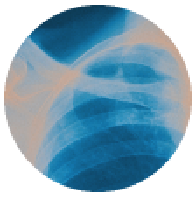
Holmes Consulting Group

SEDDON EARTHQUAKES
DETAILED DAMAGE REPORT

STRUCTURAL AND CIVIL ENGINEERS



WCC CIVIC ADMIN BUILDING (CAB)

PREPARED FOR

WELLINGTON CITY COUNCIL

110659.03

SEPTEMBER 2013

CIVIC ADMIN BUILDING – DETAILED DAMAGE REPORT

Prepared For:
WELLINGTON CITY COUNCIL

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Holmes Consulting Group LP

Wellington Office

REPORT ISSUE REGISTER

DATE	REV. NO.	REASON FOR ISSUE
19 Sept 2013	0	Client Information

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Appendix A: HCG Level 2 Rapid Structural Assessment – available on request.

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EXECUTIVE SUMMARY

This report covers the structural damage sustained by the Civic Admin Building (CAB) as a result of the earthquake sequence, centred near Seddon, which commenced 17th July, including the 'Seddon Earthquake' which struck at 5:09pm on 21st July 2013 and the 'Lake Grassmere Earthquake' which struck at 2:31pm on 16th August 2013.

Immediately following the Seddon and Lake Grassmere Earthquakes Holmes Consulting Group LP (HCG) carried out a 'Level 2 Rapid Structural Assessment' (Appendix A) of the subject property, which noted minor structural damage had been observed. Subsequent to our initial rapid assessment it has been determined compilation of this Detailed Damage Report is appropriate.

Earthquake ground motion data has been compared to the previously prepared Detailed Seismic Assessment (DSA) [1]. Based on this comparison it is likely the Seddon and Lake Grassmere Earthquakes produced seismic demands less than the buildings assessed capacity. However, ground motion data suggests demands were potentially sufficient to cause structural damage, specifically yielding.

Damage noted typically confirms the findings of our DSA and the proposed seismic securing measures recommended in our DSA report. We do not believe that the seismic capacity of the building has been significantly reduced as a result of the Seddon and Grassmere Earthquakes. However, the early onset of damage has been observed and we strongly recommend that the seismic securing measures already documented are implemented – and we understand that this work is underway.

Damage to the sliding bearing supports of the Portico, where it is supported on the Central Library side, has been identified. This damage does not pose an immediate Life Safety risk, however we have recommended that this damage is either repaired in the short-medium term or that previously planned demolition of the Portico is brought forward. We are advised that planning for Portico demolition has been advanced in light of this.

1. INTRODUCTION

Holmes Consulting Group LP (HCG) has been engaged by Wellington City Council to complete a structural review of the subject property following the Seddon earthquake and subsequent aftershocks.

Immediately following the Seddon and Lake Grassmere Earthquakes, HCG carried out a 'Level 2 Rapid Structural Assessment' of the subject property. This assessment was generally in accordance with the 2009 NZSEE Guidelines for Building Safety Evaluation [2]. Our Rapid Structural Assessments were documented in post-earthquake site reports, issued on 24/7/13 and 19/8/13. A copy of these reports are available on request.

The Seddon and Lake Grassmere earthquakes have likely subjected the building to moderate ground motions. The associated seismic demands (accelerations) placed upon the structure were less than the buildings assessed capacity. However, ground motion data suggests accelerations were potentially sufficient to cause structural damage, specifically yielding. Yielding of a given structural element can generally be summarised as permanent deformation of the element, often resulting in visible damage, although this damage may be slight and masked by architectural finishes. Damage associated with yielding, if significant, can diminish a structures capacity.

Given the above, it has been determined that a Detailed Damage Report is appropriate for the subject property. Figure 1-1 illustrates our review and inspection process.

1.1 SCOPE OF WORK

The scope of work for this project included the following:

- Revision of structural drawings and our previous seismic assessment work for this building, to determine its structural systems, clarify seismic loading it was designed to resist and predict areas of likely damage.
- Collation of the most relevant GNS ground motion data from the Seddon Earthquake and relate to fundamental periods of this structure to estimate seismic demands placed on the structure.
- Inspection of a significant enough amount of the building structure to be able to make a determination of the behaviour of the building in the earthquake, and to map damage to the structure or determine that limited or no damage was observed in key areas.
- Determination of whether the building's post-earthquake capacity has diminished.
- Specification of structural repairs if necessary or recommendations of further action required.

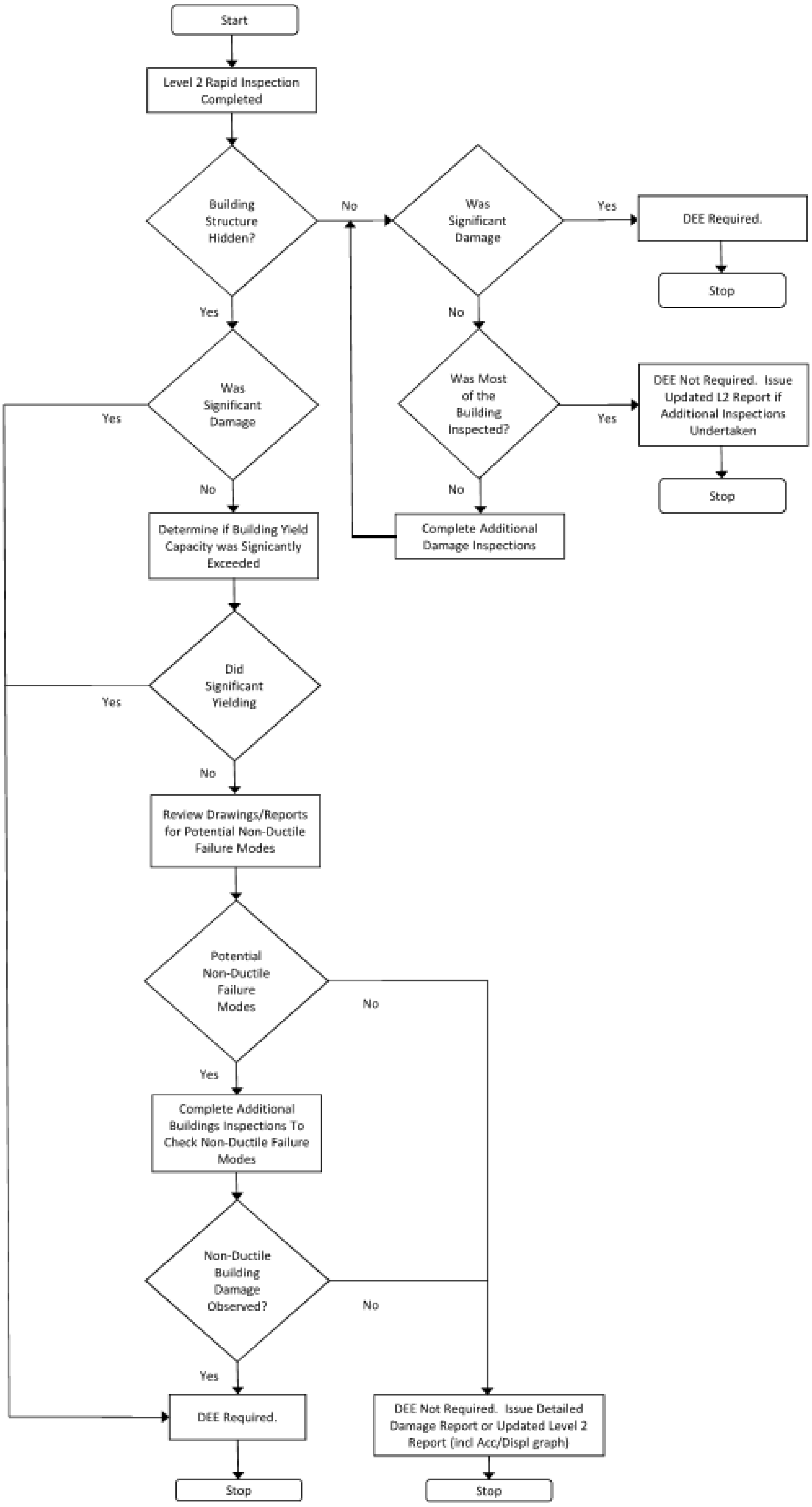


Figure 1-1: Building review and inspection process

1.2 LIMITATIONS

Findings presented as a part of this project are for the sole use of Wellington City Council in its evaluation of the subject property. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses.

Our observations have been visual only and limited to representative samples, as described in our record of observations. Our observations have been restricted to structural aspects only. Waterproofing elements, electrical and mechanical equipment, fire protection and safety systems, service connections, water supplies and sanitary fittings have not been inspected or reviewed, and secondary elements such as windows, facades, canopies and fittings have not generally been reviewed.

Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report.

2. STATUTORY REQUIREMENTS

2.1 BUILDING ACT

When dealing with existing buildings there are a number of relevant sections of the Building Act [3] that need to be considered in relation to the building's structure and strength.

Section 121 – Meaning of Dangerous Building

Section 121 of the Building Act 2004 deems a building to be dangerous if in the ordinary course of events (excluding an earthquake) it is likely to cause injury or death, or damage to other property.

Section 122 – Meaning of Earthquake Prone Building

Section 122 of the Building Act 2004 deems a building to be earthquake prone if its ultimate capacity (strength) would be exceeded in a "moderate earthquake" and it would be likely to collapse causing injury or death, or damage to other property.

The Building Regulations (2005) define a moderate earthquake as one that would generate loads 33% as strong as those used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

If a building is found to be dangerous or earthquake prone, the territorial authority has the power under section 124 of the Building Act to require restraint or strengthening work to be carried out, or to close/cordon off parts or the whole of the building and prevent occupancy.

Section 131 – Earthquake Prone Building Policy

Section 131 of the Building Act requires all territorial authorities to adopt a specific policy on dangerous, earthquake prone, and unsanitary buildings.

2.2 BUILDING CODE

The Building Act requires all new building work to comply with the New Zealand Building Code [4] which outlines the performance standards required for new building work. The Ministry of Business, Innovation and Employment (MBIE) also publishes Compliance Documents which may be used to establish compliance with the Building Code.

2.3 WELLINGTON CITY COUNCIL POLICY

Earthquake Prone Buildings Policy

In 2009 Wellington City Council (WCC) adopted their current Earthquake Prone Buildings Policy [5], which states that building owners have 10 - 20 years to strengthen an earthquake prone building, as defined by the 2004 Building Act. The exact time frame depends upon a buildings age, importance and condition.

Dangerous Buildings Policy

In 2006 Wellington City Council (WCC) adopted their current Dangerous Buildings Policy [6] which states:

> When a building is determined to be Dangerous, the building owner or their agent is contacted to discuss remedial options and actions when the urgency of the situation allows. The building owner can agree to complete the work within a specified time or otherwise the Council can issue a notice to require that work be done to reduce or remove the danger.
>
> Where danger continues, further notices to do the remedial work will be issued. Continued failure to comply with a notice can lead to prosecution. Another option is for Council to undertake the work and recover the costs from the building owner.

3. PRE-EARTHQUAKE BUILDING ASSESSMENT

This section discusses the form and capacity of the building prior to the Seddon Earthquake. Information provided here is only intended as a brief summary and is drawn from of our Detailed Seismic Assessment report [1] issued previously.

3.1 BUILDING FORM

The Civic Admin Building was designed and constructed in 1990. The building comprises six floors above ground level.

Figure 3-1: Civic Admin Building

Seismically, the CAB is a reinforced concrete frame structure. Lateral loads in the building are resisted by a perimeter reinforced concrete moment resisting frame with two internal "gravity only" concrete frames running through the centre of the building. Typical floors consist of precast prestressed hollowcore units with an insitu topping spanning in the transverse ("short") direction of the building. Precast concrete cladding panels, incorporating window penetrations, are used to all levels above Level 2, the lower storeys comprising of glazed units set within the concrete frame. The building is founded on a series of bored reinforced concrete piles.

3.2 PRE-EARTHQUAKE BUILDING PERFORMANCE

Previous detailed assessment of the CAB predicted that the primary building structure would perform relatively well in an earthquake. This assessment included a three dimensional elastic dynamic analysis as summarised in our Detailed Seismic Assessment Report [1].

From these analyses the building was found to have an Ultimate Limit State capacity of 55-60% DBE (Design Basis Earthquake). This is limited by the maximum allowable inter-storey drift limit of 2.5% being reached in the building frames in the short direction and is very closely matched by the flexural capacity of reinforced concrete beams in the northern end frames. The reinforced concrete columns appear to have been designed in accordance with capacity design principles meaning they typically have sufficient strength to ensure that any hinging in the frames occurs in the beams and not in the columns, minimising the potential for an undesirable soft storey mechanism.

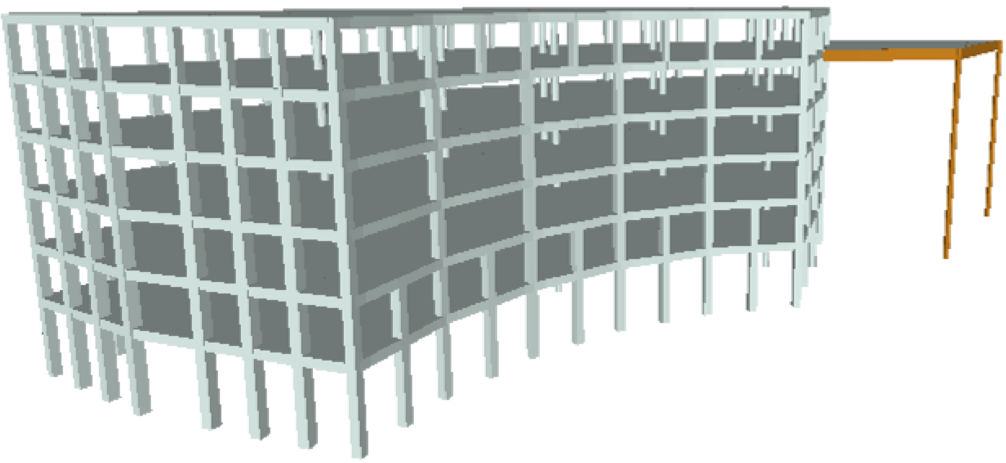


Figure 3-2: CAB Analysis Model

A number of localised structural components were found to have their capacity exceeded at load levels less than 34% DBE – below the threshold for classification as an Earthquake Prone Building.

Potential localised vulnerabilities include issues with the connection between Portico-CAB and Portico-Library buildings, lateral restraint of seismic columns (end frames), seating allowances for precast floor units, precast cladding panel movement allowances and diaphragm connections to perimeter frames.

Inspections carried out as part of this Detailed Damage Report have focused on potential vulnerabilities outlined above and in our DSA report.

4.1 EARTHQUAKE GROUND MOTIONS EXPERIENCED AT THE SITE

The Geonet Project, run by EQC and GNS Science, maintains the New Zealand National Seismograph Network which consists of a series of seismometers set up around New Zealand. The following image shows the location of the seven closest monitoring stations to the building.

Figure 4-1: Location of Nearby Monitoring Stations

Seismograph data resulting from the Seddon Earthquake has been downloaded from these monitoring stations and processed to obtain acceleration response spectra (a response spectra essentially defines the peak response for a building subjected to the ground motions, as a function of its fundamental period).

The following graphs plot the acceleration response spectra processed from the GNS monitoring stations for the initial main shock of the Seddon Earthquake at 5:09 pm on the 21st of July, as well as the elastic design spectra (NZS1170.5: 2004) [7] for a new building constructed on the site. For reference the fundamental period of the building has been plotted on the graphs of the North-South and West-East directions respectively.

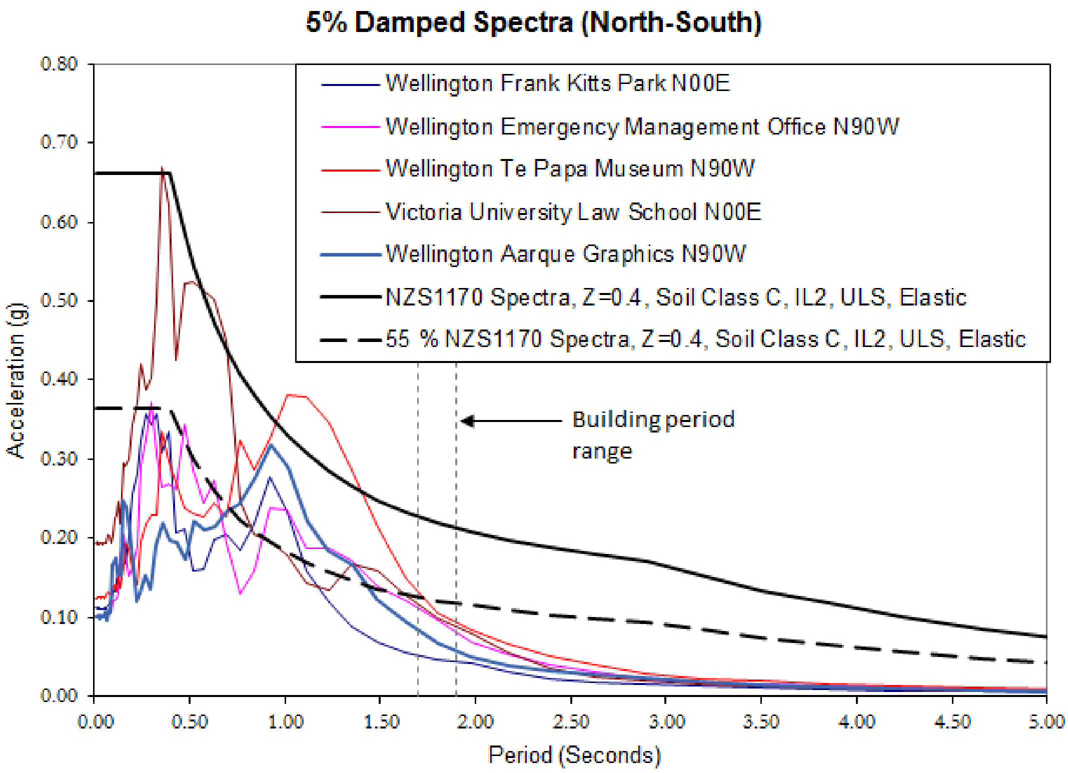


Figure 4-2: Seddon Earthquake 5% Damped Spectra – North-South

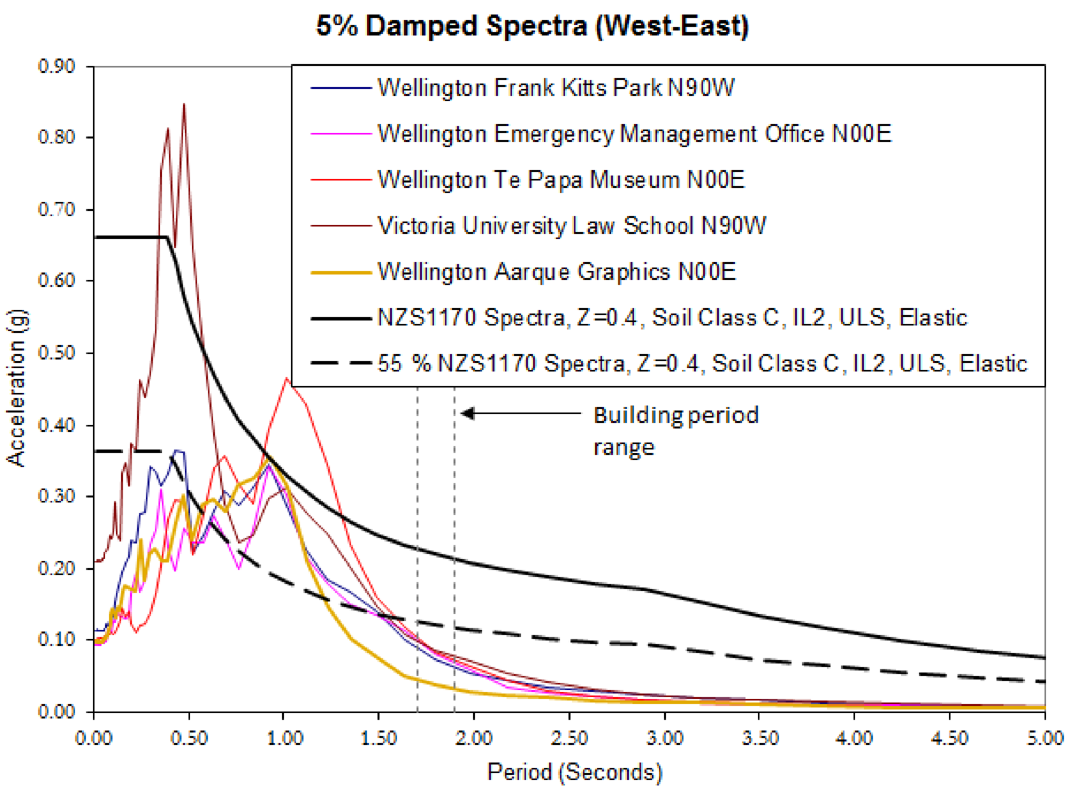


Figure 4-3: Seddon Earthquake 5% Damped Spectra – East-West

The following graphs plot the acceleration response spectra processed from the GNS monitoring stations for the initial main shock of the Lake Grassmere Earthquake at 2:31 pm on the 16th of August, as well as the elastic design spectra (NZS1170.5: 2004) [7] for a new building constructed on the site. For reference the fundamental period of the building has been plotted on the graphs of the North-South and West-East directions respectively.

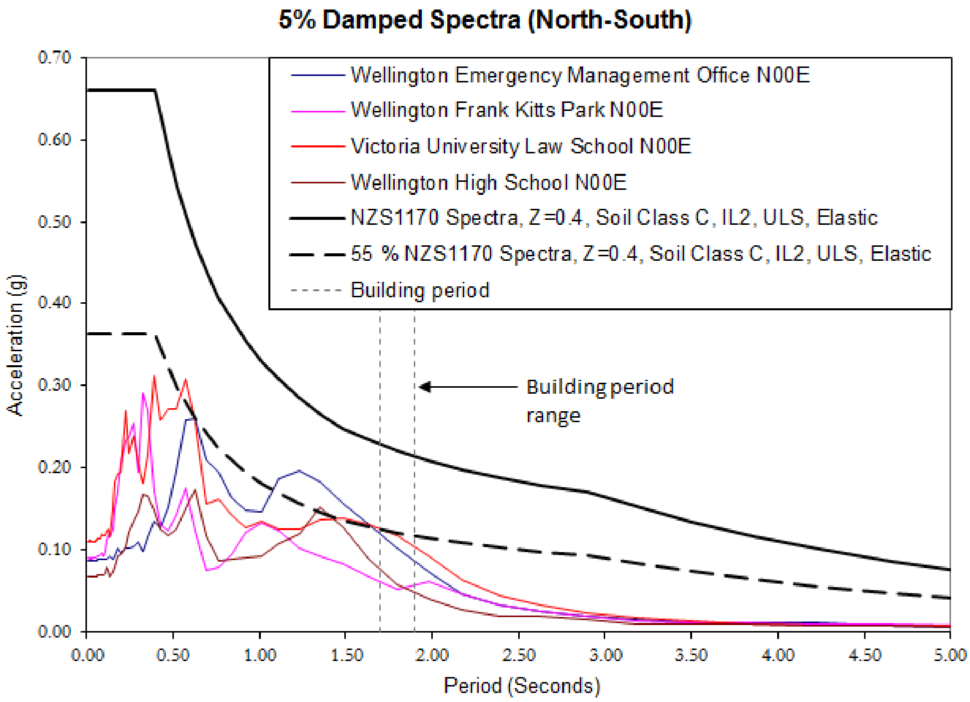


Figure 4-4: Lake Grassmere 5% Damped Spectra – North-South

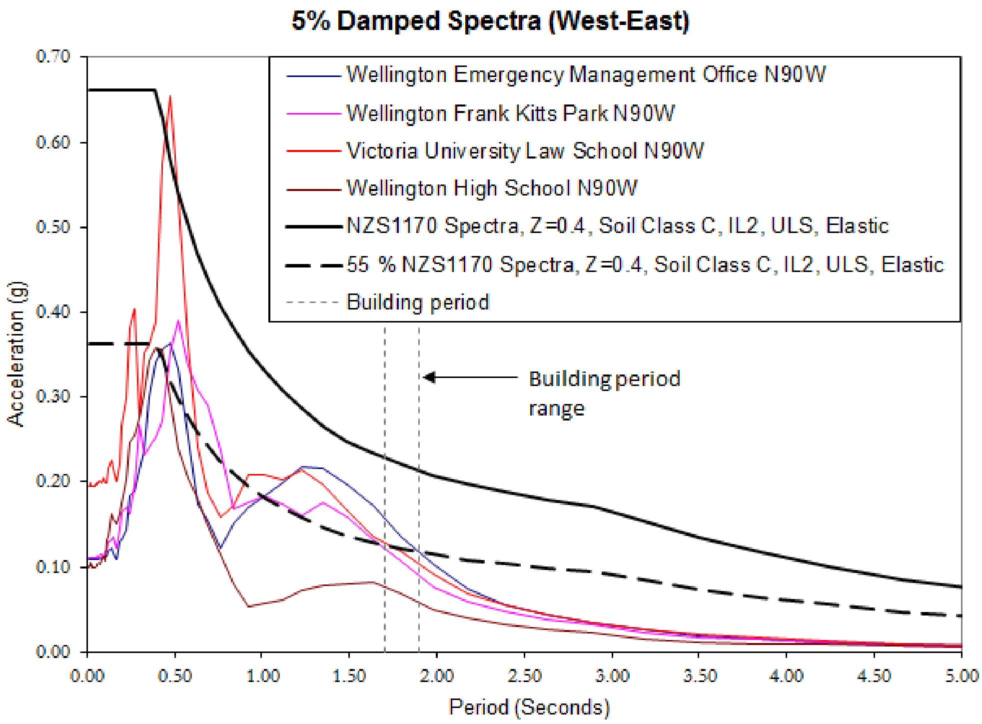


Figure 4-5: Lake Grassmere 5% Damped Spectra – East-West

Previous analyses of the CAB have determined the buildings fundamental periods to be approximately 1.70 seconds (north-south) and 1.90 seconds (east-west). Based on the seismograph data downloaded, it is likely that the earthquake produced demands less than the buildings assessed capacity, but may have caused yielding in structural elements.

4.2 BASIS FOR DETAILED INVESTIGATIONS

Areas of the building identified for detailed inspection have been selected based on:

- Typical damage expected for buildings of this form;
- Review of the original drawings;
- Analysis work undertaken to date;
- Damage observed following the earthquakes during our Level 2 Rapid Structural Assessment.

Combining our previous assessment/analysis of the building with GNS ground motion data it is possible to estimate what degree of damage is likely to have occurred. The following graphs plot ground motion against building displacement (spectral mass displacement, typically at ~2/3 of building height). The graphs below are annotated to clarify the expected onset of yielding, and thus damage, for the Seddon Earthquake at 5:09 pm on the 21st of July.

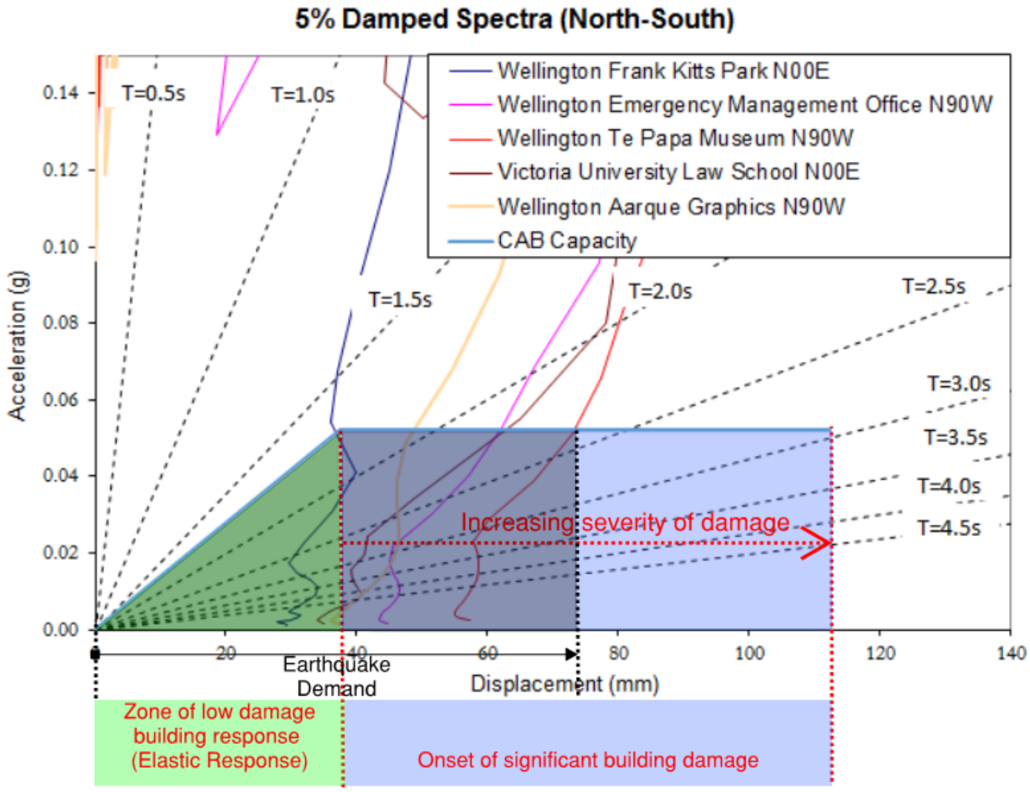


Figure 4-6: Seddon Earthquake Acceleration - Displacement Spectrum, North-South

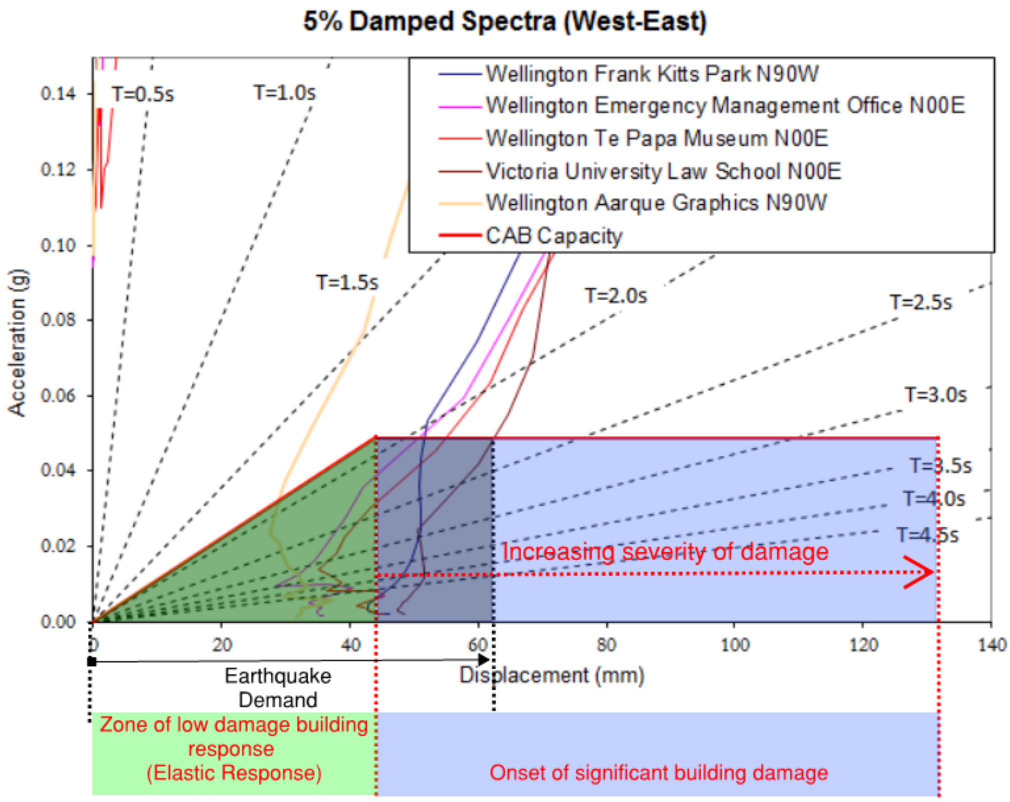


Figure 4-7: Seddon Earthquake Acceleration - Displacement Spectrum, East-West

Whilst the above plots give an indication of expected yielding and damage they are particularly sensitive to soil type, proximity (of the accelerometer record station to the building in question) and building orientation to north-south axis. From the above plots it can be seen that the largest seismic response was from the VUoW Law School in both the east-west and north-south directions and WEMO in the north-south direction. When looking at Frank Kitts Park and Te Papa plots it is reasonable to expect the only limited yielding (if any) may have occurred.

4.3 SUMMARY OF INVESTIGATIONS AND BUILDING DAMAGE

In the days following the Seddon earthquake a rapid assessment was carried out. The following is a summary of investigations undertaken and structural damage observed:

CAB-MOB Bridge – damage evident and junction between buildings (floor cover plates, ceiling linings and building flashings). Damage expected and of no concern structurally.

CAB/Portico-Central Library – significant non-structural damage at seismic joint between Portico and Central Library in ceilings, flashing and some external glazing panels. In addition damage to structural sliding bearing supports was identified. Displacement in the range 50-100mm at this junction (larger at L5) was apparent. Some residual displacement 10-15mm might remain although this is difficult to quantify.

Stairs – there was damage to non-structural plasterboard linings within both north and south stair wells. In addition is was evident that stair flights had moved relative to concrete landings and some minor spalling of concrete finishes/edges was evident. This damage was typically non-structural and expected and was of no concern structurally. Stairs are generally well detailed and have adequate seismic movement capacity.

Floors – raised floor tiles were removed at corners and ends of the building to check nay cracking/tearing of the floor diaphragm adjacent to end frame beams. Some recent cracking was evident which suggests low levels of geometric frame elongation may have occurred (including the onset of corner columns being jacked out). Level of cracking was generally minor-moderate and not typically requiring remediation. However, this damage reinforces the need to progress previously recommended seismic securing works.

Portico-CAB Connection – floors and walls were opened up at CAB L5 to inspect the steel PFC connection of the Portico structure to CAB. Minor weldplate and column cracking only was evident and was of no concern structurally. There was no evidence of yielding of the PFC beams that span between columns.

Perimeter Frame – an external inspection of the perimeter frame was carried out in particular at the MOB end where it is exposed within the MOB atrium. Minor cracking of beams is evident (at ends within expected plastic hinge locations) and column bases – however these cracks are hairline and do not warrant remedial work. Some tile finishes "popped" off columns at ground floor which confirms some flexing of these columns occurred. Some minor/hairline cracking to beams within the building are also evident. Again we do not believe remedial action is necessary.

Basement Column G/12 – inspected after a vertical crack was noted by council workers. The area around the crack was chiselled away to reveal cracking was only in aesthetic render layer. However, exposing column found that stirrups at bottom of column lack cover concrete and corroding reinforcing was evident which should be repaired to maintain longer term durability.

Cracked End Frame Columns – the beam to column connection at grid C/28 on floors levels L2 and L3 was undertaken by removing stair wall linings and gaining access into the wall cavity. Supported (grid C) beam does not seem to have moved significantly on seating. However cracking and spalling observed in the beam directly adjacent to the connection on the western side indicates the supported beam has moved during the earthquake but come to rest back in its original position. Such cracking was only seen in the corbel on top of the beam which is not a critical part of the structural member and is due to concrete being cast directly onto a beam that is designed to move. Cracking indicates reasonable levels of movement occurred and further reinforces need to progress building seismic securing works.

Based on our observations, it appears that the building has undergone some limited yielding and that reasonable levels of movement has occurred (as would be expected of this building during an earthquake). The small amount of yielding observed indicates that the building's capacity should not have been significantly reduced as a result of the earthquake.

4.4 FURTHER INVESTIGATIONS

Beyond the observations and investigations undertaken by HCG, the owner may wish to undertake further studies such as:

- Fire Engineering Report – to confirm fire ratings are maintained, especially within the stair wells.

5. DAMAGE OBSERVED & REPAIRS REQUIRED

Table 5-1 provides a photographic summary of the observed damage and typical repairs (if needed). A repair specification can be provided where necessary.

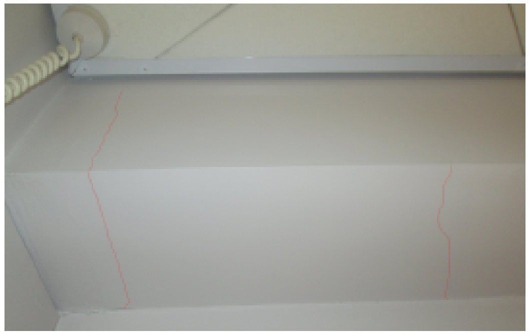
If any additional cracking or damage is uncovered as part of ongoing occupation of the building, upcoming Seismic Securing contract works, or future demolition of the Portico we request that we are notified to enable further inspections to be undertaken.

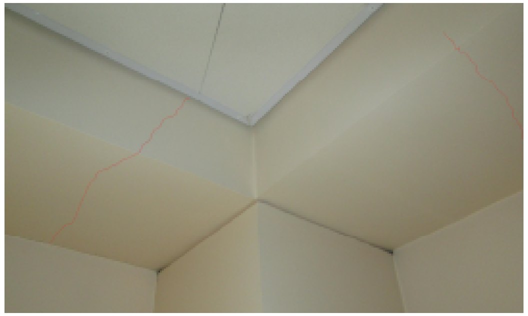
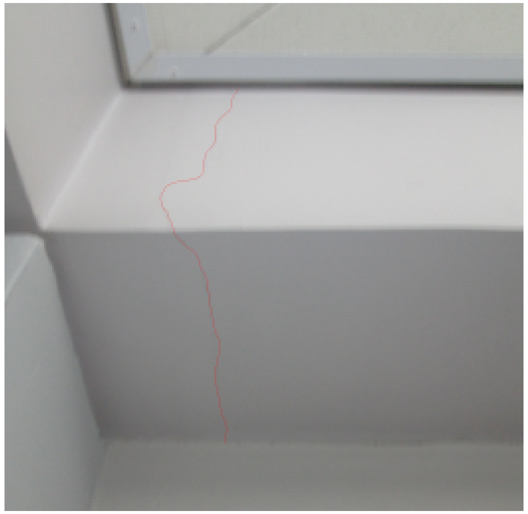
Table 5-1: Civic Admin Building - Photographic Summary of Damage Observed & Repairs Required

Damaged Item	Location	Example	Recommended Repair
1.0 Vertical crack in base of basement column	Basement carpark, column G/12		Re-mortar column render layer – once boney concrete is removed and rusting reinforcing is addressed.
1.1. Stirrup exposed at base of column	Column G/12		See above.

Damaged Item	Location	Example	Recommended Repair
2.0 Cracking >1.5mm adjacent to RHS supported column	Top face of beam on western side of column C/28 on floor 3		No urgent action required – progress documented seismic securing works.
2.1	Same as above.		As above.

Damaged Item	Location	Example	Recommended Repair
2.2	Bottom face of beam on western side of column C/28 on floor 3		As above.
2.3	Top face of beam on western side of column C/28 on floor 2		As above.

Damaged Item	Location	Example	Recommended Repair
3.0 Two hairline cracks on bottom face of beam	Seen from L2, end bay of grid line 28, next to column D/28		No remedial action required.
3.1 Two hairline cracks seen from beneath beam	Seen from L2, Grid line 11, adjacent to column A/11		As above.

Damaged Item	Location	Example	Recommended Repair
3.2 Hairline cracking of beams at corner joint.	Seen from L2, around column D/11		As above.
3.3 Two hairline cracks seen from beneath beam (only one shown in photo as other crack was further along same beam)	Seen from L3, grid line 11, adjacent to column A/11		As above.

Damaged Item	Location	Example	Recommended Repair
3.4 Two hairline cracks seen from beneath beam	Seen from L3, grid line 28, adjacent to column D/28		As above.
4.0 Cracking seen on top surface of concrete floor topping layer at beam to Dycore interface. Example shows largest cracking seen on L2, located in corner A/11.	Floor of L2, cracking seen in corner bays around column A/11		No remedial Action required.

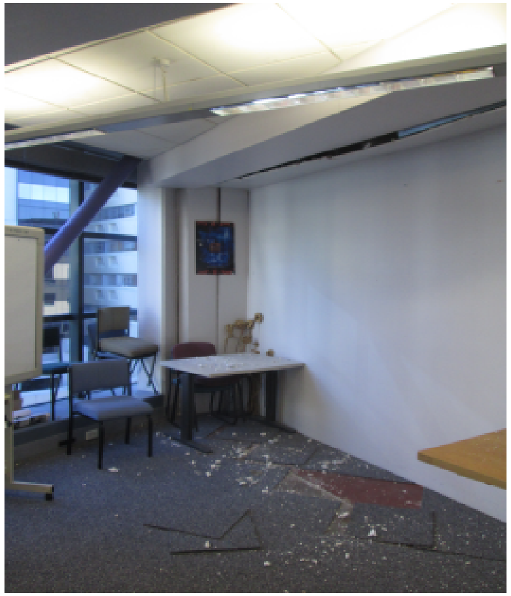
Damaged Item	Location	Example	Recommended Repair
4.1 Same as 4.0. Showing worst crack observed on L2 , ~1.4mm	Floor of L2, cracking seen in corner bays around column A/11		Localised issue – no remedial action required.
4.2 Cracking seen on top surface of concrete floor topping layer at beam to Dycore interface. ~0.4mm	Floor of L2, cracking seen in middle bay between A/11 and B/11		No remedial action required.

Damaged Item	Location	Example	Recommended Repair
4.3 Cracking seen on top surface of concrete floor topping layer at beam to Dycore interface.	Floor of L2, cracking seen between A/11 and B/11, in bay adjacent to B/11		As above.
4.4 Cracking seen on top surface of concrete floor topping layer at beam to Dycore interface. ~0.4mm	Floor of L2, cracking seen in corner of building around column D/11		As above.

Damaged Item	Location	Example	Recommended Repair
4.5 Cracking seen on top surface of concrete floor topping layer at beam to Dycore interface. ~0.6mm	Floor of L2, cracking seen in corner of building around column D/28		As above.
4.6 Cracking seen on top surface of concrete floor topping layer at beam to Dycore interface. ~1.0mm	Floor of L3, cracking seen in corner bay around column A/11		Epoxy grouting repair recommended.

Damaged Item	Location	Example	Recommended Repair
4.7 Cracking seen on top surface of concrete floor topping layer at beam to Dycore interface. ~0.5mm	Floor of L3, cracking seen in middle bay between A/11 and B/11		No remedial action required.
4.8 Cracking seen on top surface of concrete floor topping layer at beam to Dycore interface. ~1.8mm	Floor of L3, cracking seen between A/11 and B/11, in bay adjacent to B/11		Epoxy grouting repair recommended.

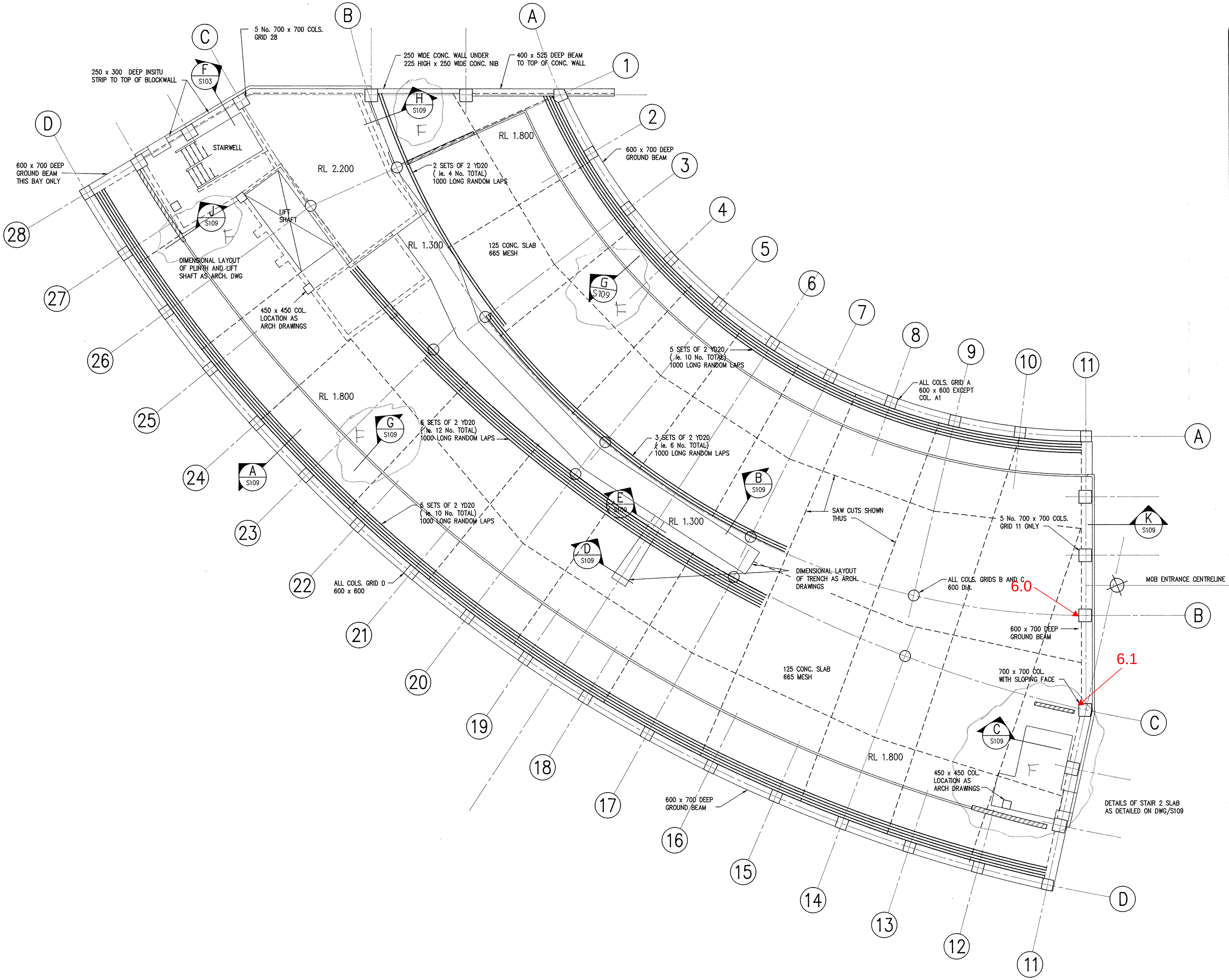
Damaged Item	Location	Example	Recommended Repair
4.9 Cracking seen on top surface of concrete floor topping layer at beam to Dycore interface. ~0.6mm	Floor of L3, cracking seen in corner of building around column D/28		No remedial action required.
5.0 It is evident the Portico has experienced approximately 50-100mm of movement with approx 10-15mm residual displacement. Some of which may be pre-existing.	Carpet movement above sliding joint on Library side of portico.		Restricted access to Portico and advance Portico demolition planning.

Damaged Item	Location	Example	Recommended Repair
5.1 The Portico sliding bearings with “frozen” puck and subsequent damage to bearing guides.	Portico sliding bearings on Central Library side within access spaces at Library L2.		As above.
5.2 Damage to non-structural elements at connections to Portico. Damage was more extensive on Central Library side due to sliding joint.	Example photo is on CAB side.		As above.

Damaged Item	Location	Example	Recommended Repair
5.3 External Portico glazing damage (and replacement with ply panel) due to seismic movement (65mm minimum to cause glazing to balustrade contact).	Portico external glazing at junction with Central Library external roof deck.		As above.
6.0 Tile dislodged revealing hairline crack on column behind	Ground floor, column B/11.		No structural remedial action required.

Damaged Item	Location	Example	Recommended Repair
6.1 Tile dislodged revealing hairline crack on column behind	Ground floor, column C/11.		As above.
7.0 Ground floor crack in slab on grade	Ground floor at junction from CAB to MOB		Not a structural issue. Epoxy repair of cracks and floor levelling may be required to reinstate floor levels/finishes.

Damaged Item	Location	Example	Recommended Repair
8.0 Crack visible on exterior of L1 beam	Visible from lobby/atrium of MOB building.		No remedial action required.



Issue		Date
A	PERMIT ISSUE	4/9/89
B	GENERAL REVISIONS	11/9/89
C	SAW CUTS ADDED	6/10/89
D	CONSTRUCTION ISSUE	9/2/90
E	TOILET SLAB, PANEL FIXINGS	14/3/90
F	NIBS ADDED	4/05/90

No.	Revision	Date

S&T
Stephenson & Turner New Zealand Limited
Principal Consultant

MORRISON COOPER LIMITED

Drawn	Approved	File
DGN		A9023S08

Scale	Date
1:100	2/9/89

GROUND FLOOR PLAN

CITY ADMINISTRATION BUILDING
CAB

CIVIC CENTRE REDEVELOPMENT

FLETCHER
Fletcher Development and Construction Limited
11 Aurora Terrace P.O. Box 548, Wellington New Zealand
Tel: (04) 720-358 Fax: (04) 733-695
DESIGN & BUILD

Drawing No.	Date 12:55 04/05/90
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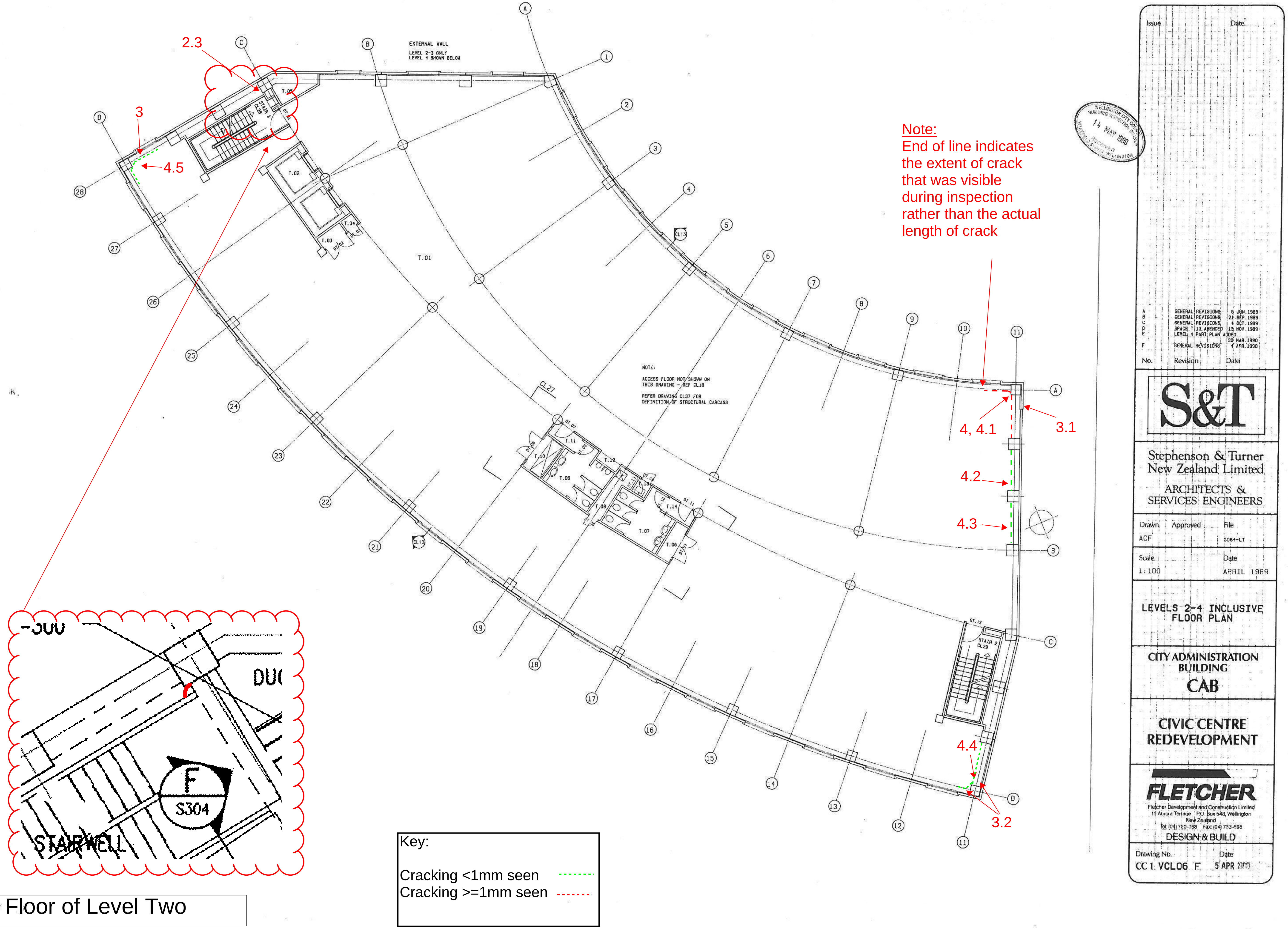
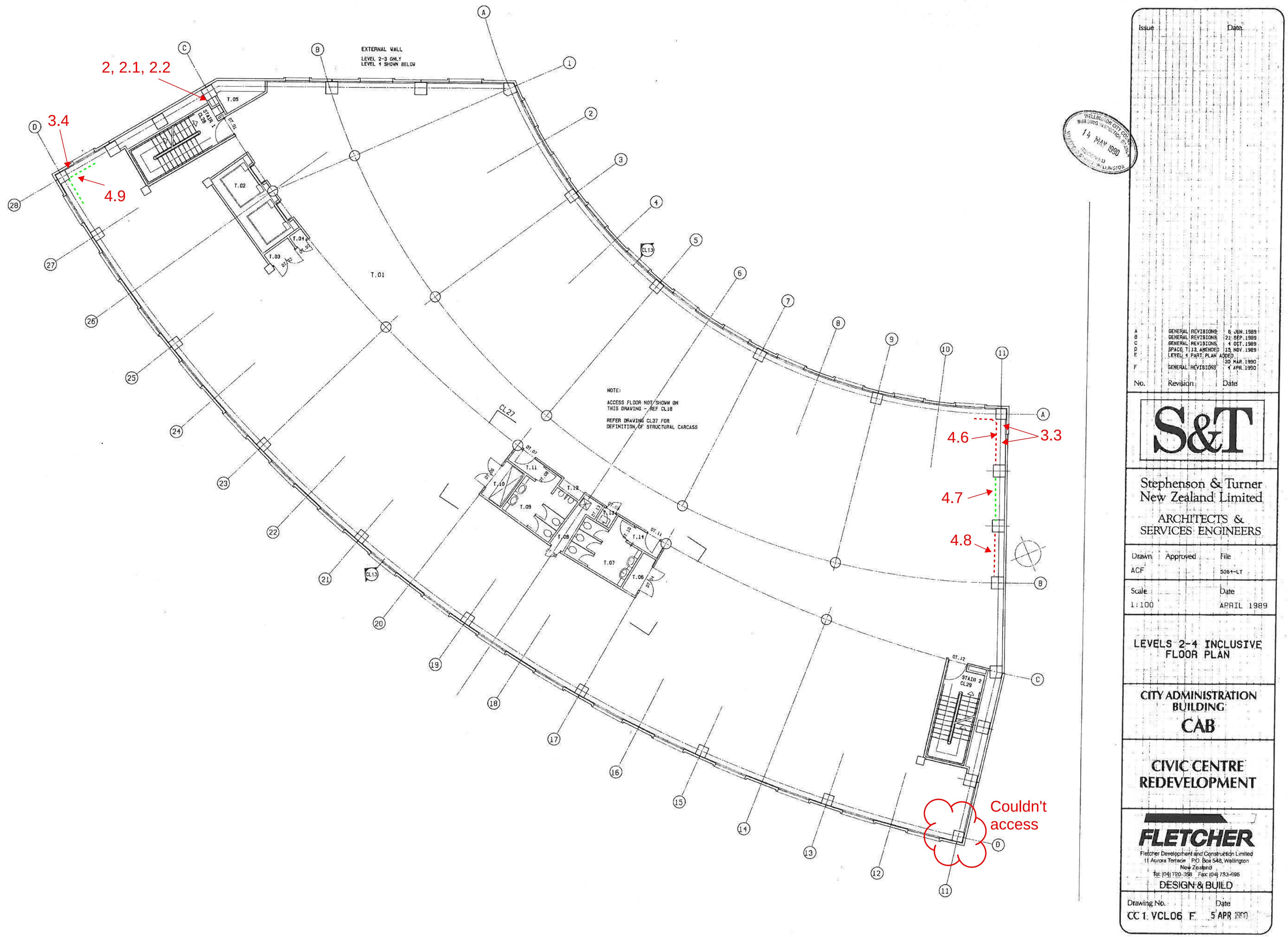
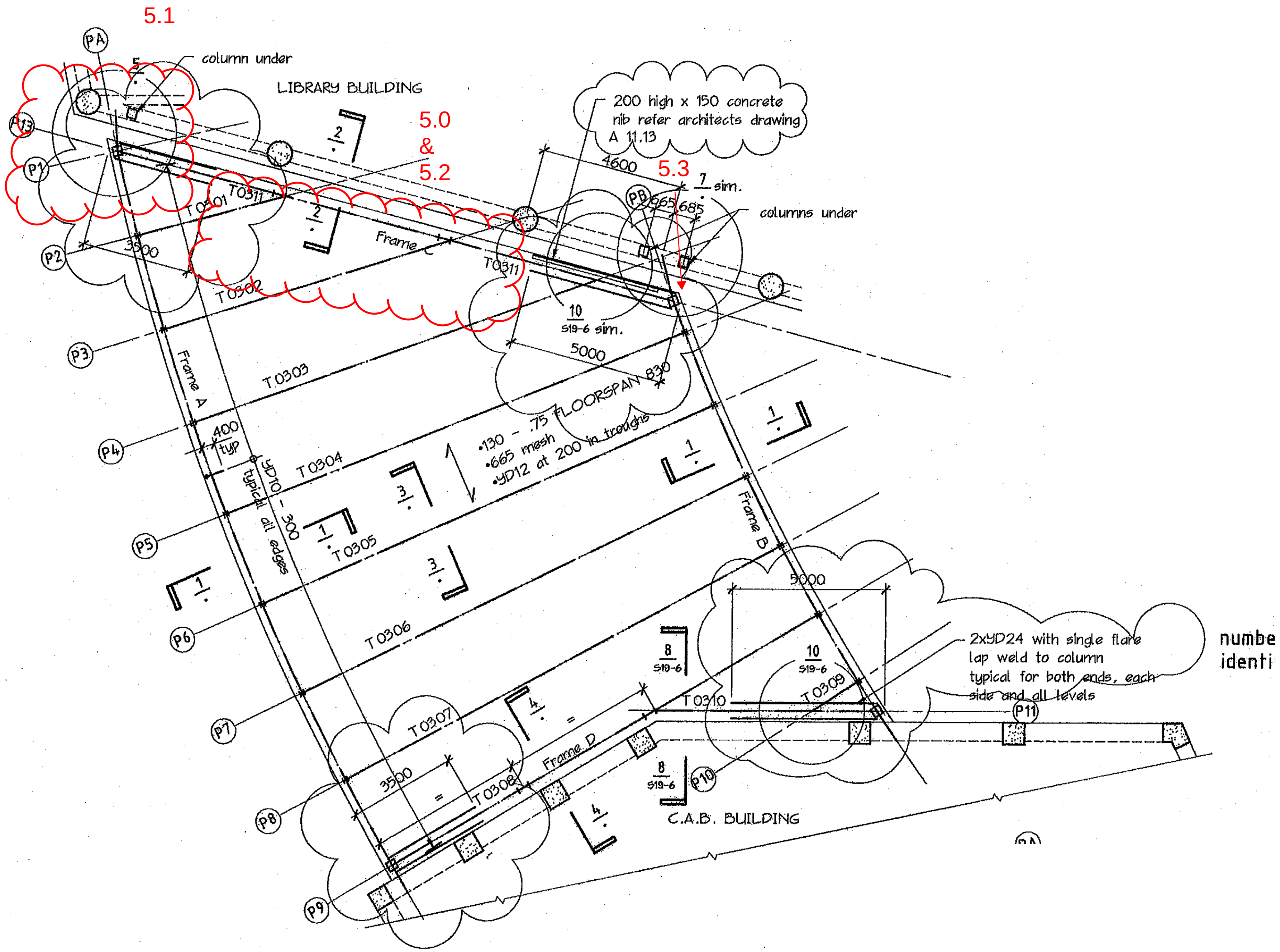


Floor of Level Two



Floor of Level Three



Date: Issued to:

NOTES:

1. Construction sequence for pouring floors to be level 3, level 5, level 4.
2. Trusses will require vertical support and temporary bracing to the top chord during construction due to the curvature in the truss elements. Contractor to submit method statement for erection procedure for comment
3. For details of slab edge at corners refer Architects drawing A 11.11 typical for all levels
4. ℄ of truss equals ℄ of grid typical

Date	Revision	No
20/12/90	GENERAL REVISION	B
3/12/90	CONSTRUCTION	A
3/10/90	REISSUE FOR TENDER	3
3/9/90	TENDER	2
20/2/90	PERMIT	1

HOLMES CONSULTING GROUP
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DESIGN & BUILD

WELLINGTON
CIVIC CENTRE
REDEVELOPMENT

LIBRARY and
BASEMENT CARPARK

Drawn: HUGH
File: SPORPLN3
Scale: 1:100 1:10 1:20
Engineer:
Approved:

Drawing Name:
PORTAL
LEVEL 3
PLAN

Drawing No: CC2 / S19-1
Revision: B

6. POST-EARTHQUAKE BUILDING CAPACITY

6.1 POST-EARTHQUAKE BUILDING CAPACITY

Structural damage sustained during the earthquakes is considered minor in terms of the main Civic Administration Building and moderate in terms of the Portico to Central Library connection. The sliding bearing junction that forms part of the Portico to Central Library structural connection has been damaged and repair or demolition in the short-medium term has been recommended. The short term Life Safety of this connection under "moderate" seismic load levels can still be maintained – however under larger load levels this connection could be compromised resulting in a higher friction steel on steel situation, which would not be satisfactory to the continued performance of this system.

Connection of the Portico to the CAB has been inspected in detail and no significant damage to this connection was apparent.

Structural damage to the main CAB is considered minor. Considerable building movement and flexing has obviously occurred and this is consistent with our expectations based on our Detailed Seismic Assessment of this building. A comparison of likely seismic load levels experienced to that DSA has been undertaken and we conclude that only very minor levels of yielding (if any) has occurred within the main structural system – again this has been confirmed by building visual inspection.

Some flexing of building components, in particular higher stressed areas of floor diaphragms appears to have occurred and the very early onset of floor diaphragm damage is evident. This confirms the need to progress with seismic securing measures already documented and planned.

Otherwise, we believe that the building has generally performed as expected and subject to addressing issues associated with the Portico and localised repair of floor cracks noted, we believe that the seismic capacity of the main CAB has not been significantly reduced as a result of the recent earthquake events.

7. REFERENCES

1. *WCC Civic Admin Building Detailed Seismic Assessment Report*, Holmes Consulting Group LP, May 2013

2. *Guidelines for Building Safety Evaluation During a State of Emergency*, New Zealand Society for Earthquake Engineering, 2009

3. *Building Act 2004*, New Zealand Government

4. *New Zealand Building Code 2011*, New Zealand Government

5. *Earthquake-Prone Buildings Policy 2009*, Wellington City Council

6. *Dangerous and Insanitary Buildings Policy 2006*, Wellington City Council

7. *Structural Design Actions Part 5: Earthquake Actions – New Zealand, NZS 1170.5:2004*, Standards New Zealand, 2004