not prone to liquefaction and would need to be grouped to provide adequate lateral and shear resistance in the event that earthquake induced liquefaction occurs in the overlying loose soils.

Given the area of treatment would encompass the whole of the building footprint it is unlikely that any of the above treatment options could be implemented without first removing the existing flooring.

A detailed assessment of the options would be required to determine which offers the most effective solution. Criteria to be used in the evaluation would be:-

- Cost
- Construction Programme / Duration
- Effectiveness – degree to which liquefaction effects can be mitigated
- Site Constraints – suitability of treatment process given existing site constraints.
- Environmental Impacts – degree to which noise, vibration, silt / water discharges from the site could impact on the environment and neighbouring properties.

On the balance of the above factors and given our current understanding of the site constraints we would currently predict that the Deep Soil Mixing or Displacement Piling solutions would be favoured.

7. Seismic Loading

The following criteria has been used to determine the seismic loading in accordance with NZS 1170.5:

- **Table 5: Seismic Design Parameters**

Factor	Value (other structures)	Value (Groundsmans Shed)	Discussion
$C_h(T)$	3.00	3.00	As above Site Subsoil class D, with period less than 0.4 seconds
Z	0.3	0.3	Altered Seismic Zone factor for Canterbury following the Canterbury Earthquakes
R	1.0	1.0	Importance Level 2, 50 year design life and Annual Probability of exceedance for ULS 1/500
N(T,D)	1.0	1.0	No near fault considerations required
S_p	0.9	1.0	Ultimate Limit state structural performance factor using ZNS 1170.5 figures.
k_μ	1.14	1.0	Ductility 1.00 for Groundsmans shed and 1.25 for other structures, assumed period less than 0.4sec
$C_d(T_1)$	0.73	0.9	

8. Assumptions

The following assumptions have been made in the detailed engineering evaluation:

- Structural Steelwork material grade = 300MPa (Softball Complex, Dugouts and Light Towers)
- Concrete material grade = 30MPa (Grandstand), 30MPa (Softball Complex, Groundsmans Shed, Light Towers, Dugouts)
- Reinforcing Steelwork grade = 300MPa (Grandstand D bars), 500MPa (Grandstand H bars), 485MPa (Grandstand Mesh), 300MPa (Softball Complex, Groundsmans shed), 500MPa (Light Towers, Dugouts)
- Blockwork strength = 12MPa (Groundsmans Shed and Softball Complex)
- The building was built according to the drawings and according to good practice at the time. We have reviewed the building and from our visual inspection the structure appears to be built in accordance with the drawings.

9. Investigation scope and limitations

This report covers DEEs only of the structures listed above in the Introduction. The DEE process is outlined in guidance notes from the Engineering Advisory Group[3] and aims to be a 'review of the building design, construction, and how the building has performed in recent earthquakes to understand its potential performance in future earthquakes and to determine what repair or strengthening is required to bring it to a satisfactory level of compliance or to simply improve its future performance.'

These DEEs were based on either drawings of the structure or a site inspection as detailed in section 2 and 3. The detailed engineering analysis is a post construction evaluation. Since it is not a full design and construction monitoring, it has the following limitations:

- It is not likely to pick up on any concealed construction errors (if they exist)
- Other possible issues that could affect the performance of the building such as corrosion and modifications to the structure will not be identified unless they are visible and have been specifically mentioned in this report.
- The detailed engineering evaluation deals only with the structural aspects of the structure. Other aspects such as building services and building fabric are not covered.

9.1. Available Information

The DEEs were based on the following information:

- Softball complex – original drawings dated 1987-1988 by the Christchurch City Council City Works and Planning Department
- Grandstand – original consent drawings dated 2009 by Alan Reay Consultants
- Groundsmans shed – no drawings were available for this building. Our DEE was based on site measurements and a rebar survey
- Light towers – drawings date 2003 by CSP Pacific and City Solutions
- Dugouts – 2003 drawings by City Solutions
- Canopy between the Softball Complex and Cowles Stadium – no drawings were available for this structure. Our DEE was based on site measurements and an intrusive investigation into the ceiling of the structure.

[3] See EAG 2011, *Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury - Draft*, p 10

9.2. The Detailed Engineering Evaluation process

The DEE is a procedure written by the Department of Building and Housing's Engineering Advisory Group and grades buildings according to their likely performance in a seismic event. The procedure is not yet recognised by the NZ Building Code but is widely used and recognised by the Christchurch City Council as the preferred method for preliminary seismic investigations of buildings[4].

The procedure of the DEE is as follows:

1) Qualitative assessment procedure
    a. Determine the building's status following any rapid assessment that have been done
    b. Review any existing documentation that is available. This will give the engineer an understanding of how the building is expected to behave. If no documentation is available, site measurements may be required
    c. Review the foundations and any geotechnical information available. This will include determining the zoning of the land and the likely soil behaviour, a site investigation may be required
    d. Investigate possible Critical Structural Weaknesses (CSW) or collapse hazards
    e. Assess the original and post earthquake strength of the building
2) Quantitative procedure
    a. Carry out a geotechnical investigation if required by the qualitative assessment
    b. Analyse the building according to current building codes and standards

The DEE assessment ranks buildings according to how well they are likely to perform relative to a new building designed to current earthquake standards, as shown in Table 6. The building rank is indicated by the percent of the required New Building Standard (%NBS) strength that the building is considered to have. Earthquake prone buildings are defined as having less than 33 %NBS strength which correlates to an increased risk of approximately 20 times that of 100% NBS[5]. Buildings that are identified to be earthquake prone are required by law to be strengthened within 30 years of the owner being notified that the building is potentially earthquake prone[6].

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[4] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf
[5] NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes,* p 2-2
[6] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf

- **Table 6: DEE Risk classifications**

Description	Grade	Risk	%NBS	Structural performance
Low risk building	A+	Low	> 100	Acceptable. Improvement may be desirable.
	A		100 to 80	
	B		80 to 67	
Moderate risk building	C	Moderate	67 to 33	Acceptable legally. Improvement recommended.
High risk building	D	High	33 to 20	Unacceptable. Improvement required.
	E		< 20	

The DEE method rates buildings based on the plans (if available) and other information known about the building and some more subjective parameters associated with how the building is detailed and so it is possible that %NBS derived from different engineers may differ.

This assessment describes only the likely seismic Ultimate Limit State (ULS) performance of the building. The ULS is the level of earthquake that can be resisted by the building without catastrophic failure. The DEE does also consider Serviceability Limit State (SLS) performance of the building and or the level of earthquake that would start to cause damage to the building but this result is secondary to the ULS performance.

The NZ Building Code describes that the relevant codes for NBS are primarily:

- AS/NZS 1170.0,1,5 Structural Design Actions
- NZS 3101:2006 Concrete Structures Standard
- NZS 3404:1997 Steel Structures Standard
- NZS 2606:1993 Timber Structures Standard
- NZS 4230:1990 Design of Reinforced Concrete Masonry Structures

10. Discussion

The information below confirms the outcome of our detailed engineering evaluation as well as discusses any critical structural weaknesses which have been identified.

10.1. Geotechnical results

The bearing capacity of the soil under non-seismic cases appears to be adequate, however under earthquake loading there is a high liquefaction potential. Liquefied soils are likely to result in further settlement and possible structural damage. It is recommended that a detailed design assessment of the possible ground remediation or foundation strengthening solutions is undertaken.

10.2. Critical Structural weaknesses

10.2.1. Softball complex

The only critical structural weakness in the softball complex is the stairs. The stairs of this building are detailed in such a way that they are considered a critical structural weakness, however since the structure is a single level shear wall structure it is not anticipated that sway will be large enough to cause the stairs to collapse and in addition there is an alternative means of escape down the bleachers of the grandstand. Removing this critical structural weakness would cost only a small amount by the addition of two new structural steel columns under the landing. It is anticipated that detailed design should confirm these new columns are able to rest on the existing floor slab.

10.2.2. Grandstand

The Grandstand is not thought to have any critical structural weaknesses. The stairs of this structure are detailed such that they might be classified as a critical structural weakness, however since the structure is a single level shear wall structure it is not anticipated that sway will be large enough to cause the stairs to collapse and in addition there is an alternative means of escape down the bleachers.

10.2.3. Groundsmans shed

The Groundsmans Shed is not thought to have any critical structural weaknesses.

10.2.4. Light towers

The Light Towers are not thought to have any critical structural weaknesses.

10.2.5. Dugouts

The Dugouts are not thought to have any critical structural weaknesses.

10.2.6. Canopy

A portion of the canopy is being supported by Cowles Stadium. This connection will initially transfer all longitudinal loads from the canopy into Cowles Stadium and then into the foundations. From intrusive investigations it was found the lateral loads from the canopy transfers loads to Cowles Stadium by horizontal nail connections. The capacity of this connection has been accounted for in our design and as such can be ignored.

10.3. Detailed Engineering Results

The equivalent static force method was used to analyse the seismic capacity of the structures. The results of the analysis are reported below. The results below are calculated for the structures in the damaged state. The results have been broken down into their seismic resisting elements.

10.3.1. Softball complex

The steel portal frame on the first floor was found to have insufficient strength due to the lack of bracing in the longitudinal direction – having an existing capacity of 60%NBS.

It was also noted that the lack of bracing will produce large deflections in moderate seismic events and if future strengthening is undertaken this will need to be addressed.

Some of the block walls at ground floor level were found to have inadequate reinforcing – having an existing capacity 56%NBS.

A section of the first floor slab cantilevers to the south west toward the grandstand and was found to have insufficient strength – having an existing capacity of 39%NBS (this is due to vertical earthquake accelerations).

The failed cantilever modesty wall is assumed to have a capacity less than 10%NBS. As noted in section 3 this wall and the matching wall at the opposite end of the building have been demolished to remove the immediate safety risk. The capacity of the modesty walls in their undamaged state has been assessed at 26%.

Appendix 3 – Survey Results contains the results of limited surveys which were undertaken. These generally show that the some areas of the ground bearing floor slab are out of level and should be replaced with new code-compliant floor slabs. In addition the survey shows that the walls have settled, these settlements should be corrected and the foundations improved to limit future liquefaction settlement.

- **Table 7: DEE assessment summary for the Softball Complex**

Seismic Resisting Element	Seismic Rating (%NBS)
Modesty walls in damaged condition	<10
Modesty Wall prior to Earthquake Damage	26
First floor slab cantilevers to the south west	39
Concrete Block Walls	56
Steel Portal Frames (ULS)	60

10.3.2. Grandstand

Our analysis found that the structural connection between the grandstand bleachers and the foundations were inadequate – having existing capacity of 52%NBS. The connection should be strengthened by adding additional bars drilled and grouted through the bleachers into the foundation. Our analysis found that the structural connection between the precast wall panels and the foundations were less than current requirements – having existing capacity of 80%NBS. The connection could be strengthened by adding additional bars drilled and grouted at an angle near to vertical through wall panels into the foundations.

Appendix 3 – Survey Results contains the results of limited surveys which were undertaken. The survey shows that the walls have settled, these settlements should be corrected and the foundations improved to limit future liquefaction settlement. Detailed design will be required for the foundation upgrade.

- **Table 8: DEE assessment summary for the Grandstand**

Seismic Resisting Element	Seismic Rating (%NBS)
Bleacher to Foundation Connection	52
Precast Wall connection to Foundation	80

10.3.3. Groundsmans shed

The block walls were shown to have insufficient strength – having existing capacity of 43%NBS.

The roof diaphragm was shown to have insufficient strength – having existing capacity 19%NBS.

The shed was not surveyed since there was no visible reason to believe that any settlement had occurred. The foundations of the building may need to be strengthened in order to limit future settlements. Detailed design will be required for the foundation upgrade.

- Table 9: DEE assessment summary for the Groundsmans Shed

Seismic Resisting Element	Seismic Rating (%NBS)
Roof diaphragm	19
Block walls	43

10.3.4. Light towers

The light towers were found to have a capacity in excess of 100% and so no strengthening is proposed.

- Table 10: DEE assessment summary for the Light Towers

Seismic Resisting Element	Seismic Rating (%NBS)
Entire structure	>100%

10.3.5. Dugouts

The Dugouts were found to have a capacity in excess of 100% and so no strengthening is proposed. There was no visual evidence of settlement and so no survey was undertaken. Due to the value of the Dugouts foundation strengthening to prevent future liquefaction settlement is not proposed.

- Table 11: DEE assessment summary for the Dugouts

Seismic Resisting Element	Seismic Rating (%NBS)
Entire structure	>100%

10.3.6. Canopy

The connection between the canopy and Cowles Stadium is inadequate based on intrusive investigations.

There was no visible settlement and so a survey has not been undertaken. The foundations of the building may need to be strengthened in order to limit future settlements. Detailed design will be required for the foundation upgrade and this is currently excluded from the strengthening concept.

- **Table 12: DEE assessment summary for Canopy**

Seismic Resisting Element	Seismic Rating (%NBS)
Earthquake loads in longitudinal direction, governed by withdraw of the nail connections	23
Concrete Block Wall at Cowles Stadium	54
Earthquake loads in transverse direction	100

10.3.7. Assessment Summary

Table 13 below summarises the earthquake prone status of each building on the site.

- **Table 13: DEE assessment summary**

Building	Date of drawings	%NBS estimate	Earthquake prone	Earthquake risk	Rating
Softball complex (modesty walls in damaged condition)	1988	<10	Yes	Yes	E
Softball complex (modesty walls prior to the earthquakes)	1988	26	Yes	Yes	E
Groundsmans shed	Not available	19	Yes	Yes	E
Canopy	Not available	23	Yes	Yes	D
Softball complex (modesty walls demolished)	1988	39	No	Yes	C
Grandstand	2009	52	No	Yes	C
Light towers	2003	>100	No	No	A+
Dugouts	2003	>100	No	No	A+

As above the Groundsmans Shed, Canopy and the Softball Complex are Earthquake Prone buildings. Based on the above we recommend that the Softball Complex be vacated immediately pending strengthening. Christchurch City Council may wish to vacate the Groundsmans shed until it is strengthened or stabilised on the basis of the limiting building capacity summarised above in Table 13 but it is understood that there is no legal requirement to do so at this point.

Note that the proposed strengthening designs are conceptual designs only and full detailed design will be required prior to confirming the details and the associated costs.

If it is determined that the structures should be repaired there are a number of issues which will need to be investigated and associated documents prepared in order to submit a building consent application. Listed below are the likely items the council may require to be explored:

- A detailed assessment of the foundation remediation works will be required so that the costs of the work can be included in the cost estimate.
- A fire report will be required and all necessary upgrades to egress routes, emergency lighting and specified systems will need to be undertaken.
- An emergency lighting design will be required to meet the provisions noted in the fire report.
- A disabled access summary will be required including provision for disabled facilities.
- The site amenities (toilets and the like) will need to be reviewed to ensure that there are sufficient facilities for the expected number of people on site.
- Landscaping will need to be considered although we do not anticipate that any modifications will be required since you will not be adjusting the footprint area of buildings on site and will likely only be required for the new build option.

11. Conclusion

We have inspected the Softball Complex, Grandstand, Groundsmans Shed, Light Towers, Dugouts and Canopy structures on the Cuthberts Green site and commented on levels of damage. In addition we have undertaken a detailed engineering evaluation of the structures to consider the structures seismic capacities compared with New Building Standard. The outcome of this analysis is shown in Table 16 below:

- **Table 14: DEE Summary Table**

Description	Grade	Risk	%NBS Pre EQ	%NBS Post EQ	Structural performance
Softball complex (modesty walls in damaged condition)	E	High	26	<10%	Unacceptable. Improvement required.
Groundsmans shed	E	High	19	19	Unacceptable. Improvement required.
Canopy	D	High	23	23	Unacceptable. Improvement required.
Softball complex (modesty wall demolished)	C	Moderate	39	39	Acceptable legally. Improvement recommended.
Grandstand	C	Moderate	52	52	Acceptable legally. Improvement recommended.
Light towers	A+	Low	>100	>100	Acceptable. Improvement may be desirable.
Dugouts	A+	Low	>100	>100	Acceptable. Improvement may be desirable.

The above table excludes the portal frame serviceability capacity; we recommend that the serviceability capacity is not considered in a decision on whether to vacate the building. As shown above the Groundsmans Shed, canopy and the Softball Complex are classified as Earthquake Prone Buildings and these building are required to be strengthened to a target of at least 67% of NBS.

We make the following additional recommendations:

- A detailed design of foundation remediation solutions and associated costs obtained from a specialist contractor in order to weigh up the merits of repair options compared with demolish and rebuild options.
- The current placard status of the building of green, remain as is.
- We consider that barriers around the building are not necessary unless the Softball Complex is evacuated in which case barriers should be placed to prevent access between the Grandstand and the Softball Complex at ground level as well as onto the Softball Complex balcony at level 1.
- An options study is carried out providing solutions to strengthen the potentially earthquake prone buildings (Softball complex, Groundsmans Shed, and Canopy) to a target of 34% and 67% of New Building Standard.
- If the earthquake prone buildings are vacated then access to the adjacent Grandstand offices should also be cordoned due to the risk level associated with the access to the offices.

12. Limitation Statement

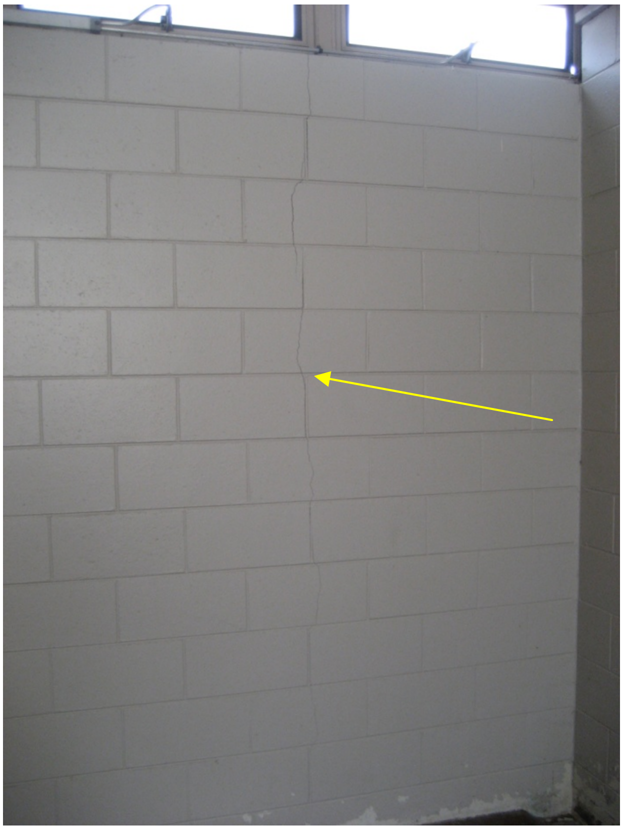
This report has been prepared on behalf of, and for the exclusive use of, SKM's client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and the Client. It is not possible to make a proper assessment of this report without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to, and the assumptions made by, SKM. The report may not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this report by any third party.

Without limiting any of the above, in the event of any liability, SKM's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited in as set out in the terms of the engagement with the Client.

It is not within SKM's scope or responsibility to identify the presence of asbestos, nor the responsibility of SKM to identify possible sources of asbestos. Therefore for any property pre-dating 1989, the presence of asbestos materials should be considered when costing remedial measures or possible demolition.

Should there be any further significant earthquake event, of a magnitude 5 or greater, it will be necessary to conduct a follow-up investigation, as the observations, conclusions and recommendations of this report may no longer apply Earthquake of a lower magnitude may also cause damage, and SKM should be advised immediately if further damage is visible or suspected.

13. Appendix 1 – Damage Photos



- **Figure 2 – Complex – Typical Damage of Modesty Walls.**
- **Figure 3 – Complex – Typical wall cracking.**

- **Figure 4 – Complex – Typical cracking and settlement of slab adjacent Grandstand.**
- **Figure 5 – Complex – Floor slab cracking and bulging.**

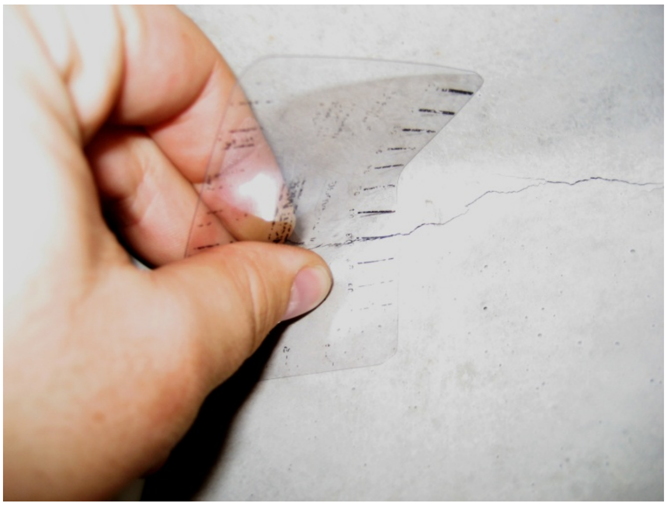
- **Figure 6 – Complex – Differential movement of column base and ground floor slab.**

- **Figure 7 – Grandstand – Cracking of stair landing.**

- **Figure 8 – Grandstand – cracking under fibreglass topping.**

- **Figure 9 – Grandstand – Damage to separation joint at Softball Complex.**

- **Figure 10 – Grandstand – Section of plastering has broken out damaging the waterproofing.**



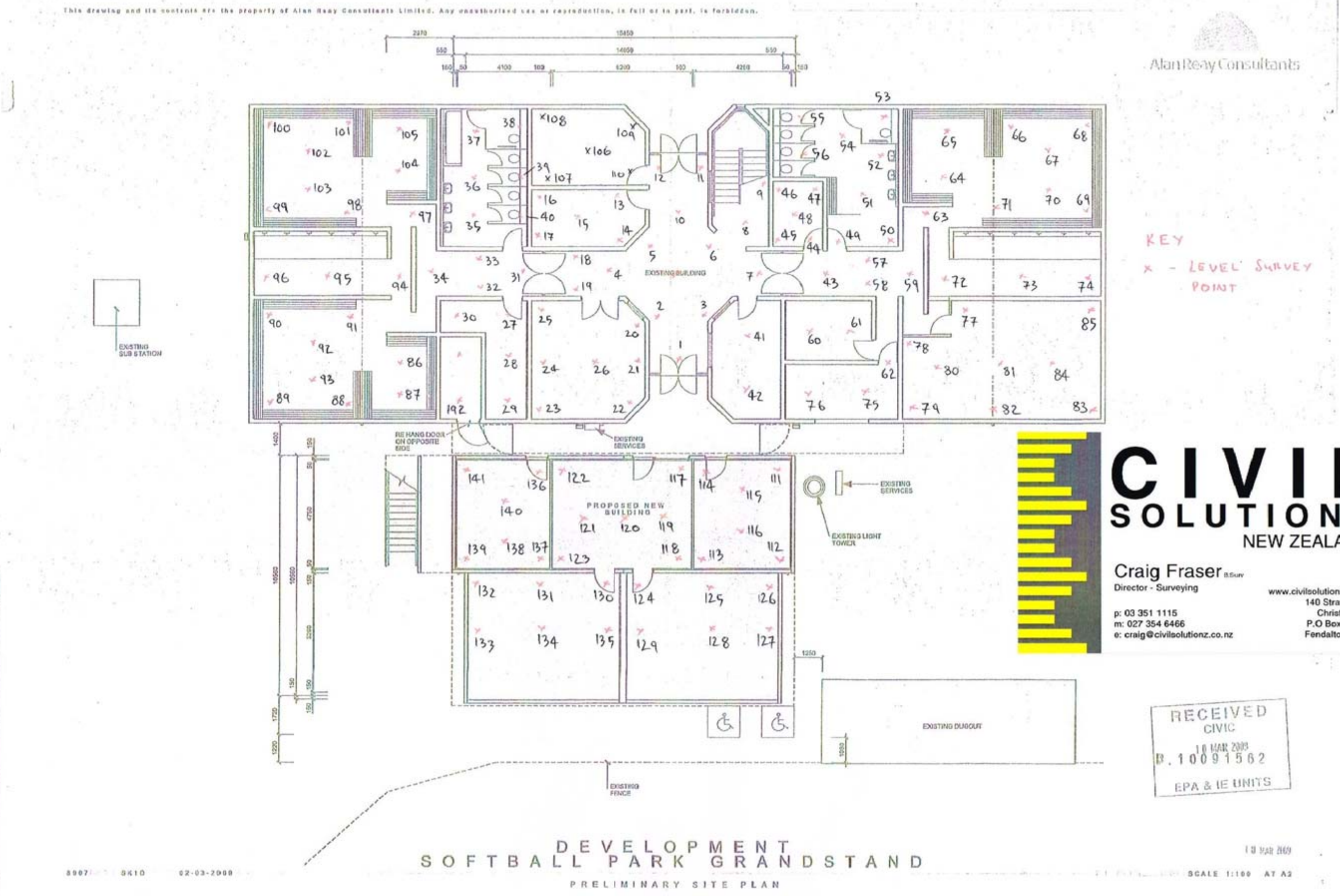
- **Figure 11 – Grandstand – Typical concrete wall cracking.**

- **Figure 12 – Groundsmans Shed – Floor slab damage at door threshold.**

- **Figure 13 – Groundsmans Shed – Typical Blockwork cracking.**

- **Figure 14 – Light Towers – Typical Base detail, some require relevelling.**

14. Appendix 2 – Survey Results



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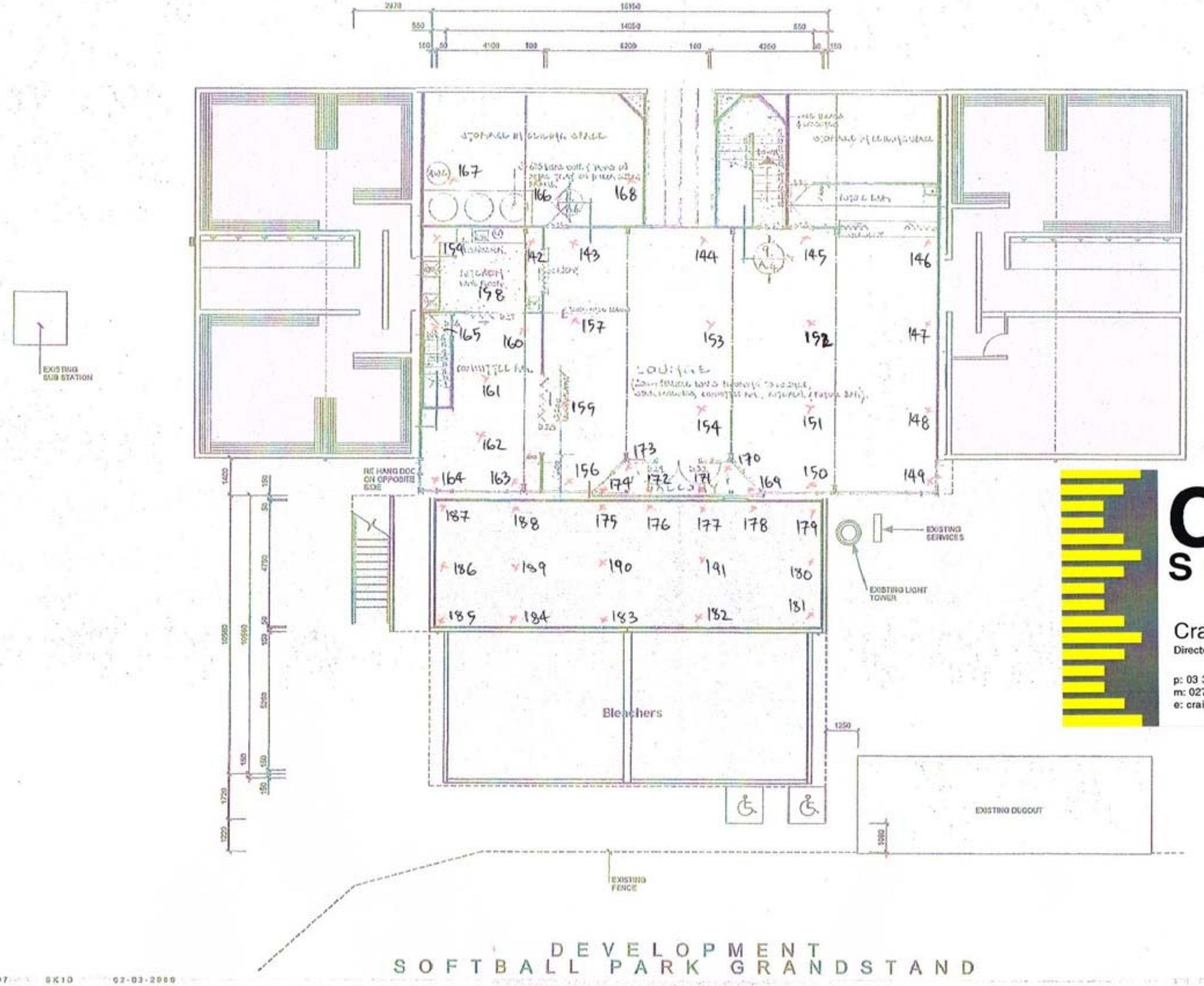

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DEVELOPMENT
SOFTBALL PARK GRANDSTAND

3907 SK10 02-03-2009 SCALE 1:100 AT A2

10 MAR 2009

FIRST FLOOR PLAN
1:100

FLOOR SLAB LEVELS

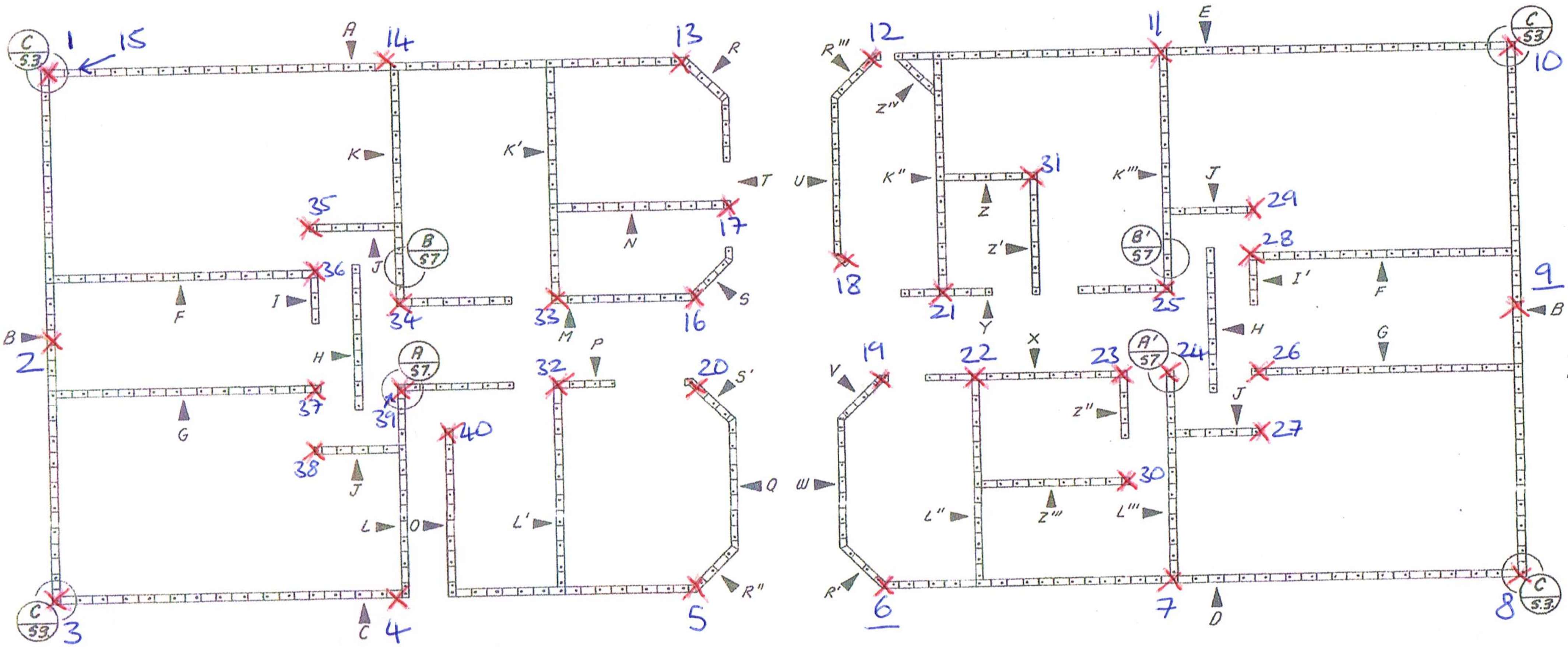
Reduced Level	Point	Difference from point 1 (mm)	Notes
8.373	1	0	
8.379	2	6	
8.373	3	0	
8.382	4	9	
8.393	5	20	
8.385	6	12	
8.384	7	11	
8.393	8	20	
8.4	9	27	
8.395	10	22	
8.398	11	25	
8.396	12	23	
8.383	13	10	
8.374	14	1	
8.378	15	5	
8.39	16	17	
8.387	17	14	
8.386	18	13	
8.386	19	13	
8.387	20	14	carpet(about 8mm)
8.391	21	18	carpet(about 8mm)
8.393	22	20	carpet(about 8mm)
8.396	23	23	lino
8.399	24	26	carpet(about 8mm)
8.397	25	24	carpet(about 8mm)
8.401	26	28	carpet(about 8mm)
8.397	27	24	
8.402	28	29	
8.397	29	24	
8.397	30	24	
8.395	31	22	
8.4	32	27	
8.397	33	24	
8.398	34	25	
8.391	35	18	
8.39	36	17	
8.403	37	30	
8.413	38	40	
8.395	39	22	
8.382	40	9	
8.385	41	12	carpet (about6mm)
8.382	42	9	carpet (about6mm)
8.374	43	1	
8.379	44	6	
8.382	45	9	
8.396	46	23	

8.395	47	22	
8.391	48	18	
8.382	49	9	
8.379	50	6	
8.388	51	15	
8.398	52	25	
8.427	53	54	
8.424	54	51	
8.427	55	54	
8.398	56	25	
8.382	57	9	
8.374	58	1	
8.377	59	4	
8.374	60	1	
8.372	61	-1	
8.369	62	-4	conc
8.394	63	21	
8.418	64	45	
8.426	65	53	
8.437	66	64	
8.431	67	58	
8.424	68	51	
8.398	69	25	
8.416	70	43	
8.4	71	27	
8.378	72	5	
8.384	73	11	
8.379	74	6	
8.375	75	2	lino
8.37	76	-3	lino
8.378	77	5	carpet (about 4mm)
8.383	78	10	carpet (about 4mm)
8.383	79	10	carpet (about 4mm)
8.386	80	13	carpet (about 4mm)
8.385	81	12	carpet (about 4mm)
8.375	82	2	carpet (about 4mm)
8.378	83	5	carpet (about 4mm)
8.392	84	19	carpet (about 4mm)
8.389	85	16	carpet (about 4mm)
8.415	86	42	
8.424	87	51	
8.445	88	72	
8.469	89	96	
8.449	90	76	
8.43	91	57	
8.454	92	81	
8.463	93	90	
8.416	94	43	
8.433	95	60	
8.448	96	75	
8.419	97	46	

8.438	98	65	
8.445	99	72	
8.468	100	95	
8.461	101	88	
8.463	102	90	
8.453	103	80	
8.441	104	68	
8.452	105	79	
8.431	106	58	
8.396	107	23	
8.429	108	56	
8.432	109	59	
8.407	110	34	
8.386	111	13	carpet (4mm?)
8.393	112	20	carpet (4mm?)
8.384	113	11	carpet (4mm?)
8.384	114	11	carpet (4mm?)
8.39	115	17	carpet (4mm?)
8.387	116	14	carpet (4mm?)
8.377	117	4	carpet (4mm?)
8.381	118	8	carpet (4mm?)
8.382	119	9	carpet (4mm?)
8.383	120	10	carpet (4mm?)
8.383	121	10	carpet (4mm?)
8.382	122	9	carpet (4mm?)
8.388	123	15	carpet (4mm?)
8.384	124	11	concrete
8.379	125	6	
8.384	126	11	
8.391	127	18	
8.387	128	14	
8.387	129	14	
8.391	130	18	
8.388	131	15	
8.394	132	21	
8.398	133	25	
8.412	134	39	
8.407	135	34	
8.379	136	6	
8.396	137	23	
8.398	138	25	
8.397	139	24	
8.389	140	16	
8.389	141	16	
8.417	192 bot stairs lino	44	

Reduced Level	Point	Difference from point 142	Notes
11.484	142	0	lino
11.486	143	2	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.484	144	0	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.486	145	2	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.476	146	-8	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.466	147	-18	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.451	148	-33	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.43	149	-54	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.429	150	-55	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.454	151	-30	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.469	152	-15	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.471	153	-13	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.454	154	-30	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.464	155	-20	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.449	156	-35	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.472	157	-12	looks like 8mm carpet over 20mm particle board (total 28mm over the concrete?)
11.48	158	-4	lino
11.487	159	3	lino
11.482	160	-2	carpet
11.474	161	-10	carpet
11.472	162	-12	carpet
11.453	163	-31	
11.48	164	-4	carpet
11.479	165	-5	lino
11.465	166	-19	
11.467	167	-17	
11.459	168	-25	
11.386	169	-98	
11.408	170	-76	
11.388	171	-96	
11.385	172	-99	
11.411	173	-73	
11.396	174	-88	
11.401	175	-83	

11.404	176	-80	
11.409	177	-75	
11.402	178	-82	
11.396	179	-88	
11.39	180	-94	
11.386	181	-98	
11.372	182	-112	
11.367	183	-117	
11.37	184	-114	
11.382	185	-102	
11.389	186	-95	
11.357	187	-127	
11.402	188	-82	
11.383	189	-101	
11.383	190	-101	
11.39	191	-94	



TYPICAL LOWER COURSE BLOCK LAYOUT
1:100

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KEY

X – Survey point on the top of the first course of block

SURVEY LOCATIONS NUMBERED

Cuthberts Green Softball Complex

RLs - Top of first course of block

Refer to PDF plan for Pt id locations

Pt id#	RL	Relative to point 1
1	8.557	0.000
2	8.551	-0.006
3	8.561	0.004
4	8.501	-0.056
5	8.482	-0.075
6	8.472	-0.085
7	8.465	-0.092
8	8.456	-0.101
9	8.473	-0.084
10	8.505	-0.052
11	8.519	-0.038
12	8.527	-0.030
13	8.512	-0.045
14	8.521	-0.036
15	8.554	-0.003
16	8.467	-0.090
17	8.488	-0.069
18	8.464	-0.093
19	8.482	-0.075
20	8.476	-0.081
21	8.480	-0.077
22	8.473	-0.084
23	8.471	-0.086
24	8.473	-0.084
25	8.479	-0.078
26	8.479	-0.078
27	8.475	-0.082
28	8.493	-0.064
29	8.500	-0.057
30	8.469	-0.088
31	8.501	-0.056
32	8.493	-0.064
33	8.484	-0.073
34	8.494	-0.063
35	8.521	-0.036
36	8.524	-0.033
37	8.520	-0.037
38	8.511	-0.046
39	8.498	-0.059
40	8.496	-0.061

15. Appendix 3 – CERA Summary Documents

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Cuthberts Green Softball Complex	Reviewer:	Nick Calvert
	Unit / No: / Street	CPEng No:	242062
Building Address:	220 Pages Road	Company:	Sinclair Knight Merz
Legal Description:		Company project number:	ZP01185
		Company phone number:	03 379 0135
	Degrees / Min / Sec		
GPS south:		Date of submission:	5-Feb
GPS east:		Inspection Date:	21/10/11, 2/11/11 and 01/02/2012
		Revision:	A
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	silt	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
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):		Approx site elevation (m):	

Building

No. of storeys above ground:	2	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	0.20
Storeys below ground				
Foundation type:	strip footings		if Foundation type is other, describe:	
Building height (m):	8.20		height from ground to level of uppermost seismic mass (for IEP only) (m):	8.2
Floor footprint area (approx):	500			
Age of Building (years):	24		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
			Brief strengthening description:	
Use (ground floor):	public			
Use (upper floors):	public			
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	steel framed	rafter type, purlin type and cladding	250UB portal, timber purlins, colorsteel cladding
Floors:	concrete flat slab	slab thickness (mm)	150
Beams:	none	overall depth x width (mm x mm)	N/A
Columns:	other (note)	typical dimensions (mm x mm)	NONE
Walls:	fully filled concrete masonry	#N/A	

Lateral load resisting structure

Lateral system along:	fully filled CMU	**Note: Define along and across in detailed report!**	note total length of wall at ground (m):	150
Ductility assumed, μ:	1.00		wall thickness (m):	0.19
Period along:	0.30	0.00 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	1		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	1		estimate or calculation?	estimated
Lateral system across:	fully filled CMU		note total length of wall at ground (m):	100
Ductility assumed, μ:	1.00		wall thickness (m):	0.19
Period across:	0.30	0.01 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	1		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	1		estimate or calculation?	estimated

Separations:

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

Non-structural elements

Stairs:	steel	describe supports	Fixed to floor at first but no seperate landing supports
Wall cladding:	other heavy	describe	All structural walls
Roof Cladding:	Metal	describe	0.6mm colorsteel cladding
Glazing:	steel frames		
Ceilings:	plaster, fixed		
Services(list):	Light electrical, few mech services		

Available documentation

Architectural	partial	original designer name/date	Christchurch City Council
Structural	full	original designer name/date	Christchurch City Council
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site:
(refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	25-100m	notes (if applicable):	Estimated
Differential settlement:	1:150 or more	notes (if applicable):	
Liquefaction:	5-10 m²/100m³	notes (if applicable):	Estimated
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	96%	Describe how damage ratio arrived at:	Damage of modesty walls is governing, 2% estimate of damaged strength
	Describe (summary):	Overall building stability not affected by damage		
Across	Damage ratio:	0%		
	Describe (summary):	Overall building stability not affected by damage		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	yes	Describe:	The stairs are a critical structural weakness because sway may cause stairs to disconnect from fllor removing support.
Pounding:	Damage?:	no	Describe:	Adjacent Grandstand expected to have suitable separation
Non-structural:	Damage?:	yes	Describe:	Mionr non-structural damage

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Recommendations

	Level of repair/strengthening required:	significant structural and strengthening	Describe:	EPB strengthening required but only relatively limited structural repairs required.
	Building Consent required:	yes	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	Building is an EPB but has no damage which would be expected to affect occupancy
Along	Assessed %NBS before:	56%	%NBS from IEP below	If IEP not used, please detail assessment methodology: Quantitative
	Assessed %NBS after:	2%		
Across	Assessed %NBS before:	39%	%NBS from IEP below	
	Assessed %NBS after:	39%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Cuthberts Green Grandstand	Reviewer:	Nick Calvert
	Unit / No: / Street	CPEng No:	242062
Building Address:	220 Pages Road	Company:	Sinclair Knight Merz
Legal Description:		Company project number:	ZP01185
		Company phone number:	03 379 0135
	Degrees / Min / Sec		
GPS south:		Date of submission:	5-Feb
GPS east:		Inspection Date:	21/10/11, 2/11/11 and 01/02/2012
		Revision:	A
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	silt	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
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):		Approx site elevation (m):	

Building

No. of storeys above ground:	2	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	0.20
Storeys below ground				
Foundation type:	bored cast-insitu concrete piles		if Foundation type is other, describe:	
Building height (m):	3.00		height from ground to level of uppermost seismic mass (for IEP only) (m):	3
Floor footprint area (approx):	160			
Age of Building (years):	3		Date of design:	2004-
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	public		Brief strengthening description:	
Use (upper floors):	public			
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	concrete	slab thickness (mm)	150
Floors:			
Beams:			
Columns:			
Walls:	load bearing concrete	thickness (mm)	150

Lateral load resisting structure

Lateral system along:	concrete shear wall	**Note: Define along and across in detailed report!**	note total length of wall at ground (m):	44
Ductility assumed, μ:	1.25		wall thickness (m):	0.15
Period along:	0.00	0.01 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	5		estimate or calculation?	estimated
Lateral system across:	concrete shear wall		note total length of wall at ground (m):	27
Ductility assumed, μ:	1.25		wall thickness (m):	0.15
Period across:	0.00	0.01 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	5		estimate or calculation?	estimated

Separations:

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

Non-structural elements

Stairs:	precast, full flight	describe supports	Fixed to floor at first but no seperate landing supports
Wall cladding:	other heavy	describe	All structural walls
Roof Cladding:			
Glazing:			
Ceilings:	light tiles		
Services(list):	Light electrical, few mech services		

Available documentation

Architectural	full	original designer name/date	Alan Reay Consulting Limitec
Structural	full	original designer name/date	Alan Reay Consulting Limitec
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	25-100m	notes (if applicable):	Estimated
Differential settlement:	1:150 or more	notes (if applicable):	
Liquefaction:	5-10 m²/100m³	notes (if applicable):	Estimated
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):	Overall building stability not affected by damage		
Across	Damage ratio:	0%		
	Describe (summary):	Overall building stability not affected by damage		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	Adjacent Softball Complex expected to have suitable separatior
Non-structural:	Damage?:	yes	Describe:	Minor non-structural damage

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Recommendations

	Level of repair/strengthening required:	significant structural	Describe:	Relevelling will be significan
	Building Consent required:	yes	Describe:	Epoxy crack injection in a number of concrete elements and possible relevelling
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	80%	%NBS from IEP below	If IEP not used, please detail assessment methodology: Quantitative
	Assessed %NBS after:	80%		
Across	Assessed %NBS before:	52%	%NBS from IEP below	
	Assessed %NBS after:	52%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Cuthberts Green Groundsmans Shed	Reviewer:	Nick Calvert
	Unit / No: / Street	CPEng No:	242062
Building Address:	220 Pages Road	Company:	Sinclair Knight Merz
Legal Description:		Company project number:	ZP01185
		Company phone number:	03 379 0135
	Degrees / Min / Sec		
GPS south:		Date of submission:	5-Feb
GPS east:		Inspection Date:	21/10/11, 2/11/11 and 01/02/2012
		Revision:	A
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	silt	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
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):		Approx site elevation (m):	

Building

No. of storeys above ground:	1	single storey = 1 / Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	
Storeys below ground			
Foundation type:	strip footings	if Foundation type is other, describe:	
Building height (m):	2.40	height from ground to level of uppermost seismic mass (for IEP only) (m):	2.4
Floor footprint area (approx):	54		
Age of Building (years):		Date of design:	1976-1992
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
		Brief strengthening description:	
Use (ground floor):	other (specify)		
Use (upper floors):			
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Timber purlins and trusses, colorsteel cladding
Floors:			
Beams:	timber	type	Trusses
Columns:			
Walls:	fully filled concrete masonry	thickness (mm)	190

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	fully filled CMU		note total length of wall at ground (m):	14.6
Ductility assumed, μ:	1.00		wall thickness (m):	0.19
Period along:	0.00	0.02 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	5		estimate or calculation?	estimated
Lateral system across:	fully filled CMU		note total length of wall at ground (m):	12
Ductility assumed, μ:	1.00		wall thickness (m):	0.19
Period across:	0.00	0.02 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	5		estimate or calculation?	estimated

Separations:

north (mm):	
east (mm):	
south (mm):	
west (mm):	

leave blank if not relevant

Non-structural elements

Stairs:			
Wall cladding:	other heavy	describe	Concrete Block
Roof Cladding:	Metal	describe	Coloursteel cladding
Glazing:			
Ceilings:			
Services(list):	None		

Available documentation

Architectural	none	original designer name/date	
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site:
(refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	25-100m	notes (if applicable):	Estimated - no survey undertaken
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	5-10 m²/100m³	notes (if applicable):	Estimated
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):	No damage observed		
Across	Damage ratio:	0%		
	Describe (summary):	No damage observed		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Recommendations

	Level of repair/strengthening required:	significant structural and strengthening	Describe:	
	Building Consent required:	yes	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	33%	%NBS from IEP below / If IEP not used, please detail assessment methodology:	Quantitative
	Assessed %NBS after:	33%		
Across	Assessed %NBS before:	19%	%NBS from IEP below	
	Assessed %NBS after:	19%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Cuthberts Green Lighting Gantries	Reviewer:	Nick Calvert
	Unit / No: / Street	CPEng No:	242062
Building Address:	220 Pages Road	Company:	Sinclair Knight Merz
Legal Description:		Company project number:	ZP01185
		Company phone number:	03 379 0135
	Degrees / Min / Sec		
GPS south:		Date of submission:	5-Feb
GPS east:		Inspection Date:	21/10/11, 2/11/11 and 01/02/2012
		Revision:	A
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	silt	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
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):		Approx site elevation (m):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground				
Foundation type:	bored cast-insitu concrete piles		if Foundation type is other, describe:	
Building height (m):	25.70		height from ground to level of uppermost seismic mass (for IEP only) (m):	25.7
Floor footprint area (approx):	1			
Age of Building (years):	9		Date of design:	1992-2004
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	public		Brief strengthening description:	
Use (upper floors):	public			
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	frame system		
Roof:			
Floors:			
Beams:			
Columns:	structural steel	typical dimensions (mm x mm)	640x640
Walls:			

Lateral load resisting structure

Lateral system along:	welded and bolted steel moment frame	**Note: Define along and across in detailed report!**	note typical bay length (m)	
Ductility assumed, μ:	1.25			
Period along:	1.60	1.60 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	15		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	15		estimate or calculation?	estimated
Lateral system across:	welded and bolted steel moment frame		note typical bay length (m)	
Ductility assumed, μ:	1.25			
Period across:	1.60	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	15		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	15		estimate or calculation?	estimated

Separations:

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

Non-structural elements

Stairs:	
Wall cladding:	
Roof Cladding:	
Glazing:	
Ceilings:	
Services(list):	

Available documentation

Architectural	none	original designer name/date	
Structural	full	original designer name/date	City Solutions
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	25-100m	notes (if applicable):	Estimated
Differential settlement:	1:350-1:250	notes (if applicable):	Verticality Issues
Liquefaction:	5-10 m²/100m³	notes (if applicable):	Estimated
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):	No damage observed		
Across	Damage ratio:	0%		
	Describe (summary):	No damage observed		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Recommendations

	Level of repair/strengthening required:	minor structural	Describe:	Relevelling required to remove verticality issues
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	100%	%NBS from IEP below	If IEP not used, please detail assessment methodology: Quantitative
	Assessed %NBS after:	100%		
Across	Assessed %NBS before:	100%	%NBS from IEP below	
	Assessed %NBS after:	100%		

Location

Building Name:	Cuthberts Green Dugouts	Reviewer:	Nick Calvert
	Unit / No: / Street	CPEng No:	242062
Building Address:	220 Pages Road	Company:	Sinclair Knight Merz
Legal Description:		Company project number:	ZP01185
		Company phone number:	03 379 0135
	Degrees / Min / Sec		
GPS south:		Date of submission:	5-Feb
GPS east:		Inspection Date:	21/10/11, 2/11/11 and 01/02/2012
		Revision:	A
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	silt	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
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):		Approx site elevation (m):	

Building

No. of storeys above ground:	1	single storey = 1 / Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	
Storeys below ground			
Foundation type:	bored cast-insitu concrete piles	if Foundation type is other, describe:	
Building height (m):	2.50	height from ground to level of uppermost seismic mass (for IEP only) (m):	2.5
Floor footprint area (approx):	2 no at 45		
Age of Building (years):	9	Date of design:	1992-2004
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	public	Brief strengthening description:	
Use (upper floors):	public		
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	frame system		
Roof:	steel framed	rafter type, purlin type and cladding	SHS portals, EA purlins, zincalume cladding
Floors:			
Beams:	steel non-composite	beam and connector type	Fully welded portal frames
Columns:	structural steel	typical dimensions (mm x mm)	50 x 50
Walls:			

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	welded and bolted steel moment frame		note typical bay length (m)	
Ductility assumed, μ:	1.25			
Period along:	0.30	0.28 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	5		estimate or calculation?	estimated
Lateral system across:	welded and bolted steel moment frame		note typical bay length (m)	
Ductility assumed, μ:	1.25			
Period across:	0.30	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	5		estimate or calculation?	estimated

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	other light	describe	Perspex cladding
Roof Cladding:	Metal	describe	Zincalume cladding
Glazing:			
Ceilings:			
Services(list):	None		

Available documentation

Architectural	none	original designer name/date	
Structural	full	original designer name/date	City Solutions
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	5-10 m²/100m³	notes (if applicable):	Estimated
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):	No damage observed		
Across	Damage ratio:	0%		
	Describe (summary):	No damage observed		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Recommendations

	Level of repair/strengthening required:	none	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	100%	%NBS from IEP below / If IEP not used, please detail assessment methodology:	Quantitative
	Assessed %NBS after:	100%		
Across	Assessed %NBS before:	100%	%NBS from IEP below	
	Assessed %NBS after:	100%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Cuthberts Green Canopy	Reviewer:	Nick Calvert
	Unit / No: / Street	CPEng No:	242062
Building Address:	220 Pages Road	Company:	Sinclair Knight Merz
Legal Description:		Company project number:	ZP01185
		Company phone number:	03 379 0135
	Degrees / Min / Sec		
GPS south:		Date of submission:	5-Feb
GPS east:		Inspection Date:	21/10/11, 2/11/11 and 01/02/2012
		Revision:	A
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	silt	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
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):		Approx site elevation (m):	

Building

No. of storeys above ground:	1	single storey = 1	
		Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	
Storeys below ground			
Foundation type:	isolated pads, no tie beams	if Foundation type is other, describe:	
Building height (m):	2.40	height from ground to level of uppermost seismic mass (for IEP only) (m):	2.4
Floor footprint area (approx):	140		
Age of Building (years):	24	Date of design:	1976-1992
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	public	Brief strengthening description:	
Use (upper floors):	public		
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	frame system		
Roof:	timber framed	rafter type, purlin type and cladding	SHS portals, timber purlins, butynol on plywood cladding
Floors:			
Beams:	steel non-composite	beam and connector type	Fully welded portal frames
Columns:	structural steel	typical dimensions (mm x mm)	100 x 100
Walls:			

Lateral load resisting structure

Lateral system along:	welded and bolted steel moment frame		**Note: Define along and across in detailed report!**	note typical bay length (m)	
Ductility assumed, μ:	1.25			
Period along:	0.30	0.27 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	5		estimate or calculation?	estimated
Lateral system across:	welded and bolted steel moment frame		note typical bay length (m)	
Ductility assumed, μ:	1.25			
Period across:	0.30	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	5		estimate or calculation?	estimated

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:			
Roof Cladding:	Membrane	substrate	Plywood
Glazing:			
Ceilings:	fibrous plaster, fixed		
Services(list):	None		

Available documentation

Architectural	none	original designer name/date	
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	25-100m	notes (if applicable):	Estimated - no survey undertaken
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	5-10 m²/100m³	notes (if applicable):	Estimated
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):	No damage observed		
Across	Damage ratio:	0%		
	Describe (summary):	No damage observed		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Recommendations

	Level of repair/strengthening required:	none	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	23%	%NBS from IEP below	If IEP not used, please detail assessment methodology: Quantitative
	Assessed %NBS after:	23%		
Across	Assessed %NBS before:	100%	%NBS from IEP below	
	Assessed %NBS after:	100%		