Attachment H: *Engineering and Structural: Brett Gilmore, Quoin*

Structural Report to Accompany Assessment of Environmental Effects & Resource Consent Application

Project	**Harley Chambers & Worcester Chambers Buildings**
Client	**Lee Pee Limited**
Address	**137 Cambridge Terrace, Christchurch & 69 Worcester Boulevard, Christchurch**

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13 December 2017

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By Email: valourproperties@xtra.co.nz

Dear Gerard & Rosie

Harley Chambers Building, 137 Cambridge Terrace, Christchurch &
Worcester Chambers Building, 69 Worcester Boulevard, Christchurch

1. Introduction

Quoin Structural Consultants Ltd (Quoin) has been engaged to complete a Structural Assessment Report to accompany the Assessment of Environmental Effects (AEE) and Resource Consent Application being lodged to demolish Harley Chambers, and redevelop the York House, Worcester Chambers and Harley Chambers sites, including some demolition of Worcester Chambers. The main purpose of this report is to summarise the following:

(a) Describe the existing buildings, their construction, and structural systems.

(b) Outline the level of investigation undertaken and where information was obtained.

(c) Summarise earthquake damage caused by the recent Canterbury Earthquake Sequence (CES).

(d) Review the buildings' performance in the recent Canterbury earthquakes.

(e) Identify critical structural weaknesses.

(f) Assess/estimate the building's seismic strength relative to New Building Standard (NBS), commonly referred to as "current code".

(g) Outline the repairs to restore the buildings to their pre-earthquake condition, and minimum earthquake strength of 34% x NBS for Harley Chambers and 73% x NBS for Worcester Chambers.

(h) Provide concept design to earthquake strengthen the Harley Chambers Building to 67% x NBS and 100% x NBS.

(i) Provide concept design to retain the façade of Harley Chambers.

(j) Provide concept design assessment for the construction effects and management plan for the retention of Worcester Chambers and construction of adjacent new hotel building.

(k) Highlight Building Act requirements and the Christchurch City Council policy for earthquake-prone buildings.

Quoin (previously Structex Metro Ltd) have had involvement with the inspection and assessment of Harley Chambers since soon after the 4 September 2010. This has included:

(l) Post-earthquake inspections.

(m) Assessments of earthquake hazards and damage.

(n) Providing advice and supervising the safe removal of contents from the building.

(o) Advising on scope of intrusive investigations and survey of the building.

(p) Completion of Detailed Engineering Evaluation to assess the building percentage x NBS (damaged and undamaged).

(q) Develop full scope of structural repairs to assist with the insurance claim, including liaising with the Quantity Surveyor and Insurer's Engineer.

(r) Concept design for earthquake strengthening of building to 67% x NBS and 100% x NBS.

2. Limitations of Report

Findings presented as part of this report are for the sole use of Lee Pee Ltd. 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 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.

3. Executive Summary & Recommendations

3.1. Harley Chambers Building

3.1.1. The building was constructed in two stages circa 1929 to 1932, with an east-west join between the main north and south section aligning with the south side of the lobby, stairs and entry door to Cambridge Terrace.

3.1.2. The building comprises of:

- Concrete first and second floors, and roof, comprising of 'waffle' type slabs.
- Timber framed ground floor.
- Concrete perimeter beams and columns.
- Concrete walls to some internal walls.
- Double brick infill to north and west exterior walls.
- Unreinforced masonry Bell block walls to interior of the north section.
- Concrete lift shaft to underside of second floor and brick above (part deconstructed).
- Part concrete basement.
- Concrete stairs.
- Shallow concrete foundations comprising of strip footings and pads.

3.1.3. Harley Chambers is listed as a Category 2 heritage building in the Heritage New Zealand Register and in the Christchurch District Plan.

3.1.4. The building suffered extensive and widespread damage due to the CES. Damage included, but was not limited to:

(a) Collapse of brick lift shaft above roof level.

(b) Severe and widespread cracking to unreinforced brick and Bell-block walls.

(c) Differential settlement of foundations across the full footprint.

(d) Cracks in basement walls causing flooding in the basement.

(e) The brick infill and parapet to the north wall directly adjacent to the boundary was removed to allow the safe construction of the new adjacent building.

(f) Widespread cracking to concrete floors, walls and columns.

(g) Widespread cracking to exterior plaster finishes throughout.

(h) Severe structural damage to north-east corner column and adjacent foundation beam/wall.

(i) Widening of the join between the north and south sections.

(j) Widespread damage to wall and ceiling finishes throughout.

3.1.5. The building in its current condition has an assessed earthquake strength of 15% x NBS.

The building in its undamaged pre-earthquake condition has an assessed earthquake strength of 25% x NBS.

The building has been assessed as being earthquake prone, with an earthquake strength of less than 33% x NBS.

3.1.6. The building has critical structural weaknesses that include:

(a) Unreinforced brick parapets.

(b) Unreinforced brick lift shaft above second floor level (part deconstructed above roof.

(c) Unreinforced brick and Bell-block walls.

(d) Severely damaged column at north-east corner.

3.1.7. Overall the extent of the widespread and significant damage is as would be expected for the type of building being subjected to the CES.

In its current condition, the main safety risk to the public is the structural integrity of the north-east column and possibility of small pieces of exterior plaster spalling and falling onto the footpath. These issues have been discussed with the Christchurch City Council. A temporary barricade has been erected adjacent to the north-east corner column.

The main safety risks to personnel, other than the public, include:

(a) Unreinforced brick parapets to the rear north and west sides of the building. This issue is more significant when the adjacent Worcester Chambers building is occupied, as the space between the buildings is a fire egress route for Worcester Chambers.

(b) Spalling and falling of loose debris from loose wall and ceiling finishes and broken windows.

(c) Health issues associated with residual part filled basement and the widespread contamination of the interior due to exposure to pigeon faecal matter.

3.1.8. The repairs required to reinstate the building to its pre-earthquake condition and to a minimum earthquake strength of 34%x NBS is extensive. The cost of these repairs as assessed by the Quantity Surveyor, including the reinstatement of the non-structural finishes and services has been assessed as being more than the cost of rebuilding as new.

3.1.9. The report outlines the design concepts to earthquake strengthen the building to 67% x NBS and 100% x NBS. These costs are additional to the cost of repairs and strengthening to 34% x NBS.

3.1.10. The report outlines the design concept to retain the exterior façade to both the Cambridge Terrace and Worcester Boulevard front elevations. The extent of the works and associated costs to temporarily support, repair and strengthen the façade to be incorporated into a new building is extensive. While it is considered to be structurally feasible to retain the façade, it may not be economic to do so. The retention of the façade may also compromise the design and functionality of any new building behind the façade.

3.1.11. The demolition of Harley Chambers has its own challenges with regards to suitable site access and its close proximity to Cambridge Terrace, Worcester Boulevard and Worcester Chambers.

The access to the current site is very limited, with an approximate 2.5m wide access way available via Worcester Boulevard between the Worcester Chambers and Harley Chambers buildings.

Given the importance of Cambridge Terrace and Worcester Boulevard to traffic flows, consideration may be given to the part demolition of the rear 1950s section of Worcester Chambers that would provide a simple access with which to undertake the demolition.

3.2. Worcester Chambers Building

3.2.1. The original front section of the building was constructed circa 1928 and it was extended to the rear in 1950.

3.2.2. The building is 2-storey and comprises of:

(a) Lightweight timber framed roof.

(b) Double brick exterior walls above first floor.

(c) Concrete first floor, supported on concrete walls and beams and columns. The concrete walls are clad in brick to give the appearance of an all brick building.

(d) Timber framed ground floor.

(e) Shallow perimeter concrete footings beneath the loadbearing walls and interior concrete piles, to the front two-thirds of the building. The rear section comprises of a concrete slab on grade and shallow perimeter concrete footings.

(f) Small semi-basement to east side of building, constructed in concrete.

(g) Main lateral resistance provided by steel frames in both directions above first floor, together with street braced walls in the east-west direction. The ground floor lateral system comprises of concrete walls in both directions, with concrete first floor diaphragm to distribute loads between walls. The rear section of the building includes concrete frames (beams and columns) in each direction.

3.2.3. Worcester Chambers is listed as a Category 2 heritage building in the Heritage New Zealand Register and Category 1 in the Christchurch District Plan.

3.2.4. Extensive alterations were carried out in 2007, including earthquake strengthening.

Steel frames are installed laterally to support the brick walls above first floor and independently support the roof trusses.

3.2.5. The building suffered damage due to the CES that includes:

(a) Weakening of chimney.

(b) Spalling of plaster to soffit over the front south walls.

(c) A decorative plaster chalice fell to the ground on the east side.

(d) Cracking to brick mortar and loosening of some bricks.

(e) Settlement to edge of stairwell.

(f) Some broken windows.

(g) Cracks to interior finishes.

3.2.6. Repairs were completed to the above noted items in 2011.

3.2.7. The building has been recently assessed by Endel Lust Civil Engineer Ltd to have an earthquake strength of 73% x NBS. No further earthquake strengthening is recommended.

3.2.8. The report outlines the main items to be considered for a new building, (with basement), to be constructed directly adjacent to Worcester Chambers. It is structurally feasible to retain the proposed section of Worcester Chambers without unduly affected its structural integrity and strength. This can be achieved by the installation of a permanent tied steel sheet pile retaining system using low vibration equipment, construction of stiff reinforced concrete walls to the basement, tying the existing foundations of Worcester Chambers onto the adjacent new building ground floor structure, and provision of seismic gaps and joints between the superstructures of Worcester Chambers and new adjacent building.

4. Harley Chambers

4.1. Building Description

4.1.1. General Description

Building Name:	Harley Chambers
Address:	137 Cambridge Terrace, Christchurch
Building Use:	Commercial Offices
Heritage Category:	2
Number of Storeys:	3
Basement:	Part concrete wall basement beneath north section of building
Roof Construction	Concrete slab
Wall Construction:	Concrete, brick infill and hollow masonry Bell-block
Floor Construction:	Concrete waffle slab at first and second floors and roof
Subfloor Construction:	Part suspended slab over basement. Timber framed to main building footprint.
Year Built:	1929 to 1932
Approx. Floor Area:	760 m^2
Building Importance:	2 (NZS1170.0)

The Harley Chambers Building is listed in the Heritage New Zealand Register and Christchurch City District Plan as a Category 2 building.

4.1.2. Structural Systems

A summary of the structural systems is as follows:

(a) The building was constructed in stages with a north building section and a south building section. The join between the building sections occurs at the doors and lobby to Cambridge Terrace.

(b) Reinforced concrete 'waffle' type suspended floor slabs at the first and second floors, and at roof level. The roof is flat and has a waterproof membrane.

(c) The north section of the roof is also clad in metal roofing over timber framing that was likely installed at a later date to improve the water tightness of the roof.

(d) The concrete floors are supported by reinforced concrete perimeter beams at the exterior walls and some steel beams to the interior.

(e) The concrete beams are supported on reinforced concrete columns. The steel beams are supported on steel columns.

(f) The exterior wall elevations to Cambridge Terrace and Worcester Boulevard comprise of concrete beams and columns as noted above with decorative plaster finishes and a large portion of windows.

(g) The exterior walls to the wall elevations not visible from the street, typically comprise of plastered concrete columns and beams with double brick infill to form the walls between the windows. The double brick walls comprise of 2 x 100 thick solid brick skins with a 100mm wide cavity between.

(h) The walls along the join line of the north and south building sections comprise of a double brick wall with cavity, similar to the exterior wall construction.

(i) The wall parapets to Cambridge Terrace and Worcester Boulevard comprise of concrete that is likely reinforced and extends above the roof level perimeter concrete beams.

(j) The wall parapets to the wall elevations not visible from the streets comprise of 270mm overall thick brick infill between 600mm x 330mm concrete piers at 1800/2100mm centres that appear to extend from the concrete perimeter beams and columns below.

(k) The lift shaft above roof level comprise of solid brick construction with a concrete slab roof. The brick walls appear to extend down to the second floor level. The walls below the second floor appear to comprise of 225mm-300mm thick concrete.

(l) The part basement beneath the north section of the building comprises of concrete walls and base slab.

(m) The ground floor comprises timber flooring on timber joists and bearers over shallow concrete piles, that extend over the main building footprint. The section of ground floor over the basement comprises of a reinforced concrete suspended slab.

(n) Most of the interior partition walls to the north section comprise of 130mm wide hollow masonry Bell block that is not reinforced. The walls are constructed hard up against the underside of the concrete suspended floors and may be partially load-bearing for the floor live load and possibly some of the gravity load. The Bell blocks comprise of soft brittle masonry.

(o) The main interior stairs located at the north section of the building are reinforced concrete.

(p) The foundations typically comprise of shallow reinforced concrete pads and strip footings beneath the columns and load-bearing walls respectively.

(q) The main lateral resisting systems comprise of a combination of concrete walls, concrete frames, concrete frames with brick infill, and hollow masonry Bell block partition walls.

4.2. Investigations

4.2.1. The building evaluation and assessment has been based on the following:

(a) Numerous visual inspections of the building carried out following the 4 September 2010 earthquake. This included several Level 2 Assessments and included inspection of the following:

- The exterior from ground level.
- The interior spaces at all floor levels.
- The roof decks.
- The basement.
- The lift shaft.

(b) Limited structural/architectural drawings/floor plans were obtained from Lee Pee Ltd. These included the following drawings titled:

- 'Medico Dental Buildings, Cambridge Terrace, Christchurch for EA Suckling Esq'.
- Drawing No. 1: Floor Plans and Sections
- Drawing No. 4: Details of Steel Construction
- Drawing No. 5: Details of Steel Reinforcing (Floors, columns, beams and foundations

The above noted drawings document the north building section only. The south building section is constructed similarly to the north, except that it has some added interior concrete walls, and no interior Bell block walls.

(c) A site specific geotechnical investigation and report has not been completed for this building site. From our experience of other sites in the nearby vicinity of the Harley Chambers Building that include the York House site at 65-67 Worcester Boulevard, and at 141 Cambridge Terrace, the soil conditions comprise of the following:

- Below the surfacing materials there is likely a layer of fine grained silt and/or silty sand. This layer may vary from 1.0m-3.5m in depth where a sandy gravel is encountered. This gravel is part of a formation which extends from

about Armagh Street in the north to south of Tuam Street and well west of Rolleston Avenue to east of Colombo Street. The gravel generally extends to 8m-10m depth and is 6m-7m thick. The gravel is likely underlain with a sequence of predominantly sand and silty sand layers, although thin layers of silt and peaty silt could be present.

- The water table is likely to be approximately 1.5m-3.0m below ground level. Following the recent earthquakes, a spring occurred at the north-east corner of the site and caused ingress of water into the basement. The basement remains partially filled despite attempts to pump the water out.
- The site is a Class D 'soft' site in terms of the seismic design requirements of AS/NZS 1170.
- There is a moderate risk of liquefaction occurring on the site.
- All the major buildings in the area between Tuam Street and Armagh Street, Rolleston Avenue and Colombo Street, including the Police Station, Clarendon Towers, the Art Gallery and HSBC Tower are all founded on the near surface gravel layer, which generally provides good bearing for shallow foundations. It is generally of sufficient thickness and density to act effectively as a raft, to spread variability in loadings from individual pad footings and minimise any potential for differential settlement in the underlying sands or soft silt lenses.
- It is noted that York House at 65-67 Worcester Boulevard suffered severe differential settlements and superstructure damage following the recent earthquakes and has since been deconstructed.

(d) The following on-site investigations have been carried out under the direction of Quoin:

- The investigation work to date has been completed in the north section of the building as this is where much of the significant damage has occurred and is the part of the building that some existing drawings have been found to assist with the structural assessment and review. The south section of the building is constructed similarly to the north section.
- A floor level survey of the first and ground floors to both the north and south sections of the building. (Refer Appendix C).
- Removal of some of the carpet floor finishes in the north section of the building to review the cracks in the ground floor suspended concrete floor slab over the north side of the basement.

- Removal of some of the wall finishes in the north section of the building, together with drilling holes in various walls, to confirm their thickness and material construction.
- Pumped out basement several times to allow inspection of walls and base slab.
- Completed make safe works, including removal of the brick wall lift shaft above roof level, replacement of broken windows and temporary bracket installed to roof parapet at the joint between the north and south building sections.

The following non-structural aspects fall outside the scope of this report and have not been covered by this investigation and assessment:

- Detailed review of non-structural finishes, fixed joinery, windows and doors etc.
- Compliance items covered by the building Warrant of Fitness.
- An electrical safety review.
- A fire safety review.

These items should be inspected and assessed by qualified trades people or specialists prior to the building being reoccupied or repair/strengthening works carried out. We request such persons be instructed to identify loose and/or inadequate fixings, and to notify the engineers if these are found.

4.3. Building Performance in recent Canterbury Earthquakes

4.3.1. Earthquake Damage

The building has suffered significant earthquake damage as summarised in Appendix B and D. Most of the significant damage occurred to the superstructure in the north section of the building together with differential settlements across the full footprint of the building.

4.3.2. Review of Building Performance

The building as a whole has performed as would be expected for its age and construction. The main areas of damage include:

(a) The unreinforced brick walled lift shaft suffered significant damage above the roof level and was subsequently temporarily secured following the 26 December 2010 earthquake and then deconstructed following the 22 February 2011 earthquake.

(b) Differential settlement of the foundations across the full footprint of the building, with some severe settlement occurring at the north-east corner of the building. This may be due to some liquefaction occurring in subsoil layers and/or the result of a spring being activated near this corner due to the earthquakes.

(c) The main lateral resisting systems appear to comprise of a combination of the following:

- Reinforced concrete frames
- Reinforced concrete frames with solid/partial unreinforced brick infill.
- Unreinforced hollow masonry Bell block partition walls.
- Reinforced concrete shear walls.
- Numerous cracks have occurred in the interior unreinforced brick and unreinforced masonry Bell block partition walls. This damage suggests that these walls have provided a substantial amount of the building's stiffness and resisted a proportional amount of the lateral earthquake loads.
- The construction joint between the north and south sections of the building has suffered differential movement that has caused a 10-20mm gap to open up along the line of the joints over the full height of the building.

4.3.3. Critical Structural Weaknesses (CSW)

From a review of existing drawings and visual inspections of the building, the following critical structural weaknesses were identified:

(a) Unreinforced brick parapets to the sides of the building that do not front onto Cambridge Terrace or Worcester Boulevard. The construction of these is as described in section 4.1. The extent of earthquake damage generally appears low except for the parapet to the north wall which has since been deconstructed.

(b) The north wall parapet was deconstructed to ensure that the new building at 141 Cambridge Terrace could be constructed safely. The section of the brick parapets suffered the worst damage.

(c) In its current state, there does not appear to be a risk of the parapets falling or suffering partial collapse. The parapets should be re-inspected following any significant earthquake aftershocks.

(d) The unreinforced brick walls to the lift shaft above the roof level were a critical structural weakness and subsequently removed.

(e) In its current state, the north-east corner column that has suffered severe cracking damage and is a critical structural weakness.

Refer to section 4.4 Seismic Assessment for discussion of the building strength in the undamaged and damaged states.

4.4. Seismic Assessment

A preliminary seismic assessment of the building has been carried out in general accordance with the New Zealand Society for Earthquake Engineering (NZSEE) "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes" guidelines (June 2006).

AS/NZS1170.5:2005 was used to determine the applied loadings to the building. A zone factor (Z) of 0.3 was adopted in accordance with changes to Section B1 of the Building Code, which came in to effect on the 19th May 2011.

NZSEE guidelines (June 2006), and standards AS/NZS3101:2006, AS/NZS3404:1997 and AS/NZS3603:1993 have been used to assess the building capacity.

The building has initially been assessed as an Importance Level 2 (normal) building. A summary of the assumptions includes the following:

- Importance Level 2 (IL2) = normal
- Soil class = D (soft)
- Sp = 1.0
- Ductility μ = 1.25 (low)
- Period T = 0.4 seconds (low)

We note that while the Buildings Act "deems a building earthquake prone if its ultimate strength capacity is exceeded, and the building would be likely to collapse", the NZSEE guidelines and CCC policy refer to a percentage of New Building Standard (%NBS). The ultimate limit state capacity of the building has been assessed as a percentage of NBS to allow comparison.

The following table summarises the results of our assessment. Elements that have less than 33% of current code strength are regarded as being earthquake prone and are highlighted in bold.

It is noted that the behaviour of the building is complex due to the combination of the various systems.

The assessment table below summarises the estimated in-plane earthquake capacity of the building for the following:

(a) Assessed design strength (undamaged), with the main building lateral resistance provided by unreinforced brick and hollow masonry Bell block walls, plus concrete shear walls, plus some concrete frames.

(b) Assessed residual strength (damaged), with the main building lateral resistance provided by some concrete shear walls and frames. This assessment assumes that the main damaged walls do not contribute to the lateral resistance.

(c) The % x NBS is given below is for the critical north section of the building.

North Section of Building (critical section for assessment) **Estimated % x New Building Standard (% x NBS)**	
(a) Assessed Design Strength at Ground Level (undamaged)	
(i) East Wing	
North-south direction	30% x NBS
East-west direction	35% x NBS
(ii) West Wing	
North-south direction	40% x NBS
East-west direction	**25% x NBS**
(b) Assessed Design Residual Strength (damaged)	
(i) East Wing	
North-south direction	**25% x NBS**
East-west direction	**15% x NBS**
(ii) West Wing	
North-south direction	**25% x NBS**
East-west direction	**20% x NBS**

The assessment indicates that the north section of the building has an assessed (undamaged) design strength of 25% x NBS and a residual (damaged) strength in its current condition of 15% x NBS.

With all of the walls in an un-cracked condition, the building has reasonable lateral resistance and provides an indication as to why the building performed as expected.

The damage caused to many of the ground level brick and hollow masonry Bell block walls has weakened the building. The preliminary assessment of the residual lateral strength confirms that the building is considered as earthquake prone with a capacity less than 33% x NBS.

It is noted that the reinforced concrete walls, frames and columns do not comply with the current NZS 3101 Concrete Structures Standard, which is understandable given the age and construction of the building. This means that these key structural elements have little or no additional ductility to dissipate seismic energy and withstand increased imposed lateral displacements.

The reinforced concrete beams, columns, slabs and walls are lightly reinforced, with much of the reinforcing comprising of non-deformed bars. The detailing of the reinforcing includes short length laps and widely spaced stirrups, both of which are considered to be poor detailing with respect to current design standards.

The building is considered to be structurally repairable and may be strengthened to increase its reliable design lateral strength to 34%-100% x NBS as required. However, the extent of works to repair the building back to its pre-earthquake condition and undertake at least nominal strengthening to 34% x NBS is significant.

Refer to Section 4.5 Earthquake Repairs and Concept for Strengthening Work.

4.5. Earthquake Repairs and Concept for Strengthening Works

This section briefly describes repair works to restore the building to its pre-earthquake condition, and additional works to strengthen the building to 34%-100% of current code. In some cases, further investigation of existing construction will be required. Where appropriate, this has been noted.

Repair and strengthening work proposed in this report have sought to preserve heritage features as much as possible. Such features include decorative corbels and pillars on the external façade and the waffle slab suspended floor system.

4.5.1. Repairs

This section describes the main scope of structural repairs to restore the building to its pre-earthquake condition. The scope is preliminary and subject to further detailed investigations, analysis and design.

The costs associated with the repairs will be assessed by a Quantity Surveyor Refer to the sketches and Earthquake Repairs Summary Table in the Appendices.

(a) **Repairs to interior hollow Bell block masonry partition walls**:

- These walls have a large height:thickness aspect ratio plus the material has been found to be very low strength.
- Remove all Bell block partition infill walls. Reinstate with 140mm masonry block, solid filled with H12 @ 400mm each way. Drill and epoxy H12 starters, 1000mm long , 200mm into all adjacent columns, beams, floors and foundations. Refer to sketches SKR2/R3 and R4.
- Allow to construct 50m of 150mm wide x 350mm deep rib in 0.6m long sections within existing first and second floors to accommodate starters for block walls that do not align with existing floor ribs. Refer to sketch SKR20.

(b) Repairs to all double brick infill walls and parapets in the north section and 5.0m beneath four windows in the south section. Refer to SKR4.

- Remove double brick walls and reinstate with solid filled 240 masonry block. Reinforce with H12 @ 400 each way. Drill and epoxy H12 starters into all adjacent columns, beams, and foundations, to match locations and spacings of main reinforcing. Reinstate plaster as required. Refer to sketches SKR2 to SKR4 inclusive.

(c) Repair and reinstate walls to lift shaft:

- Deconstruct remaining lift shaft walls down to foundation level and reconstruct. Refer to sketches SKR1 to SKR4 inclusive and sketch SKR9.Reinstate concrete roof slab, 150mm thick, reinforced with H12 @ 300 each way, and provide new 200 UB 30 lifting beam.

(d) Repair junction between the north and south building sections:

- Break out part sections of the main structural floors, beams and parapets, and reinstate with new tie connections with epoxied reinforcing. Refer to sketches SKR17 and SKR18. Fill joint gap with grout.

(e) Repair to concrete wall at north wall of lobby:

- Reconstruct as part of the basement reconstruction. Refer to sketch SKR2.

(f) Leaking Basement repairs:

- Address issues with spring.
- Reconstruct the basement walls and slab with new tanking system, including temporary propping and support works. Refer to sketches SKR5 to SKR11 inclusive.

(g) Repair concrete ground floor slab over north end of basement:

- Reconstruct as part of the basement reconstruction works.

(h) Repair expansion joint between Harley Chambers and adjacent north building at 141 Cambridge Terrace:

- Remove existing expansion joint flashings and material.
- Measure and check gap between buildings.
- Assuming that the gap is of acceptable width, reinstate expansion joint flashings etc.

(i) Foundation re-levelling and repairs across the building footprint:

- For the north section – Underpin and jack foundations using steel screw piles to approximately 3.5m depth below ground level. Note that this excludes area of basement. Interior piles supporting timber floor only and strip footings to Bell Block walls to be reconstructed. Refer sketch SKR1 and attached screw pile information SP1-SP11 inclusive. Allow for 40 piles to be jacking piles, plus allow to ground 50mm beneath 90 square metres of foundation. Refer sketch SKR21 for methodology.

- For the south section – Underpin and jack foundations using steel screw piles. Lesser number of jacking piles required than north section. Interior piles supporting timber floor only to be reconstructed. Refer attached sketch SKR12 and attached screw pile information. Allow for eight piles to be jacking piles, plus allow to grout 30mm beneath 40 square metres of foundation. Refer to sketch SKR21 for methodology.

(j) Repair cracks in concrete beams, columns, floors and walls.

- Epoxy inject all cracks. Refer to sketches SKR2, SKR15 and SKR16 and items 106, 111, 112, 113, 114, 115 and 116 in the Repair Table.

- Reconstruct columns at north-east corner and next adjacent column.

(k) Provide all temporary propping as required to undertake the repairs. Refer to items 130 and 131 in the Repair Table.

(l) Repair to damaged internal wall and ceiling linings.

(m) Remove all wall and ceiling linings and reinstate as new. Cracks in exterior plaster:

- Remove damaged sections and reinstate.

(n) Other non-structural repairs:

- Ease and adjust any jammed/catching doors/windows etc.

- Realign and re-fix any dislodged timber architraves, frames, skirting boards and trims.

- Sand, prime and repaint over to match existing.

- Repair/replace broken windows and frames as required.

4.5.2. Concept for Strengthening to 34% x NBS

In addition to the repairs outlined in the previous section 4.5.1, the following work is likely required to strengthen the building to 34% of current code. Refer to sketch in Appendix H that outlines these additional items for the north section of the building. Similar strengthening work would be required for the south section of the building.

- Remove the double brick walls at the interface of the north and south building and at the north, west and 'central' walls as shown on sketch SK11 over the full height, and reinstate with new 240 reinforced masonry block.

4.5.3. Concept for Strengthening to 67% x NBS

In addition to the repairs outlined in the previous section 4.5.1, the following work is likely required to strengthen the building to 67% of current code. Refer to sketch SK12 that outlines these additional items for the north section of the building that generally includes:

(a) Provide new 300mm thick reinforced concrete shear walls at locations shown, full height of building, unless noted otherwise.

(b) Provide new 400mm thick insitu concrete frame columns and beams to east wall elevation.

(c) Reconstruct lift core walls as new, including lift pit.

(d) Provide new foundations for the above. Allow for 800mm deep, typical.

(e) Provide enhanced floor diaphragm ties as shown (reinforcing epoxied into chases in floor slab and/or carbon fibre reinforced polymer strips (CFRP).

(f) Remove all hollow masonry Bell block partition walls and replace with lightweight non-structural partitions.

(g) Add new 150mm thick skin walls to South section of building, as shown on SK16.

- Reinforce the skin walls with H12@200 each way.
- Drill and epoxy D10 hooked ties into the existing wall (100mm embedment) @ 600crs each way.
- Allow to drill through existing floors to allow vertical bars/starters to pass through.
- Allow to drill and epoxy vertical H12 starters into the underside of the roof slab/floor.

(h) Add new 250mm thick shear walls to south section of building, as shown on SK16.

- Reinforce the walls with H16@200ew, each face. Provide HR10 strips (600mm long) plus 2HR10 links, all spaced at 100 centres, at each end of the wall, over the bottom storey height.
- Drill and epoxy D10 hooked ties into faces of the existing columns where the new wall is parallel to the adjacent to existing wall (100mm embedment) @ 600mm centres each way.
- Allow to drill through existing floors to allow vertical bars/starters to pass through.
- Allow to drill and epoxy vertical H12 starters into the underside of the roof slab/floor.
- Allow to drill and epoxy H16 horizontal starters into the existing columns at the ends of the new shear walls (H16@200 centres, x 1000lg, with 250mm embedment).

(i) Cut back the existing concrete shear walls at two locations as shown on SK17. The reason for this is to provide similar length walls across the footprint which provide for a better distribution of earthquake loads between walls.

(j) All of the perimeter columns to the south and north sections of the building are to be strengthened using Sika CarboDur, as shown on SK18. This will require the exterior plaster to be removed, as at least is partly allowed for in the repair scope, and plaster to be reinstated after.

(k) The foundations shown for the repairs are considered to be adequate for the 67% strengthening, except that need to provide new 800 x 1000d foundation beams beneath 3 of the 4 proposed new shear walls, plus add 4 piles.

(l) The floor diaphragms will need to be strengthened. Refer to sketch SK12 for the north section. For the south section, allow 200m of CarboDur strips, per each of the first and second roof levels.

It is noted that further detailed investigation, analysis and design is required to develop this option further.

4.5.4. Concept for Strengthening to 100% x NBS

In addition to the repairs outlined in the previous section 4.5.1, the following work is likely required to strengthen the building to 100% of current code. Refer to sketch SK12 that outlines these additional items for the north section of the building that generally includes:

(a) Provide new 300mm thick reinforced concrete shear walls at locations shown, full height of building, unless noted otherwise.

(b) Provide new 400mm thick insitu concrete frame columns and beams to east wall elevation.

(c) Reconstruct lift core walls as new, including lift pit.

(d) Provide new foundations for the above. Allow for 1000mm deep, typical.

(e) Provide enhanced floor diaphragm ties as shown (reinforcing epoxied into chases in floor slab and/or carbon fibre reinforced polymer strips (CFRP).

(f) Remove all hollow masonry Bell block partition walls and replace with lightweight non-structural partitions.

(g) Add new 200mm thick skin walls to South section of building, as shown on SK17.

- Reinforce the skin walls with H16 @ 200mm each way.
- Drill and epoxy D10 hooked ties into the existing wall (100mm embedment) @ 600mm centres each way.
- Allow to drill through existing floors to allow vertical bars/starters to pass through.
- Allow to drill and epoxy vertical H12 starters into the underside of the roof slab/floor.

(h) Add new 250mm thick shear walls to south section of building, as shown on SK17.

- Reinforce the walls with H16 @ 200mm each way, each face. Provide HR10 strips (600mm long) plus 2HR10 links, all spaced at 100mm centres, at each end of the wall, over the bottom storey height.
- Drill and epoxy D10 hooked ties into faces of the existing columns where the new wall is parallel to the adjacent to existing wall (100mm embedment) @ 600mm centers each way.
- Allow to drill through existing floors to allow vertical bars/starters to pass through.
- Allow to drill and epoxy vertical H12 starters into the underside of the roof slab/floor.
- Allow to drill and epoxy H16 horizontal starters into the existing columns at the ends of the new shear walls (H16 @ 200mm centres, x 1000lg, with 250mm embedment).

(i) Cut back the existing concrete shear walls at two locations as shown on SK17. The reason for this is to provide similar length walls across the footprint which provide for a better distribution of earthquake loads between walls.

(j) All of the perimeter columns to the south and north sections of the building are to be strengthened using Sika CarboDur, as shown on SK18. This will require the exterior plaster to be removed, as at least is partly allowed for in the repair scope, and plaster to be reinstated after.

(k) The foundations shown for the repairs are considered to be adequate for the 100% strengthening, except that need to provide new 800 x 1000d foundation beams beneath 5 of the 6 proposed new shear walls, plus add 6 piles.

(l) The floor diaphragms will need to be strengthening. Refer to sketch SK12 for the north section and increase the extent by 100% for the north section. For the south section, allow for 400m of CarboDur strips, per each of the first and second roof levels.

It is noted that further detailed investigation, analysis and design is required to develop this option further.

4.6. Retention of Façade

The façade to Harley Chambers could be retained and incorporated into a new building development. There are likely to be substantial additional works and cost to achieve this and the proportions of the façade may also compromise the design and functionality of any new building behind the façade.

It is noted also, that the façade has suffered earthquake damage that includes differential settlement of the foundations, severe damage to the north column and foundations, widening of the join between the north and south sections and widespread cracking of the plaster and concrete columns to the entry canopy.

The retention of the façade will require the installation of temporary steel bracing frames, underpinning and relevelling of parts of the foundations, completion of the earthquake repairs and strengthening of the façade to 100% x NBS as would be required for integrating the façade into a new building.

The steel bracing frames would likely be located on the inside of the building, rather than on the outside where they would provide significant disruption to the footpath and roads.

Briefly, the methodology, repairs and strengthening to the façade would involve:

(a) Remove windows.

(b) Install steel screw piles. Allow for underpinning piles to perimeter foundation plus back-span beams and piles, as per the Earthquake Repair Scope. Refer to sketches SKR1 and SKR13, and details of piles as part of the sketch package for repairs.

(c) Construct foundations for the temporary steel bracing frames. These foundations and piles will be permanent and designed to form part of the new building.

(d) With having a timber ground floor adjacent to the full façade perimeter, except at the entry where there is the basement, this allows the steel screw piles to be installed from the outside of the building. Access would be via the windows that would need to be removed as part of this process. This will require traffic control and temporary disruption to footpaths and roads.

(e) Install steel frames and walers with drilled and epoxied fixings into the inside face of the façade. Bolts will need to be drilled in as deep as possible. Refer to sketch SKF1 for typical steel bracing frame.

(f) The bolts are not required to pass through to the exterior as the structural sections of the façade comprise of nominally reinforced concrete.

(g) The entry section canopy to the Cambridge Terrace section will require full propping due to its current damaged condition.

(h) The north end corner of the building will need to be propped due to the severe damage to the corner columns.

(i) The north end column and approximately 4m of the adjacent foundation beam/wall next the footpath need to be reconstructed due to earthquake damage. It is recommended that the column is reconstructed over the full height of the building/façade.

(j) This new column and foundation beam/wall will be reinforced per current design codes and tied back into the existing façade and new building structure in due course.

(k) The re-levelling of the foundations at this end of the building beneath the façade will likely require reconstruction of the footpath to 15m from the north-east corner. The remainder is underpinning and should not affect the remainder of the footpath.

(l) Demolish existing building. Currently there is no reasonable access that would allow for a 'straight forward' demolition behind the façade.

(m) Given the importance of Cambridge Terrace and Worcester Boulevard to traffic flows, consideration may be given to the part demolition of the rear 1950s section of Worcester Chambers that would provide a simple access with which to undertake the demolition.

(n) All of the perimeter columns to the façade are to be strengthened to 100% x NBS. This will use Sika Carbadur strips to all sides of the columns as shown on sketch SK18 (see attached as part of 67-100% strengthening). This will require the exterior plaster to be removed, as at least is partly allowed for in the repair scope, and plaster to be reinstated after.

(o) Connect new building to façade.

(p) A significant portion of the exterior plaster to the façade is required to be removed and reinstated as part of the earthquake repairs and strengthening.

(q) The existing joint between the north and south sections of the building, that has opened up in the façade adjacent to Cambridge Terrace, is required to be tied together as part of the earthquake repairs and strengthening and is also recommended for the retention of the facade. This will involve:

- Break back exterior face of the façade to 300mm each side of the joint, and to 150mm depth over the full height of the building.
- Drill and epoxy H12 ties into each end face of the existing face, at 300mm centres over the full height.
- Provide 4-H12 vertical full height.
- Fill cut-out section with self-compacting concrete.
- Install 400 x 400 x 12 steel plates to the inside face of the façade, with 4 epoxied M16 bolts (2 each side of existing joint), and spaced at 1000mm centres over the full height.
- Reinstate plaster finishes.

(r) The extent of crack repairs to the concrete will need to be assessed after removal of the cracked plaster. Some epoxy injection work may be required.

(s) Extensive repairs are required to cracks in the concrete canopy over the main entry and to the adjacent circular columns. It is recommended that a single RB25 steel rod be drilled down the middle of the circular columns, and post tensioned, as part of the required strengthening.

(t) Some supplementary strengthening will be required to the concrete canopy. This is likely to comprise of cutting 50mm x 50mm chases into the soffit of the concrete at 300mm centres (north-south) and grouting in H12 reinforcing bars. This will be the closest like-for-like option, without provide supplementary external structure.

(u) Reinstate windows, which are part of the repairs.

(v) Re-paint façade.

(w) The above noted works to retain the façade are extensive and likely to cost significantly more than the cost of a façade to a new building. But from a structural engineering perspective, it is feasible.

(x) It is noted that the retention of the façade could compromise the design of any new building behind the façade. The proportions of the façade would determine the floor to floor heights and the level of the ground floor relative to the footpath. That could negatively impact on the efficiency and functionality of the design.

(y) There may be added costs to accommodate disabled access into the building, if the new ground floor level were to match the existing level that works well with the façade, as compared with a new building normally having its ground floor level just above footpath level.

4.7. Demolition

The demolition of Harley Chambers has its own challenges with regards to suitable site access and its close proximity to Cambridge Terrace, Worcester Boulevard and Worcester Chambers.

For this type of building, the methodology for full or part demolition would require access for high capacity equipment that has the capability to break the structure down in a safe and controlled manner. The use of smaller sized equipment may be possible but is likely to be slow and inefficient.

The access to the current site is very limited, with an approximate 2.5m wide access way available via Worcester Boulevard between the Worcester Chambers and Harley Chambers buildings.

Consideration also has to be given to protecting Worcester Chambers and have equipment work a safe and adequate distance away.

Given the importance of Cambridge Terrace and Worcester Boulevard to traffic flows, consideration may be given to the part demolition of the rear 1950s section of Worcester Chambers that would provide a simple access with which to undertake the demolition.

Without restrictions as to access, it is estimated that demolition of Harley Chambers, and the safe removal of material and debris would take four (4) weeks.

5. Worcester Chambers

Refer to the Quantitative Engineering Evaluation Report completed by Endel Lust Civil Engineer Ltd in Appendix K that includes the following:

5.1. Preliminary

5.2. Address

5.3. Site

5.4. Description of Building

5.5. Structure

5.6. Foundations

5.7. Damage

5.8. Remedial Work

5.9. Assessment

5.10. Conclusions

Refer to the Quantitative Engineering Evaluation Report 'Worcester Chambers' 69 Worcester Street for '69 Worcester Limited by Endel Lust Civil Engineer that follows as Appendix K.

5.11. Construction Effects & Management Plan for Retention of Worcester Chambers & Construction of Adjacent New Hotel Building

5.11.1. Proposal & Overall Construction Responsibilities

The proposal is as described in the Planning Report. Very briefly, the proposed development is for the construction of a new hotel across the sites that include Harley Chambers, the rear of Worcester Chambers and the previously deconstructed York House.

The Worcester Chambers building has been assessed as having an earthquake strength of 73% x NBS.

The Worcester Chambers building has a good distribution of lateral resisting walls and frames. Therefore, it is likely that no added strengthening would need to be undertaken if the section of the building to be retained, and only added works would be required along the line of the building where it is cut back, as would be expected.

As is typically the case for a project of this nature, a main contractor is proposed to be appointed to carry out the construction works. The main contractors' responsibilities will include management of any subcontractors engaged for the development. The piling work may be carried out as a separate contract.

The main contractor will be required to appoint a Site Manager who will be responsible for the implementation of a Construction Management Plan. The Site Manager will have a range of responsibilities, which will include a liaison role to address any construction related issues that may arise, and which impact on the surrounding environment.

5.11.2. Time Frame

The project will be undertaken over a period of approximately 2.5 years.

5.11.3. Description of Work Activities

The project works includes the construction of a new hotel adjacent to the Worcester Chambers building as indicated on the Concept Architectural drawings. The hotel includes the construction of the underground carpark, and low height glazed atrium directly adjacent to the east, north and west sides of Worcester Chambers. A brief description of the main works is set out as follows.

(a) Carefully deconstruct Harley Chambers and rear section of Worcester Chambers.

(b) Install a permanent ground retention system around the perimeter of the Worcester Chambers building and overall site to allow construction of the basement. This would likely involve the following, subject to detailed design:

- Retention system likely to be installed approximately 0.6m-1.0m away from Worcester Chambers.
- Steel sheet piling using low vibration equipment.
- Install near horizontal ties beneath the foundations of Worcester Chambers to tie the top of the sheet pile walls together.
- Part excavate and install horizontal steel walers near the top of the sheet piling, and temporary braces that extend from the walers down to temporary foundations at the level of the new basement.
- Complete full excavation for the basement, construct the foundations, and utilise the steel sheet piling as permanent formwork to construct the concrete walls to the basement.

(c) Construction of concrete foundations to the basement.

(d) The foundations of Worcester Chambers to be laterally tied into the new ground floor level slab and beams to the new building as construction of the building proceeds.

(e) The design of the basement structure adjacent to Worcester Chambers to incorporate laterally stiff elements on all sides of Worcester Chambers (eg walls and/or steel braced frames) so that the performance of Worcester Chambers remains unchanged.

(f) Typically provide seismic joints and gaps between Worcester Chambers and the new building, above ground floor level only. There may be sections of Worcester Chambers where the new building adjoins via flashings, sliding joints, corbels etc.

5.11.4. **Construction Management Plan**

(a) All construction projects have construction related effects and project of this scale is no different. A construction management plan (CMP) is therefore a key ongoing tool for systematically managing these effects so that they can be minimised to the extent practicable. A construction management plan is not intended to be a rigid or inflexible document, rather it can evolve as more detail is developed on the various construction aspects of the project.

(b) There are numerous templates available for developing a CMP, however the majority will include a range of key features which have been incorporated into the attached draft. These include

- Regular site meetings
- Management of Dust, Noise and Vibration
- Establishment of a Complaints Protocol.

(c) Site Meetings

During construction a weekly formal site meeting will occur. Those present at these meetings will include:

- The Engineer to the contract and/or his representative.
- The Contractor.
- Any other personnel considered necessary.

Matters to be addressed at every site meeting will include a review of the ongoing work programme and any matters that have arisen since the previous meeting.

(d) Noise, Dust & Vibration

There are a range of management measures proposed within the CMP to address these particular effects: They include:

- Where required, machinery is to be muffled so that they comply with the limits for construction noise as set out in the Christchurch City Plan. Construction noise and vibration is to comply with New Zealand Standard NZS 6803:1999 'Acoustics – Construction Noise.
- The Contractor is to provide the Engineer with certification for each piece of heavy machinery and its compliance with the relevant noise limits.
- No work is permitted on Sundays or public holidays.

- The Contractor is to have a water cart and/or water sprinkler equipment available during the earthworks activities to be used to supress dust during dry or windy periods; and

- Vibration from earthworks machinery is to be monitored by the Site Manager and Engineer and if found to be excessive then alternative methods of construction employed. This is to be discussed between the Engineer and Site Manager at the time of the works.

(e) Complaints Protocol

- It is important for the Contractor to be constantly aware of possible impact construction effects will have on neighbours and to be responsive to concerns raised.

- This in mind, the CMP requires a register is to be kept by the Site Manager of any complaints received from the public or the Council. This register is to be available for viewing by the Engineer and the Council. The Site Manager is to investigate each complaint made and make recommendation to the Engineer on how to rectify the problem. The Engineer will then, if necessary, instruct the Site Manager to undertake the work as appropriate.

- If a complaint is received from or via the Council then the Site Manager is to keep Council and the Engineer informed of remedial measures taken, where required.

- A notice board will be erected next to the site entrance. The notice will identify the Site Manager, and the appropriate contact details so as to ensure they are readily contactable by neighbours.

(f) Access to the Site

Access to site is to be provided off Worcester Boulevard. Due to the nature of the area, care is to be taken for the establishment of large equipment and the delivery of bulk materials.

(g) Site Maintenance

The site is to be maintained in a tidy state at all times. Any rubbish is to be removed on a weekly basis. Materials are to be stored in tidy stockpiles. The Engineer will inspect the site on a weekly basis and will instruct the Site Manager to rectify any areas of the site that is left untidy.

(h) Sediment Control

A sediment control plan is to be submitted to the Engineer for approval and submitted to Christchurch City Council before construction works commence. The sediment control plan is to follow ECAN Erosion & Sediment Control guideline 2007.

(i) Traffic Management

A traffic Management Plan (TMP) is to be developed by the Contractor identifying how material supplies and mechanical plant are to be delivered to site. A copy of the TMP is to be held on site. The TMP is to be submitted for approval by Christchurch City Council before construction works commence.

(j) Conclusion

A project of the scale and nature of the current proposal will inevitably have construction related effects. These effects will be managed by, amongst others the conscious choice to use vibration free sheet piling for the basement car-park and also by the adoption and implementation of an ongoing construction management plan. Such plans are a tried and tested approach to the management of construction effects and in this case will help to manage these effects to an acceptable and appropriate level.

5.12. Assessment of Alternative Options to Retain Sections of Worcester Chambers

The following assesses the structural feasibility of retaining varying portions of the front section of Worcester Chambers.

The options to be considered are as generally described in the Planning Report. These include:

(a) Option A: 6.5m Retention

(b) Option B: 13.0m Retention

(c) Option C: Full Retention

5.12.1. **Option A: 6.5m Retention**

The structural requirements to retain the front 6.5m of Worcester Chambers are as generally described in Section 5.11.2.

The proposed works involve the use of traditional methodologies that have been used on numerous projects where existing buildings are to be retained, underpinned, and integrated with new adjacent buildings. The methodologies take into account the relative heavy weight of the superstructure (concrete first floor, brick and concrete walls, and concrete foundations), and utilise systems that minimise the effects on the existing building to be retained, including eliminating the need for adding supplementary structure within the retained building and minimising the risk of causing any consequential damage during the retention process.

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5.12.2. Option B: 13m Retention

Quoin have considered various sub-options to retain the front 13m of Worcester Chambers as follows:

5.12.2.1 Option B1: 13m Retained Superstructure on Existing Ground

It is noted that the superstructure to Worcester Chambers as summarised in Sections 5.4 Description of Building and Section 5.4 Structure includes very heavy elements such as the concrete first floor, brick and concrete walls and concrete foundations.

The simplest and least risk option is to retain the superstructure as described in Option A. The only difference is that the footprint of the retention is larger, which is likely to affect the functionality of the spaces above and below ground level.

5.12.2.2 Option B2: 13m Retained Superstructure Part Transferred Over Basement

This option retains the front 6.5m of Worcester Chambers on the existing ground the same as Option A, and transfers the next adjacent 6.5m over the basement, with the intention of reducing the impacts on the functionality and space in the basement that would result from Option B1.

This option is likely to require significant additional work that would include the installation of:

(a) Heavy transfer beams beneath the existing foundations.

(b) Additional columns and walls/frames in the basement to support the added gravity weight and seismic mass of the heavyweight superstructure.

(c) Enhanced ground floor slab and/or steel floor bracing to distribute the increased lateral earthquake loads to the basement walls/frames.

The above-noted additional works will add significant extra cost to the retention of Worcester Chambers, plus there is added risk of causing consequential damage to the Worcester Chambers superstructure during the retention process when compared with Options A and B1.

5.12.2.3 Option B3: 13m Retained Altered Superstructure Part Transferred Over Basement

This option is the same as Option B2, except that the Worcester Chambers superstructure is altered to reduce its overall weight and reduce the sizes and costs of the transfer beams, columns, walls and enhanced ground floor.

There are numerous variations possible that could involve one or more of the following:

(a) Remove heavy concrete first floor, and install new steel frames to laterally support the retained walls over their full height to roof level.

(b) Deconstruct the full superstructure, and reinstate with lightweight roof, walls, floors, frames and brick veneer to match the current aesthetic of the walls (although it is noted that this would impact the historic heritage that this option was seeking to retain.

It is Quoins opinion that the benefits of reducing the overall weight of the superstructure on the transfer beams and structure below ground level are likely to be offset by the added cost of removing the heavyweight structure and installing supplementary steel frames to allow the works to be undertaken.

The costs are likely to be similar or higher than Option B2, depending on the final extent of the works.

5.12.3. Option C: Full Retention

The structural requirements to retain the full footprint of Worcester Chambers are similar to Options B1, B2 and B3, except that the footprint of the retention is significantly larger.

The effects on the functionality of the spaces above and below ground are hugely significant, for whichever option is chosen.

From a structural perspective, the basement could be constructed in two sections, each side of Worcester Chambers, and linked together via a tunnel (or tunnels – one in each direction). This would at least require transfer beams and slab beneath the foundations of Worcester Chambers to act as a roof to the tunnel(s).

It is Quoin's opinion that any option to retain the full footprint of Worcester Chambers would result in a significant compromise to the functionality of the ground floor spaces, and a combination of significant additional costs and/or compromise to the functionality of the basement space.

6. Statutory Regulations Concerning Existing & Earthquake-Prone Buildings

This section highlights statutory requirements concerning existing and earthquake-prone buildings as laid out in the Building Act 2004, Building Code, and the Christchurch City Council's Earthquake-prone Building Policy 2010.

6.1. Building Act Requirements

The Building Act 2004 came into force on 31 March 2005 along with the Building Regulations. In considering the structure of existing buildings the relevant sections of the Act are as follows:

Section 124 – Powers of territorial authorities in respect of dangerous, earthquake-prone, or insanitary buildings.

If the Territorial authority is satisfied that a building is dangerous or earthquake prone, the Territorial Authority may:

(a) Put up a hoarding or fence to prevent people approaching the building;

(b) Place a notice on the building warning people not to approach the building; or

(c) Give written notice requiring work to be carried out on the building to reduce or remove the danger.

Section 122 – Meaning of earthquake-prone building

This section of the Act deems a building earthquake prone if its ultimate strength capacity would be exceeded, and the building would be likely to collapse causing injury or death, in a "moderate earthquake". The size of a "moderate earthquake" is defined in the Building Regulations as one third the size of the earthquake used to design a new building at that site.

Section 112 – Alterations to Existing Buildings

This section requires that after any alterations, the building shall continue to comply with the structural provisions of the Building Code to at least the same extent as before the alteration. This means that alteration work cannot weaken the building. Additional building strength would therefore be required where structural elements are to be removed or weakened, or additional mass to be added. The building will also need to be assessed in terms of the egress from fire, and access for persons with disabilities provisions of the Building Code and upgraded to comply, as nearly as is reasonably practicable.

Section 67- Waivers and Modifications

This section allows the Territorial Authority to grant a Building Consent subject to waivers or modifications of the Building Code. The Territorial Authority may impose any conditions they deem appropriate with respect to the waivers or modifications.

The Building Act was also altered by the Canterbury Earthquake (Building Act) Order 2010, which, amongst other things, gave additional powers to the Territorial Authorities, extended the definition of a dangerous building and extended the Schedule 1 list of building work exempt from Building Consent.

6.2. Christchurch City Council Requirements for Earthquake-Prone Buildings

The Christchurch City Council adopted a new policy for earthquake-prone buildings in September 2010.

The policy reflects the Christchurch City Council's determination to reduce earthquake risk to buildings and ensure that Christchurch "is a safe and healthy place to live in" and may be viewed on the CCC website.

In summary, the relevant items of the policy are as follows:

(a) Buildings are assessed using the New Zealand Society of Earthquake Engineering (NZSEE) guidelines with applied loadings from AS/NZS 1170.5 and are classed as earthquake prone if its strength is less than 33% of the applied loading from the loading standard AS/NZS 1170.5.

(b) It outlines the Council's approach to earthquake-prone buildings including identification, prioritisation, timeframes and implementation. In general, Importance Level 4 buildings (Post-disaster facilities, as defined by AS/NZS1170) will have 15 years from 1 July 2012 to either be strengthened or demolished. Importance Level 3 (crowd or high value) buildings will have 20 years and Importance Level 2 (normal) buildings will have 30 years. There are also additional triggers for requiring assessment and strengthening work to be undertaken at an earlier stage (including "significant" alterations or earthquake damage).

(c) The Council has a commitment to maintaining the intrinsic heritage values of Heritage buildings and has some discretion with regards to strengthening levels and methods. Each building will require discussion with Council Heritage team and Resource Consent prior to any strengthening or repair works being undertaken.

To date the Council has identified 67% of New Building Standard (NBS), or current Code, as the target level for strengthening of earthquake-prone buildings. However, the actual level of strengthening for each building can be agreed between the Council, the building owner and their insurer between the levels of 33% and 67% of current code, taking into account the following:

- The cost of strengthening
- Building use
- Level of danger presented by the building
- How much the building has been damaged

For buildings with a damaged building strength >33% of current code, it is recommended (but not required) that the building also be strengthened.

6.3. Recent Seismicity Changes for Christchurch

As a result of new information from the recent Canterbury earthquakes, changes have been made to Section B1 of the Building Code, increasing seismic code levels within areas covered by the Christchurch City, Selwyn District and Waimakariri District Councils. Such changes include:

- Increasing the zone hazard factor (Z) in AS/NZS1170.5 from 0.22 to 0.3, and serviceability limit state risk factor (R_s) from 1.25 to 1.33.
- Replacing Section 5 of NZS3604:1999 with NZS3604:2011 Section 5, adopting Earthquake Zone 2.

These changes came into effect on the 19th May 2011 and are interim code levels pending further seismological study and investigation. For further information on other changes refer:

http://www.dbh.govt.nz/information-sheet-seismicity-changes.

If you have any queries regarding the above Structural Assessment Report, please do not hesitate to contact the undersigned.

Yours sincerely
Quoin Structural Consultants Limited

Brett Gilmore B.Eng (Hons)(Civil)
Senior Structural Engineer &
Director
MIPENZ; CPEng (# 139988)
PE (USA), Int PE

Appendix A: Existing Building Plans & Drawings

Harley Chambers

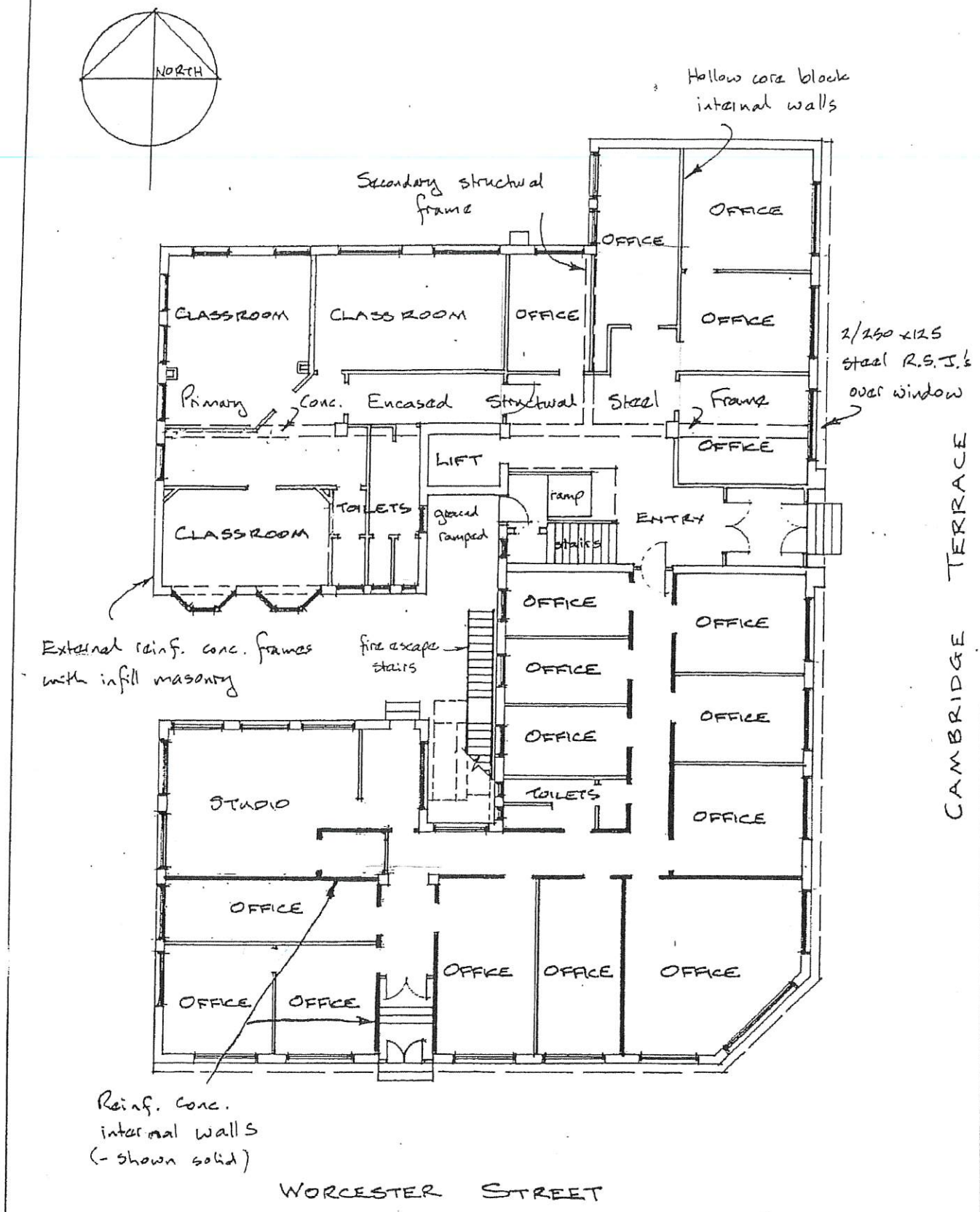
Existing Drawings

1.1 Main Building Plans (Scale 1:200 @ A4)

- SK00 Existing Ground Floor Plan
- SK01 Existing First Floor Plan
- SK02 Existing Second Floor Plan

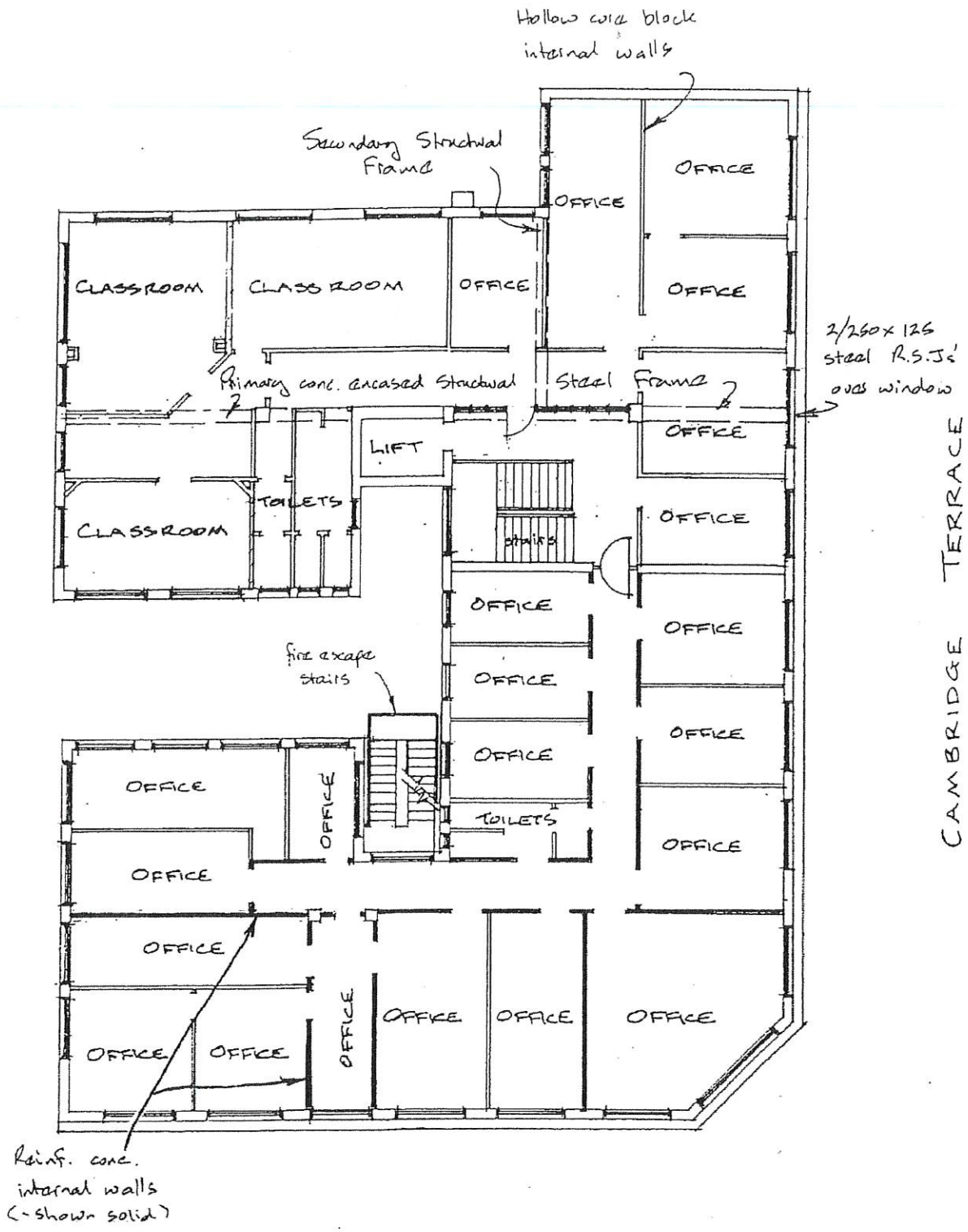
1.2 North Section (Scale 1:100 @ A3)

- SK1 Existing Ground Floor Plan
- SK2 Existing First Floor Plan
- SK3 Existing Second Floor Plan
- SK4 Existing Basement & Sections A-B
- SK5 Existing Basement & Sections E-F
- SK6 Existing Typical Floor Beam & Stair Details



'HARLEY CHAMBERS' - GROUND FLOOR PLAN

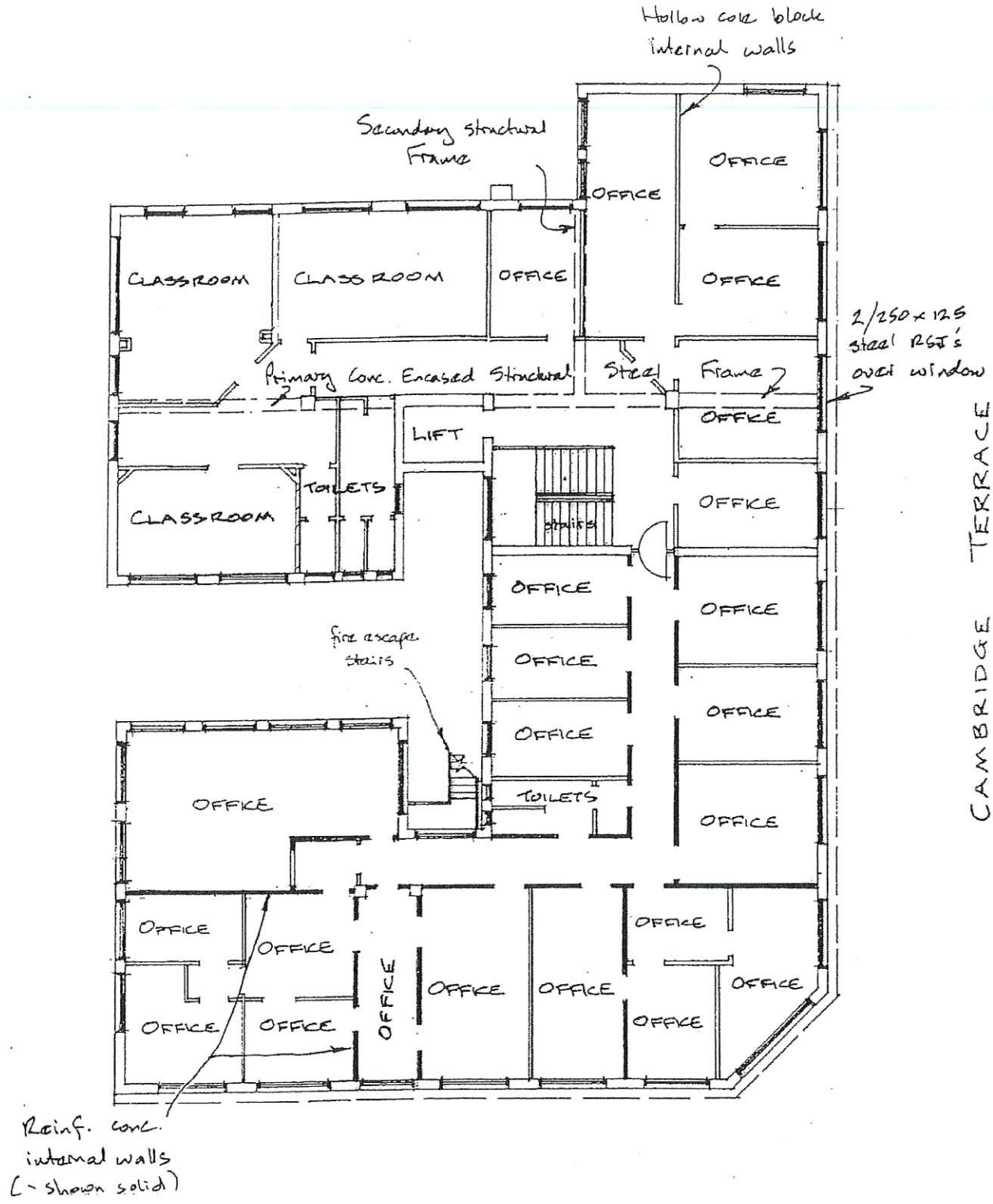
Quoin 03 968 4925 quoin.co.nz	SCALE: 1:200 (A4)	DRAWN:	BAG	SK00
	DATE: 24-7-2015	APPROVED.		



'HARLEY CHAMBERS' - FIRST FLOOR PLAN

Quoin
03 968 4925
quoin.co.nz

SCALE: 1:200 (A4)	DRAWN:	BAG	SK01
DATE:	APPROVED:		



'HARLEY CHAMBERS' - SECOND FLOOR PLAN

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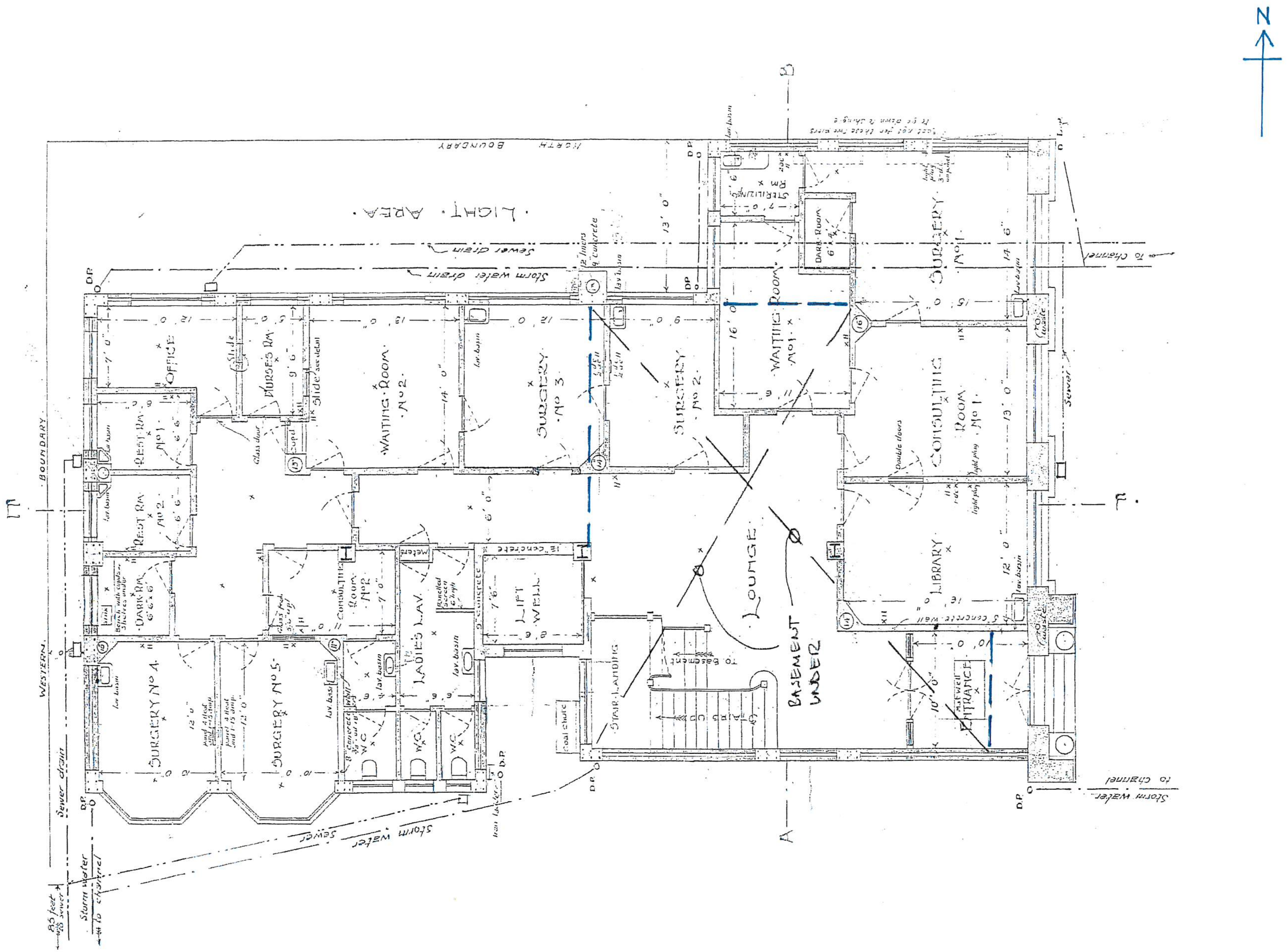
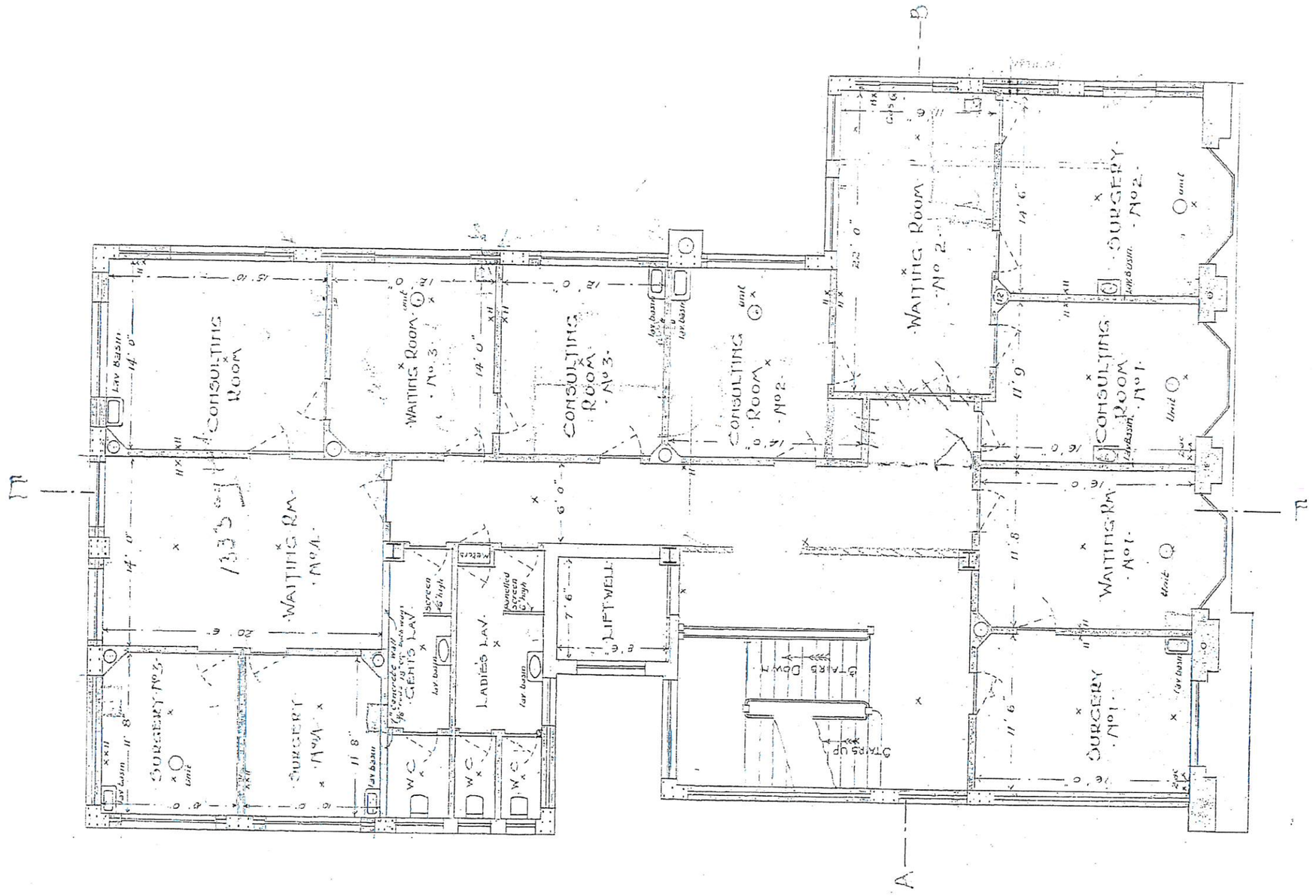
DATE:	APPROVED:		



Issue		By	Appd	Date	Drawn	Designed	Approved	Scales	Client	Project Title			Drawing Title	Drawing no	Issue
0	Preliminary Information	BG		23.09.2011	BG	BG	BG	1:100	Lee Pee Limited	Harley Chambers	Quoin	03 968 4925 quoin.co.nz	Existing Ground Floor Plan North Building	SK1	Project 10490 0



0 Issue	Preliminary Information	BG By		23/09/2011 Date	BG Drawn	BG Designed	BG Approved	1:100 Scales	Lee Pee Limited Client	Harley Chambers Project Title

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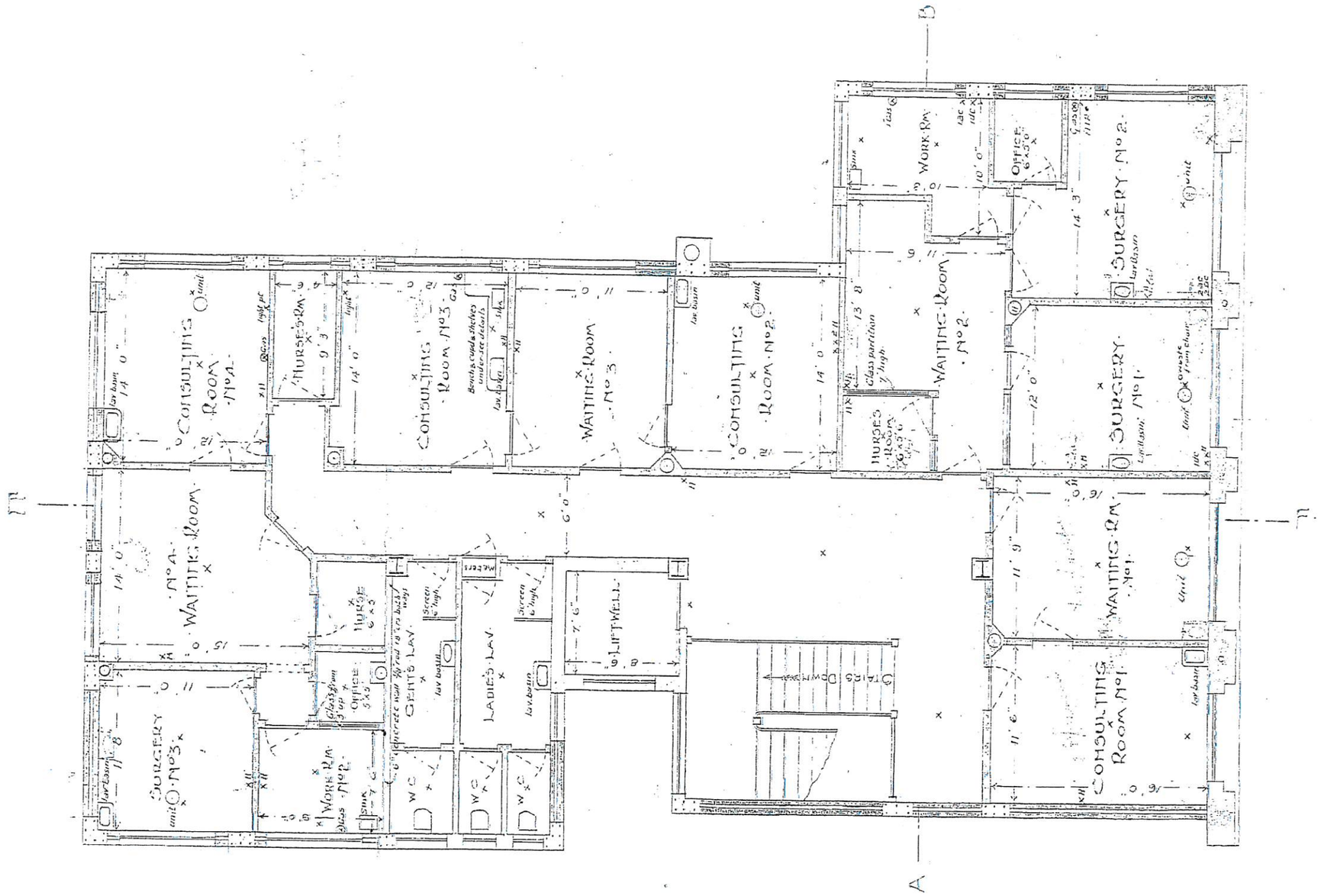
Existing First Floor Plan North Building Drawing Title	SK2 Drawing No.	Project 17490	0 Issue



0 Issue	Preliminary Information	BG By	Appd	23.09.2011 Date	BG Drawn	BG Designed	BG Approved	1:100 Scales	Lee Pee Limited Client	Harley Chambers Project Title	Quoin

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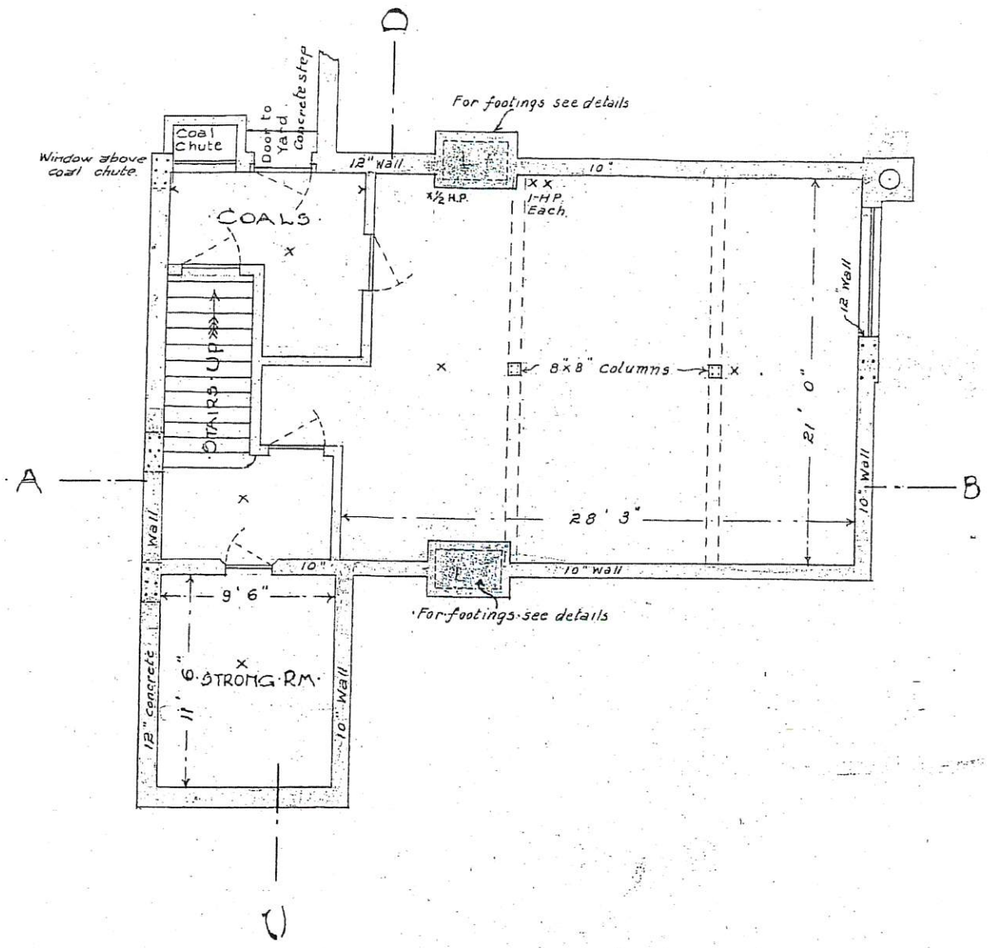
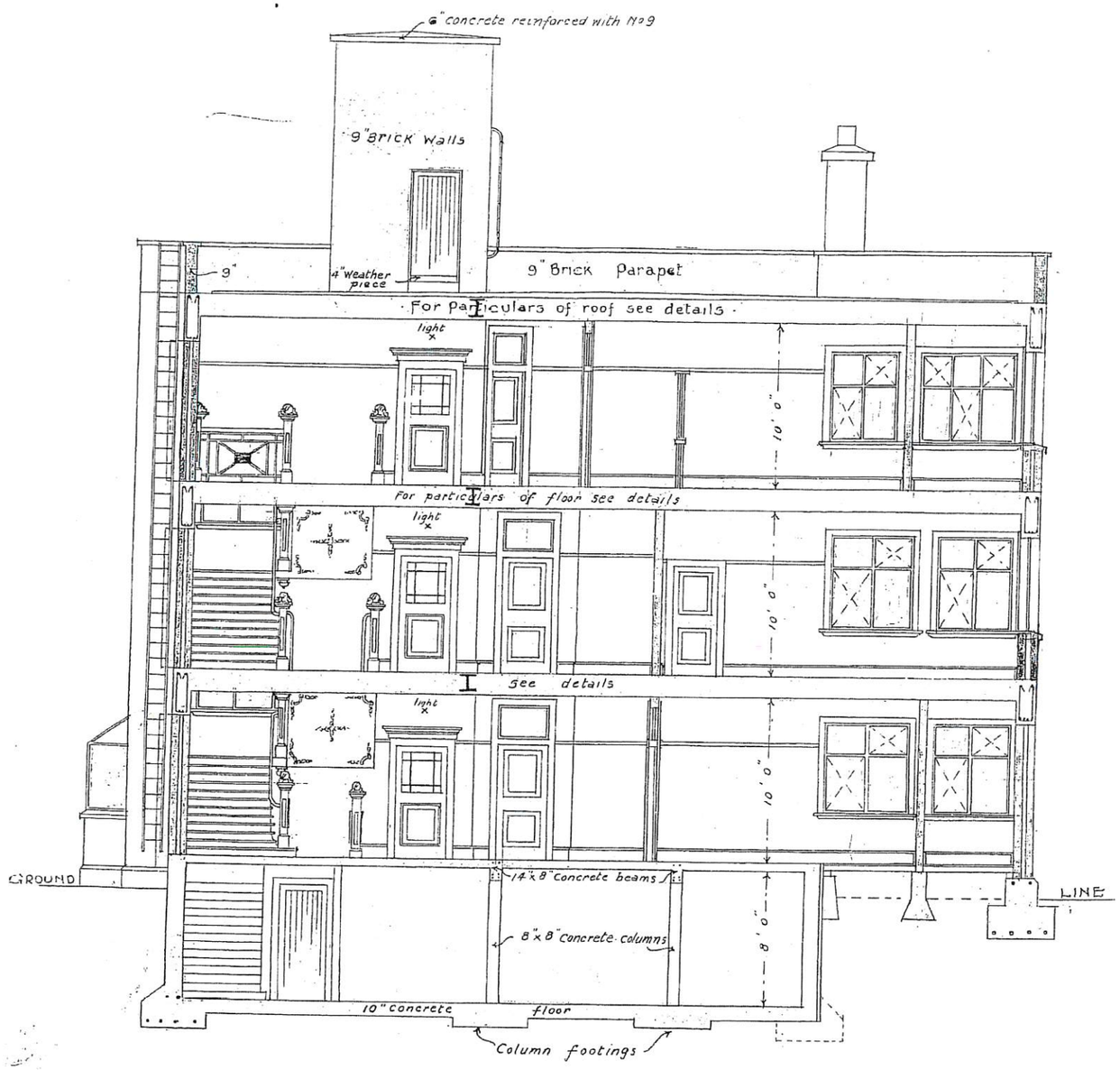
Existing Second Floor Plan North Building Drawing Title	SK3 Drawing No.	Project 1049C / 3 Issue



BASEMENT PLAN

SCALE 1/8" = ONE FOOT



TRANSVERSE SECTION A B

0 Issue	Preliminary Information	BG By	Appd.	23/09/2011 Date	BG Drawn	BG Designed	BG Approved	1:100 Scales	Lee Pee Limited Client	Harley Chambers Project Title	

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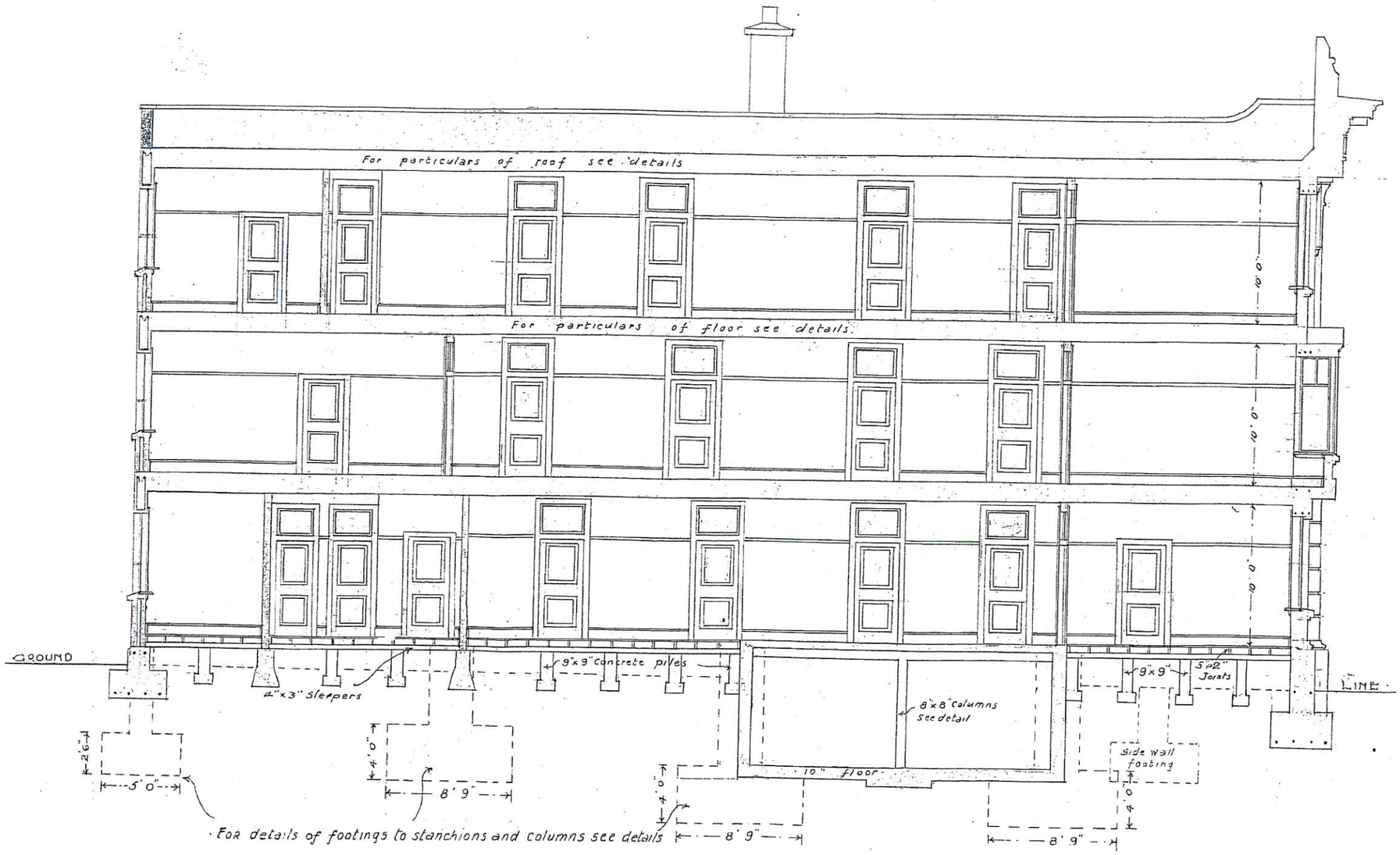
Existing Basement Floor Plan and Section A-B - North Building
Drawing Title

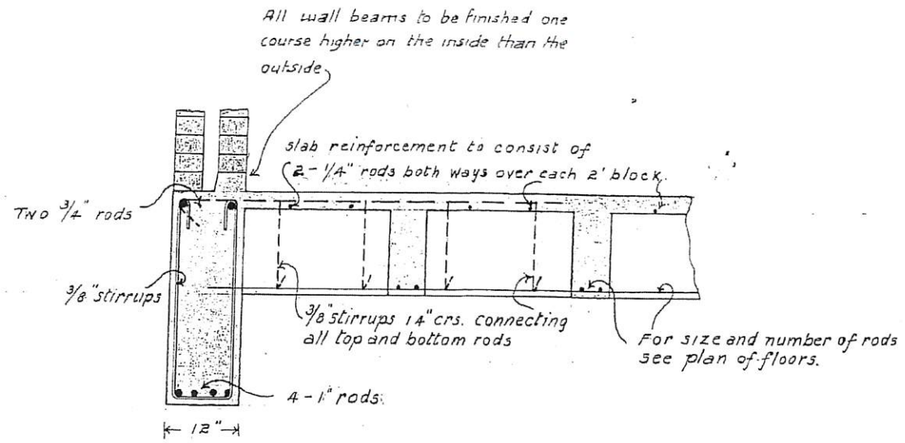
SK4
Drawing No.

Project 10490
Issue 0



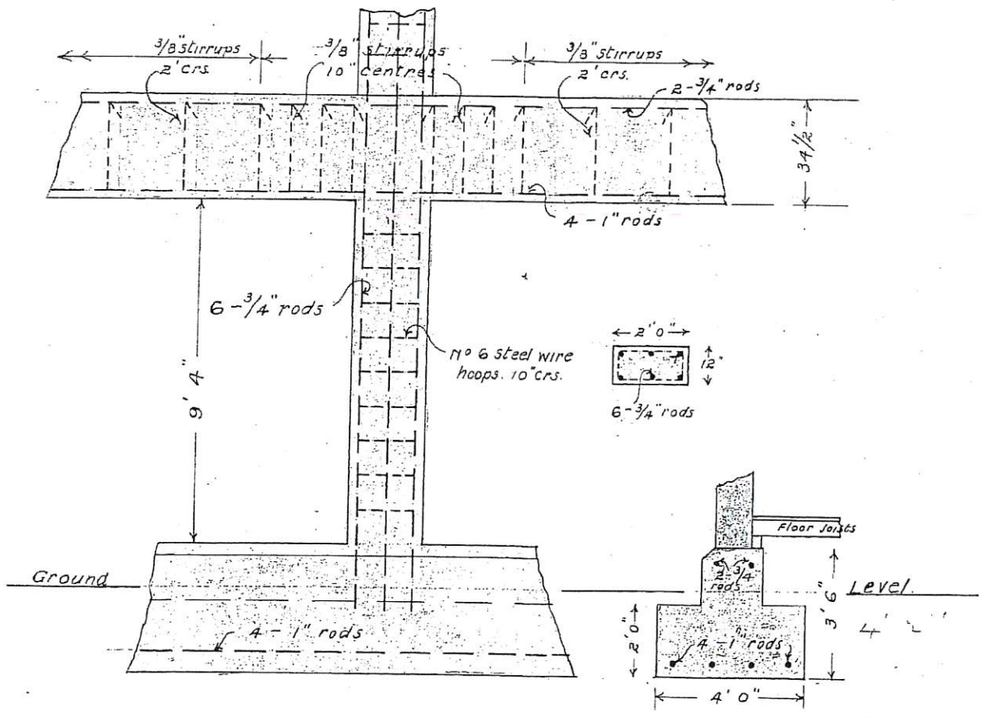
LONGITUDINAL SECTION E-F

0 Issue	Preliminary information	BG By	Appd.	23/09/2011 Date	BG Drawn	BG Designed	BG Approved	1:100 Scales	Lee Pee Limited Client	Harley Chambers Project Title	Quoin 03 968 4925 quoin.co.nz	Existing Section E-F North Building Drawing Title	SK5 Drawing No.	Project 10490 / 0 Issue



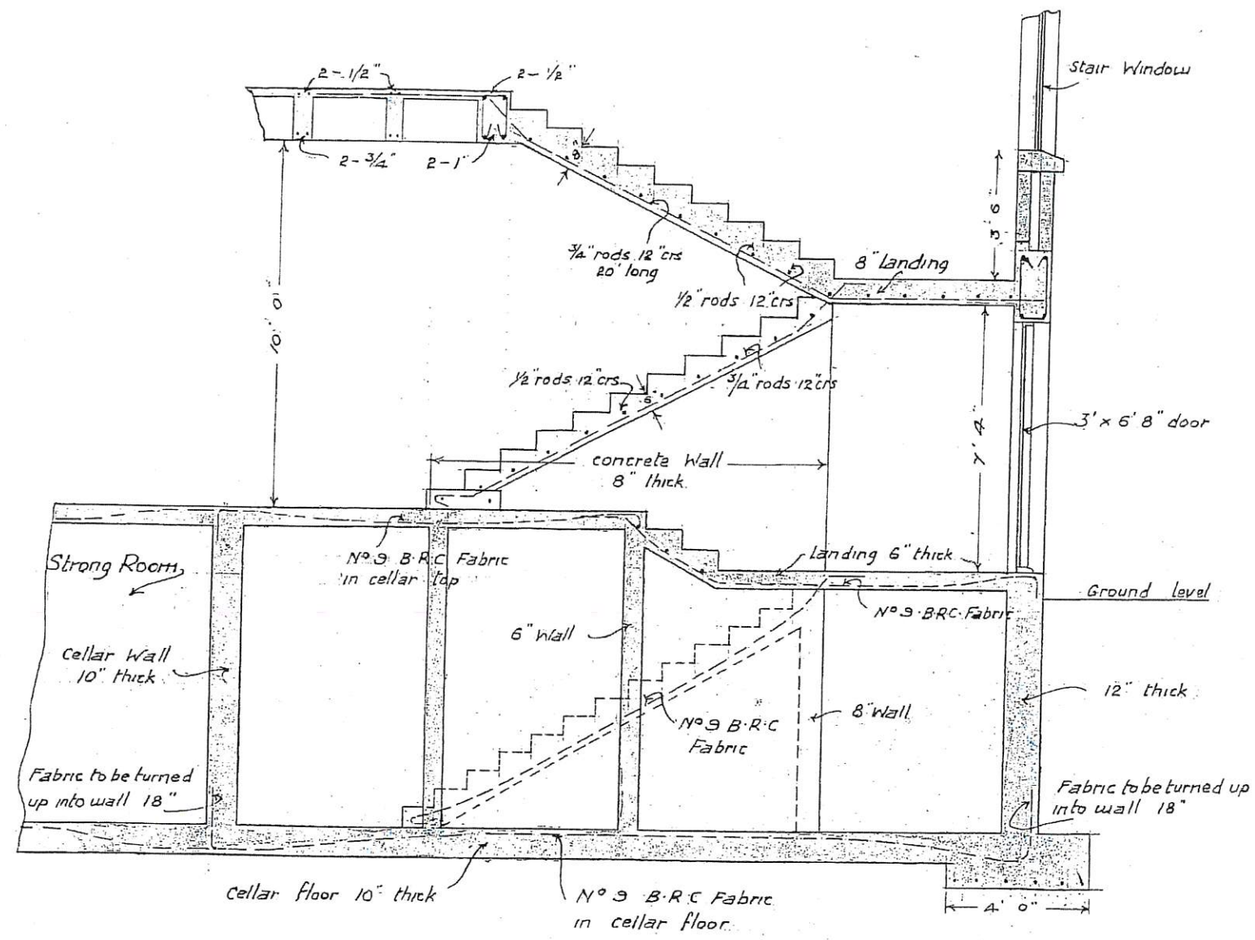
WALL BEAM DETAILS and SLAB SECTION

1/2" SCALE



TYPICAL DETAILS OF WALL COLUMNS and FOUNDATIONS

SCALE 1/4"



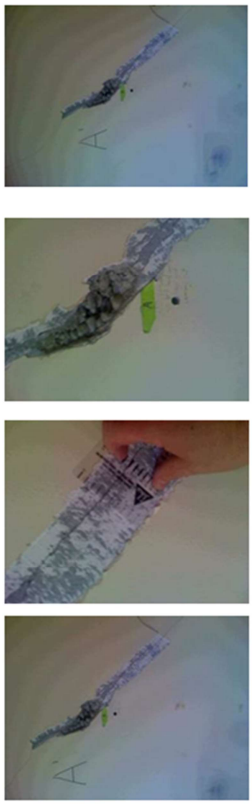
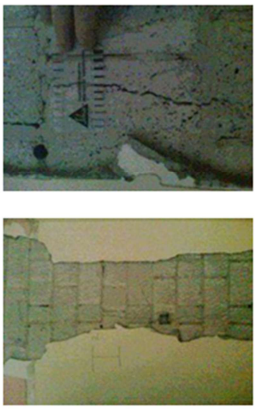
DETAIL OF STAIR REINFORCEMENTS

SCALE 1/4"

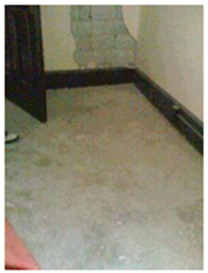
0 Issue	Preliminary Information	BG By	Appd.	23/09/2011 Date	BG Drawn	BG Designed	BG Approved	AS SHOWN Scales	Lee Pee Limited Client	Harley Chambers Project Title	Quoin 03 968 4925 quoin.co.nz	Typical Floor, Beam, and Stair Details North Building Drawing Title	SK6 Drawing No.	Project 10490 / 0 Issue

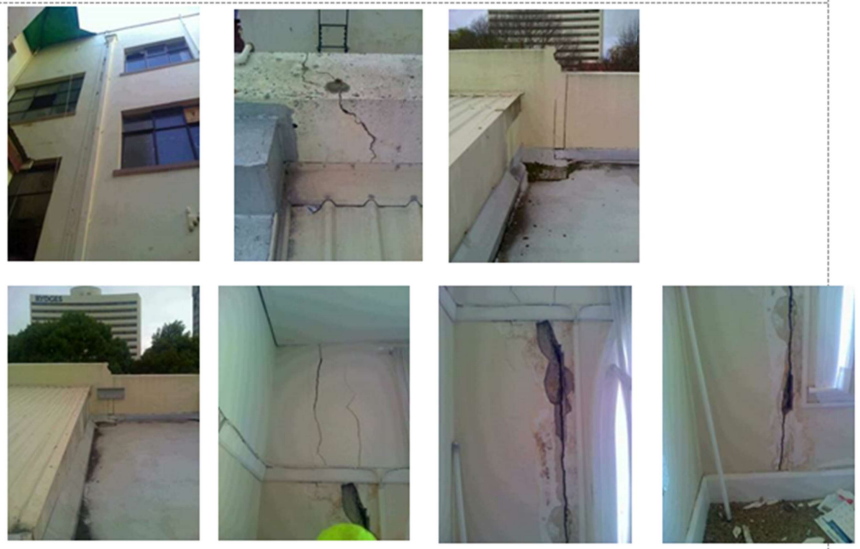
Appendix B: Summary of Earthquake Damage to North Section of Building

Harley Chambers

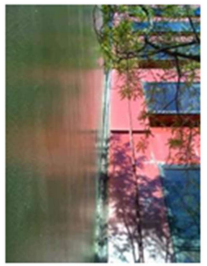
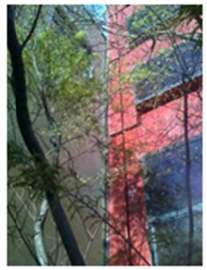
Location	Earthquake Damage	Repair Option(s)	Photo
1-Wall A	Crack in concrete wall with plaster finish	• Epoxy resin injection to reinstate • Concrete is weak & boney, so consideration should be given to replacing this wall	
2-Wall I2	Crack in masonry block wall	• Epoxy resin injection to reinstate • Recommend remove & replace	
3-Wall 02	Crack in masonry block wall	• Epoxy resin injection to reinstate • Recommend remove & replace	

Location	Earthquake Damage	Repair Option(s)	Photo
4-Wall J2	Crack in masonry block wall	• Epoxy resin injection to reinstate • Recommend remove & replace	
5-Wall P4	Crack in masonry block wall	• Epoxy resin injection to reinstate • Recommend remove & replace	 
6-Wall R4	Crack in masonry block wall	• Epoxy resin injection to reinstate • Recommend remove & replace	  

Location	Earthquake Damage	Repair Option(s)	Photo
7-Wall R1	Crack in masonry block wall	• Epoxy resin injection to reinstate • Recommend remove & replace	 
8-Wall C1	Crack in masonry block wall	• Epoxy resin injection to reinstate • Recommend remove & replace	
9-Floor	Cracks in concrete suspended floor	• Epoxy injection	

Location	Earthquake Damage	Repair Option(s)	Photo
10-Junction of north & south building sections	Junction between the north & south building sections has opened up over the full height & width of the building	• Break out part sections of the main structural walls, floors and parapets, and reinstate with new tie connections with epoxied reinforcing	
11-Wall B2	Crack in brick wall & finishes	• Remove brick wall and replace with new reinforced concrete wall over full height & width of building for both walls B1 & B2	

Location	Earthquake Damage	Repair Option(s)	Photo
12-Lift Shaft	The top portion of the lift shaft above roof level comprises of brick wall construction with a concrete slab roof. The walls were severely damaged above roof level and have been removed. The walls were temporarily secured following the 26 December 2010 earthquake. Some cracks observed in the walls to the lift shaft below roof level.	• Reconstruct the lift shaft walls as new reinforced concrete down to 2nd floor level as part of the repair to reinstate • Recommend that consideration to reconstruct walls down to ground level as part of overall repair	
13-Parapets	Some cracks noted at base of parapet to exterior of north-east corner along east elevation of south section of building	• Provide additional lateral support to parapets or remove and replace	

Location	Earthquake Damage	Repair Required	Photo
14-Expansion joint to north boundary & building	Expansion joint between Harley Chambers & the adjacent north building needs to be inspected in detail.	• Reinstate joint	 
15-Floor at north east corner	Floor is out of level at ground floor indicating that some settlement of the foundations has occurred.	• Re-level affected area of floor	
16-Basement	Several cracks noted in the basement walls with water ingress through cracks due to new spring	• Epoxy injection and consider application of waterproof tanking to inside face of walls and floor	
17-Non-structural elements	Structex have not inspected the non-structural elements in any detail. These include but are not limited to: • wall/floor/ceiling finishes • windows and doors • services/electrical/mechanical, water, power etc • lift		

Appendix C: Floor Level Survey & Wall Investigations

Harley Chambers

Sketches

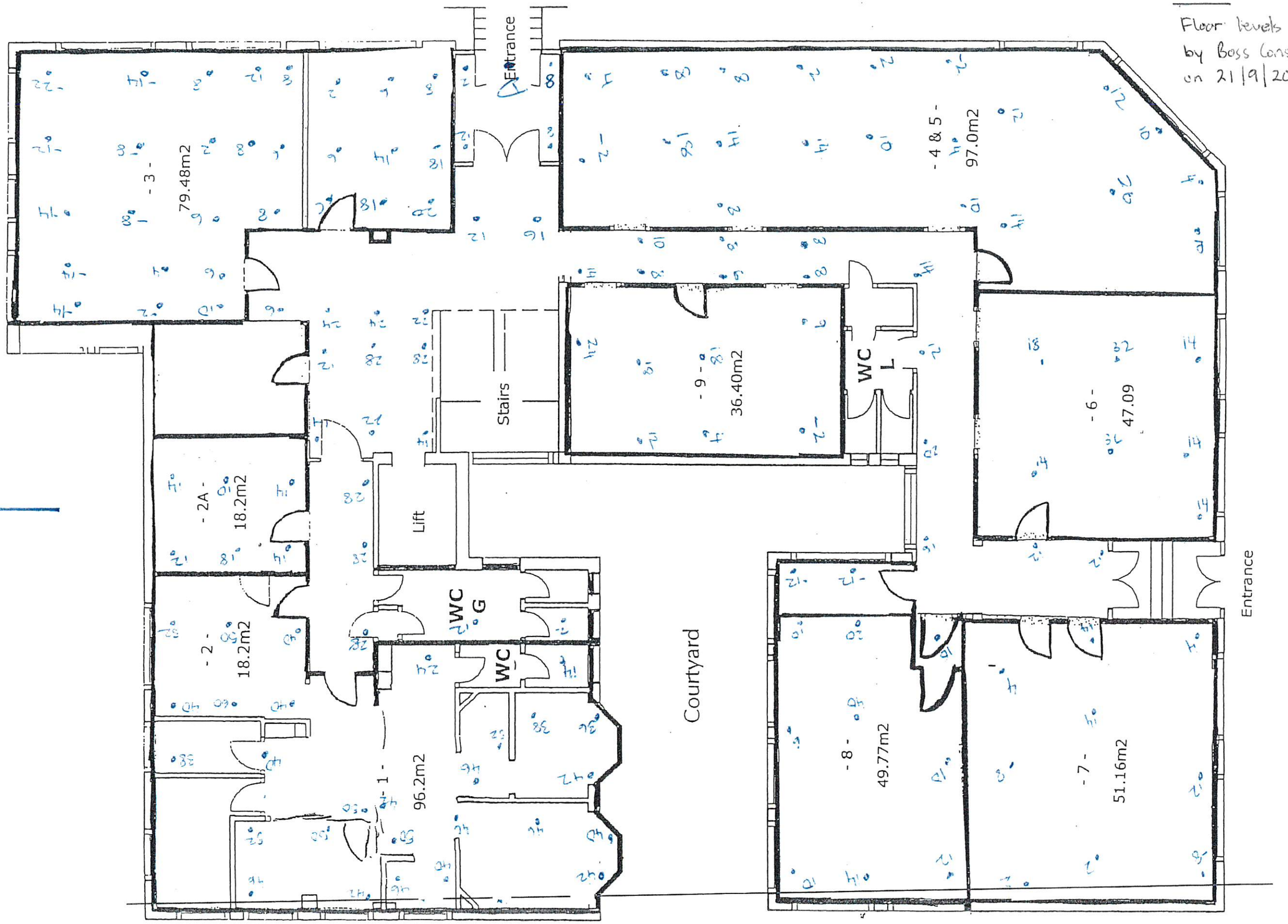
SK08 Floor Levels on Existing Ground Floor

SK09 Floor Levels on Existing First Floor

SK10 Existing Ground Floor Plan – North Building – Wall Information

Note:

Floor levels completed by Boss Construction on 21/9/2011



0 Issue	Preliminary Information	BG By	Appd.	23/09/2011 Date	BG Drawn	BG Designed	BG Approved	1:100 Scales	Lee Pee Limited Client	Harley Chambers Project Title	Quoin 03 968 4925 quoin.co.nz	Floor Levels on Existing Ground Floor Plan Drawing Title	SK8 Drawing No.	Project 10490 / 0 Issue

Note

Floor levels completed by Boss Construction on 21/9/2011

N

- 12B - 18.2m2
- 12C - 18.2m2
- 12A - 18.2m2
- 11 - 20.61m2
- 13 & 14 - 157.86m2
Stairs
Lift
WC G
WC L
- 10 - 42.88m2
- 20 - 36.40m2
WC L
- 16 - 21.30m2
- 15 - 39.37m2
- 17 - 41.42m2
Courtyard
- 19B - 29.34m2
- 19A - 15.03m2
- 18 - 49.97m2

0 Issue	Preliminary Information	BG By	Appd.	23/09/2011 Date	BG Drawn	BG Designed	BG Approved	1:100 Scales	Lee Pee Limited Client	Harley Chambers Project Title	

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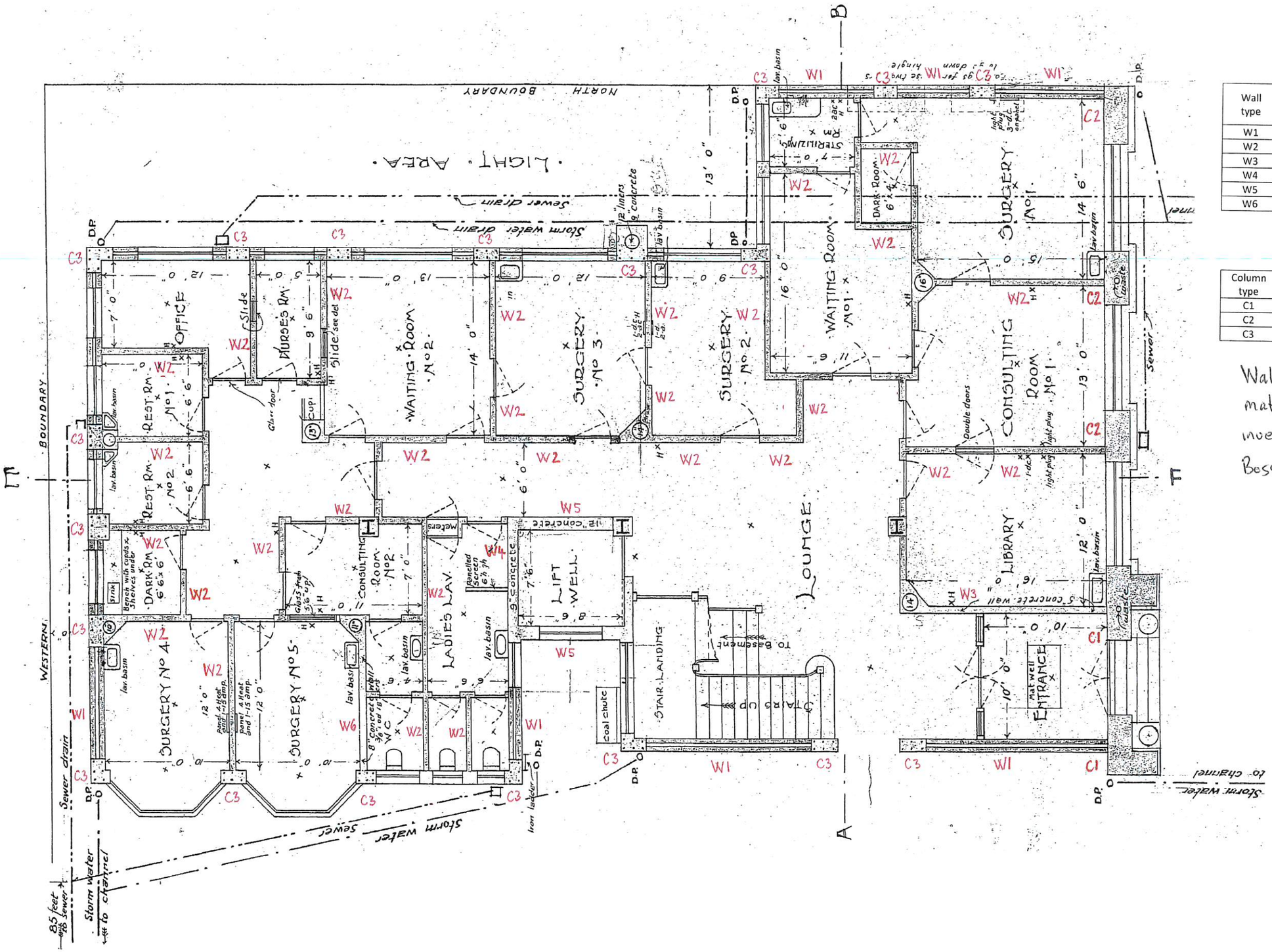
Floor Levels on Existing First Floor Plan	SK9	Project 10490
Drawing Title	Drawing No.	0 Issue



Wall type	Overall Thickness (mm)	Material
W1	350	120 brick + 110 cavity + 120 brick
W2	130	hollow masonry block
W3	127	solid reinforced concrete
W4	230	solid reinforced concrete
W5	305	solid reinforced concrete
W6	200	solid reinforced concrete

Column type	Dimensions (mm)	Material
C1	1600 x 660	reinforced concrete
C2	1200 x 660	reinforced concrete
C3	600 x 330	reinforced concrete

Wall types, thicknesses and materials confirmed by investigation with Boss Construction

N

0 Issue	Preliminary Information	BG By	Appd.	23/09/2011 Date	BG Drawn	BG Designed	BG Approved	1:100 Scales	Lee Pee Limited Client	Harley Chambers Project Title	Project 10490

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Existing Ground Floor Plan
North Building - Wall Information
Drawing Title

SK10 Drawing No.

Issue 0

Appendix D: Earthquake Repairs Summary Table

Harley Chambers

HARLEY CHAMBERS - EARTHQUAKE DAMAGE AND REPAIRS

Item No	Earthquake Damage	Earthquake Repair Strategy Comments
1	**Earthquake Damage - Structural**	**Comments**
101	Cracks in basement walls, resulting in leaking and pooling of approx 400-600mm of water.	Basement to be demolished, removed and reconstructed. This strategy is the only strategy that repairs the basement to its pre-earthquake watertight condition. Our recent experience with similar damaged basements is that Contractors are unable to provide guarantees for water tightness unless reconstructed. Refer supplementary notes on sketch SKR11 for reconstruction methodology, and sketches SKR5 - SK10 inclusive.
102	North Section settlement of foundations, resulting in foundations and timber ground floor framing not being level. Levels vary 82mm across the North Section footprint.	Allow for underpinning and jacking of foundations using steel screw piles to approximately 3.5m depth below ground level. Note that this excludes area of basement - refer Item 101. Interior piles supporting timber floor only and strip footings to Bell Block walls to be reconstructed. Quoin to confirm extent by sketches. Refer sketch SKR1 and attached screw pile information. Allow for 40 piles to be jacking piles, plus allow to grout 50mm beneath 90sm of foundation. Refer sketch SKR21 for methodology. Sketch SKR1 updated to substitute 310 UC's for 500 x 500 concrete underpinning beam.
103	South Section settlement of foundations, resulting in foundations timber ground floor framing not being level. Levels vary 52mm across the South Section footprint	Allow for underpinning and jacking of foundations using steel screw piles. Lesser number of jacking piles required than North Section. Interior piles supporting timber floor only to be reconstructed. Quoin to confirm extent by sketches. Refer attached sketch SKR12 and attached screw pile information. Allow for 8 piles to be jacking piles, plus allow to grout 30mm beneath 40sm of foundation. Refer to sketch SKR21 for methodology.
104	Cracks in concrete floor slab at ground floor over basement	This slab removed and reconstructed as part of basement reconstruction.
105	Cracks in interior masonry Bell block partition walls - North Wing	Remove all block partition infill walls. Reinstate with 140mm masonry block, solid filled, reinforced with H12@400 ew. Drill + epoxy H12 starters, 1000mm lg, 200mm into all adjacent columns, beams, floors and foundations. Refer to sketches SKR2/R3 and R4. Allow to construct 50m of 150mm wide x 350mm deep rib in 0.6m long sections within existing first and second floors to accommodate starters for block walls that do not align with existing floor ribs. Refer to sketch SKR20.
106	Cracks in interior concrete partition walls - South Wing. Refer to attached sketches SKR14/R15 and R16 for general extent.	Epoxy inject cracks. Allow for 100 lineal metres.
107	Cracks in interior double brick walls along interior wall line between North and South Wings	Remove brick infill. Reinstate with 240mm masonry block, solid filled, reinforced with H12@400 ew. Drill + epoxy H12 starters, 1000mm lg, 200mm into all adjacent columns and beams. New block infill constructed over new basement wall. Refer sketches SKR2/R3 and R4.
108	Cracks in concrete shear wall at north side of entry lobby in North Wing.	This wall removed and reconstructed as part of basement reconstruction. Refer sketch SKR2.
109	Cracks in exterior plastered double brick walls - North Wing	Remove brick infill as shown on sketches. Reinstate with 240mm masonry block, solid filled, reinforced with H12@400 ew. Drill + epoxy H12 starters, 1000mm lg, 200mm into all adjacent columns, beams, floors and foundations. Refer to sketches SKR2/R3 and R4. Sketches SKR2/R3 and R4 updated to include repairs to brick walls (BWR) using Helifix ties, plus epoxy injection, plus removal and reinstatement of interior 25mm plaster.
110	Cracks in exterior plastered double brick walls - South Wing	Investigation confirmed that exterior cracks do not generally penetrate the bricks. Some damage was noted in brick walls to the south-east corner of the second floor level. Allow to remove and replace 5.0m of brick wall beneath four windows in the south section, similar to Item 109.
111	Cracks in concrete exterior beams and columns to entire North Elevation of North Wing. These beams and columns extensively cracked compared to most other beams and columns.	Investigations confirmed that cracks do not appear to penetrate into the beams and columns. Two concrete columns at the ground floor level have damage. Recommend reconstruct between foundation and first floor beam. Refer sketch SKR2.
112	Cracks in plastered concrete columns (exterior) - North Wing (excludes Item 111 above).	Epoxy inject cracks. Investigations confirmed that cracks in plaster do not appear to penetrate the concrete. Assume a nominal amount of cracks in concrete to be epoxy injected (25m).
113	Cracks in plastered concrete beams (exterior) - North Wing (excluding Item 110 above)	Epoxy inject cracks. Investigations confirmed that cracks in plaster do not appear to penetrate the concrete. Assume a nominal amount of cracks in concrete to be epoxy injected (25m).
114	Cracks in plastered concrete columns (exterior) - South - Wing	Epoxy inject cracks. Investigations confirmed that cracks in plaster do not appear to penetrate the concrete. Assume a nominal amount of cracks in concrete to be epoxy injected (25m).
115	Cracks in plastered concrete beams (exterior) - South - Wing	Epoxy inject cracks. Investigations confirmed that cracks in plaster do not appear to penetrate the concrete. Assume a nominal amount of cracks in concrete to be epoxy injected (25m).
116	Cracks in concrete floors - Refer to attached sketches SKR15 and SKR16 for extent of cracks observed in rooms where carpets lifted.	Epoxy inject cracks. Estimate 180m at first floor level, and 340m at second floor level. Some cracks appear old and some appear new caused by earthquakes. The extent of cracks reduces the strength of the floor to act as a diaphragm.
117	Cracks and damage to North double brick parapet wall directly adjacent to boundary (removed as part of partial S38 works)	Reinstate with 240mm masonry block, solid filled, reinforced with H12@400 ew. Drill + epoxy H12 starters, 1000mm lg, 200mm into all adjacent column piers and beams. 240 block is closest 'like for like'. Refer to sketch SKR4.
118	Cracks and damage to double brick parapet walls - North Wing	Reinstate with 240mm masonry block, solid filled, reinforced with H12@400 ew. Drill + epoxy H12 starters, 1000mm lg, 200mm into all adjacent column piers and beams. 240 block is closest 'like for like'. Refer to sketch SKR4. Sketch SKR4 updated to include repair comprising of cut-down top of parapet and form concrete bond beam with epoxied bars.
119	Cracks and damage to double brick parapet walls - South Wing	Damage to parapets not as extensive as north wing. Allow to repair 2 bays of parapet the same as Item 118 with formed concrete bond beam.
120	Cracks to plastered concrete parapet walls - North Wing - Cambridge Tce frontage	Epoxy inject cracks. Allow for 20m.
121	Cracks to plastered concrete parapet walls - South Wing - Cambridge Tce and Worcester Boulevard frontages	Epoxy inject cracks. Allow for 20m.

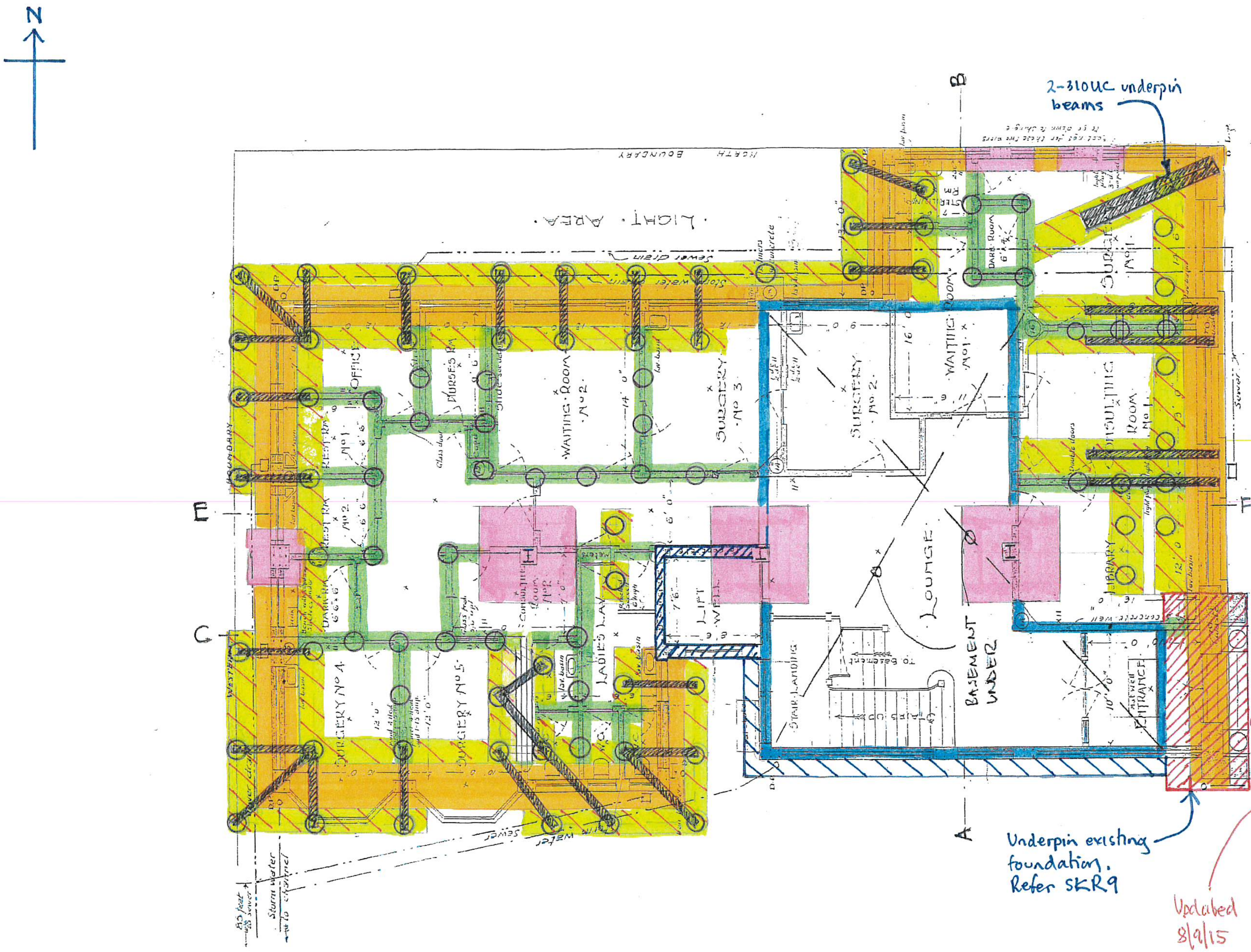
122	Spalling and/or separation of vertical joint between North and South wings - East End	Ensure that North and South Sections are well tied together. Quoin to propose details. Refer to sketches SKR17 and SKR18. Fill joint gaps with grout.
123	Spalling and/or separation of vertical joint between North and South wings - West End	Ensure that North and South Sections are well tied together. Quoin to propose details. Refer to sketches SKR17 and SKR18. Fill joint gaps with grout.
124	Separation of floor and roof joints between North and South wings.	Ensure that North and South Sections are well tied together. Quoin to propose details. Refer to sketches SKR17 and SKR18. Fill joint gaps with grout.
125	Cracks and damage to double brick walls to lift shaft above roof level (removed as part of emergency safety works)	Reinstate with 270mm (average thickness) reinforced concrete wall, reinforced with H12@300 ew, ef. Refer sketch SKR9.
126	Cracks to double brick walls to lift shaft between Level 2 to roof level	Demolish this section of lift shaft walls to allow reconstruction of walls above per Items 125 and 101. Reinstate with 270mm (average thickness) wall, reinforced with H12@300 ew, ef. Drill + epoxy H12 starters at 400crs, 1000mm lg, 200mm into existing floors. Refer to sketch SKR9.
127	Cracks to concrete walls to lift shaft between Foundation level and Level 2	Demolish lift shaft and reconstruct as part of basement reconstruction. Refer to sketches SKR1/R2/R3/R4 and R9.
128	Roof slab to lift shaft (previously removed as part of emergency works).	Reinstate as 150mm thick insitu concrete slab, reinforced with H12@250crs ew, and tie into shaft walls. Reinstate light roof cladding on timber battens over slab. Install new 200UB30 lifting beam.
129	Cracks in soffit to main stairs at top of each flight (concrete)	Epoxy inject cracks and install steel plates per Endel Lust scope. Refer to sketch SKR19.
130	Temporary gravity propping to allow repair works to be undertaken (Items 101,105, and 111).	Significant propping required to North Section. Stx to describe in further detail. Allow to provide average of 2 x 3T acrow props spaced at 1.0m centres x 250m spread over three floors.
131	Temporary lateral propping (steel braces) to allow repair works to be undertaken for North Section.	Significant propping required to North Section. Bell block walls and lift shaft walls provide main lateral resistance and these are to be removed and reconstructed. Recommend allow to provide the following steel braces with 20mm "L" end plates and 8 x M16 epoxied bolts per end plate. 6-200 x 6 SHS x 8.5m long 18-150 x 6 SHS x 6.7m long 24-150 x 6 SHS x 4.6m long
2	**Earthquake Damage - Non-Structural**	**Comments**
201	Cracks to ceiling finishes - North Wing	Allow to remove all ceilings and reinstate. This also allows full assessment of floors and repairs to masonry block partitions to be undertaken, plus repairs to floor where required.
202	Cracks to ceiling finishes - South Wing	Allow to remove all ceilings and reinstate. This also allows full assessment of floors and repairs to masonry block partitions to be undertaken, plus repairs to floor where required.
203	Cracks to interior light weight wall finishes not noted in other items - North Wing	Allow to remove all wall finishes and reinstate.
204	Cracks to interior light weight wall finishes not noted in other items - South Wing	Allow to remove all wall finishes and reinstate.
205	Cracks to exterior plaster finishes	Remove damaged sections as part of Items 112, 113, 114, 115, 118, 119, 120, 121 and reinstate. Allow for 350m to east, south and west elevations. The north elevation is worst affected and recommend remove all plaster to beams and columns and reinstate (170sm).
206	Broken windows	Replace as required. This will require use of Flemish glass in many of the locations.
207	Broken windows in office doors as part of earthquake emergency services	Replace as required. This will require use of Flemish glass in many of the locations.
208	Damage to expansion joint flashings between Harley Chambers and building at North Boundary	Noted that there is now a new building adjacent to the boundary with Harley. Allow for new joint flashings as required.
209	Jammed and/or misaligned interior and exterior doors	Remove/reinstall as required to suit damage and repairs to other elements. Remove temporary store as part of repairs. Refer to Item 405 for temporary removal of all doors.
210	Movement gaps/cracks to interior finishes(architraves, skirtings, etc)	Remove/replace as required to suit damage and repairs to other elements.
211	Removal and reinstatement of all interior floor finishes. Floor finishes suffered extensive damage (pigeon droppings, ingress of moisture, etc)	Removal also allows full assessment of floors, plus repairs to masonry block partition walls, and cracks in floors.
212	Check metal roof cladding to North wing. Allow for disruption for repairs.	As noted. This will require removal and reinstatement to all perimeter sections adjacent parapet and lift shaft repairs and reconstruction. Replace any damaged areas. Refer repair items 118, 119, 125.
213	Remedial works to roof membrane as part of repairs to parapets and tied joint between North and South Sections. (Items 118/119 and 122/123/124)	As noted.
3	**Structural Repairs for 34% x NBS - Additional to Above**	**Comments**
301	Floor slab edges remedial works to ensure adequate tie between perimeter beams and infill masonry block walls and floor diaphragms	Stx to review
302	Floor slab remedial works to ensure adequate tie between interior masonry block walls and floor diaphragms	Stx to review
303	Check floor slabs for adequate diaphragm capacity.	Stx to review
304	Allow to install glass panels to sides of main access stair to achieve compliance as part of Building Consent.	As noted.
305	Allow to install accessible toilets on the ground floor level to achieve compliance for Building Consent. Likely involve alterations to existing partition walls and plumbing etc.	As noted.

Appendix E: North Section Repair Sketches

Harley Chambers

North Section Repair Sketches (Scale 1:100 @ A3)

- SKR1 Pile Underpinning & Foundation Plan
- SKR2 Ground Floor Plan
- SKR3 First Floor Plan
- SKR4 Second Floor Plan
- SKR5 Basement Reconstruction Plan & Section A-B
- SKR6 Basement Reconstruction - Section E-F
- SKR7 Ground Floor Plan – Temporary Transfer Truss & Beams
- SKR8 Temporary Transfer – Section E-F
- SKR9 Temporary Transfer Truss & Beams – Section C-D
- SKR10 Temporary Beams to Support Stair & South Wall – Section A-B
- SKR11 Basement Reconstruction Methodology
- SKR12 Cracks in Walls to Lift Shaft (A4 Sketch for reference)
- SKR19 Repairs to Main Stairs
- SKR20 Floor Details for New Block Partition Wall



NOTES

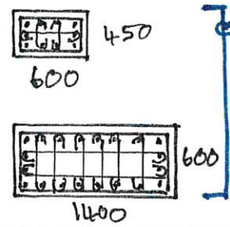
1. Existing deep pads under columns
2. Existing shallow depth strip footings 1200mm wide
3. Location of reconstructed Basement walls
4. Lift shaft walls and pit to be reconstructed
5. Existing footings removed beneath Bell block walls and reconstructed as new 600x600 (10-H20 + HR10 stirrups @250)
6. New steel screw piles (168Ø x 3m deep with 600 helix typ) and new 800w x 1000d foundation beam tied into existing foundations, typical
7. 500x500 concrete beam 4-H25 T+B, HR10 @ 150crs over steel screw piles
8. Refer to Screw Pile Information for Access, Rigs, Capacities and Typical Details

Issue		By	Appd	Date	Drawn	Designed	Approved	Scales	Client	Project Title			Drawing Title	Drawing No	Project / Issue
	Pricing	BG		24-7-2015	BG	BG	BG	1:100 (A3)	Lee Pee Limited	Harley Chambers	Quoin	03 968 4925 quoin.co.nz	Pile Underpinning & Foundation Plan North Section	SKR1	15490 / 0

N

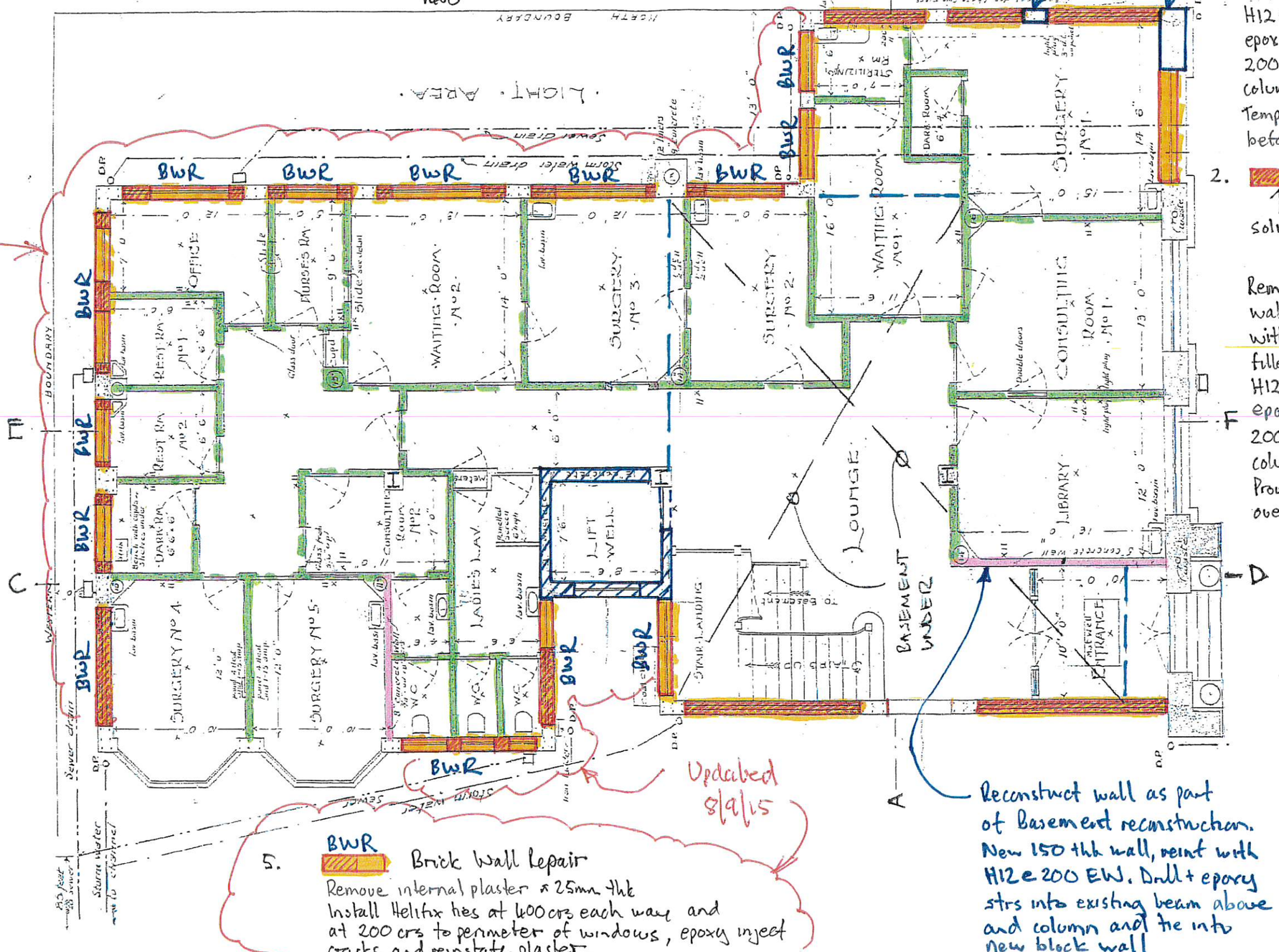
① 10-H20+HR10@75

② 1400x600
20-H25+HR10@200



Reconstruct columns between Foundation and underside of first floor beam. Drill + epoxy STRS T+B of column

Updated 8/9/15



Updated 8/9/15

5. BWR Brick Wall Repair

Remove internal plaster x 25mm thk
Install Helifix ties at 400 crs each way and at 200 crs to perimeter of windows, epoxy inject cracks, and reinstate plaster.

Reconstruct wall as part of Basement reconstruction. New 150 thk wall, reinf with H12 @ 200 EW. Drill + epoxy strs into existing beam above and column and tie into new block wall

NOTES

1. Remove existing Bell Blocks and reinstate with 140 block, solid filled, reinf with H12 @ 400 EW. Drill + epoxy H12 strs, 1000 lg, 200mm into all adjacent columns, beams, floors. Temporary prop floors before removal.

2. solid wall above & below windows

   Remove double brick walls and reinstate with 240 block, solid filled, reinf with H12 @ 400 EW. Drill + epoxy H12 strs, 1000 lg, 200mm into all adjacent columns, beams, floors. Provide HR10 @ 200 links over windows.

3. Existing concrete wall

4. Reconstruct lift shaft walls as part of Basement reconstruction Refer SKR

3	Pricing	BG	24-7-2015	BG	BG	BG	1:100 (A3)	Lee Pee Limited	Harley Chambers	Project 10490
Issue		By	Date	Drawn	Designed	Approved	Scales	Client	Project Title	Issue 0

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Ground Floor Plan
North Section
Drawing Title

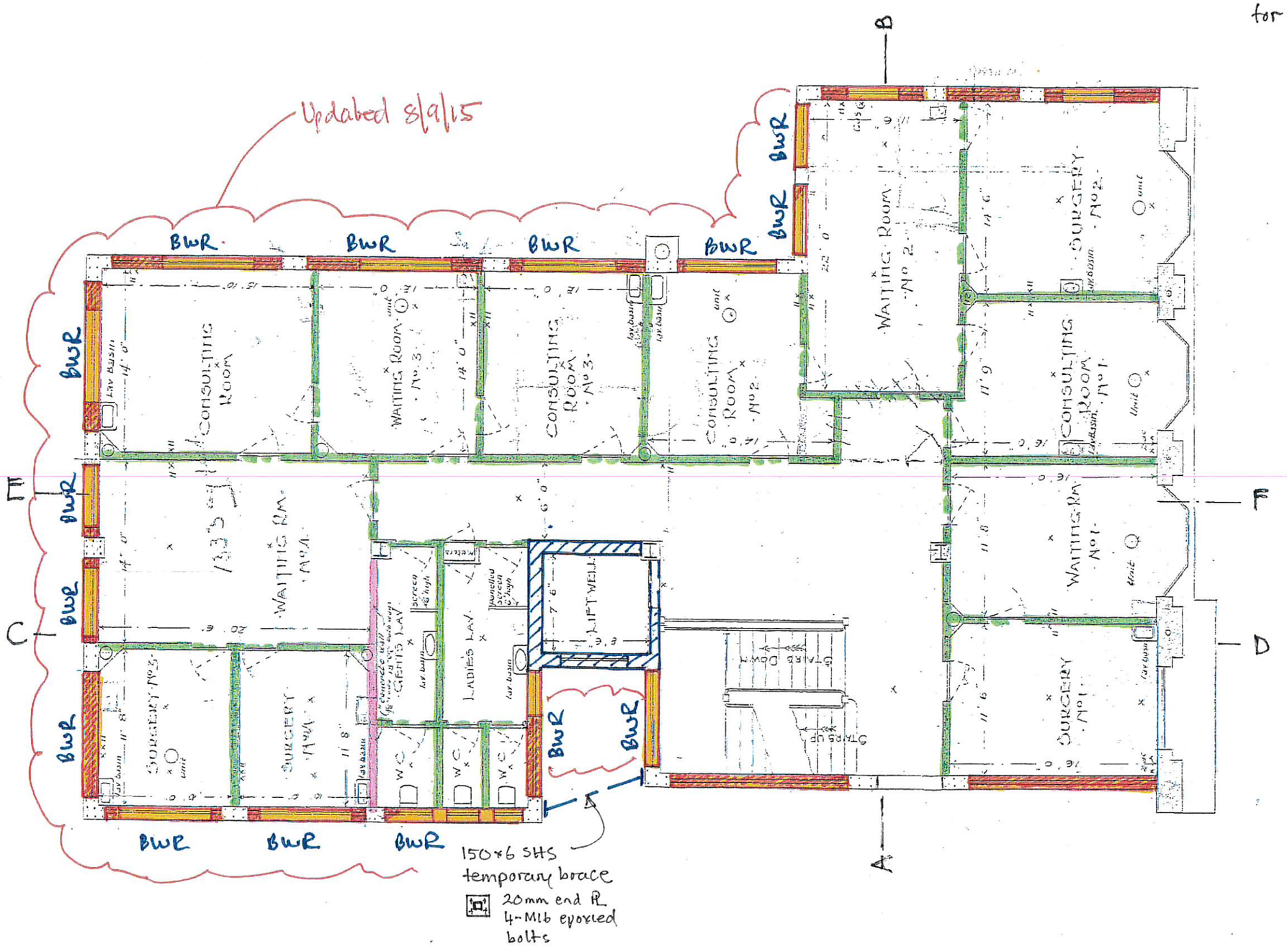
SKR2
Drawing No

N

NOTES

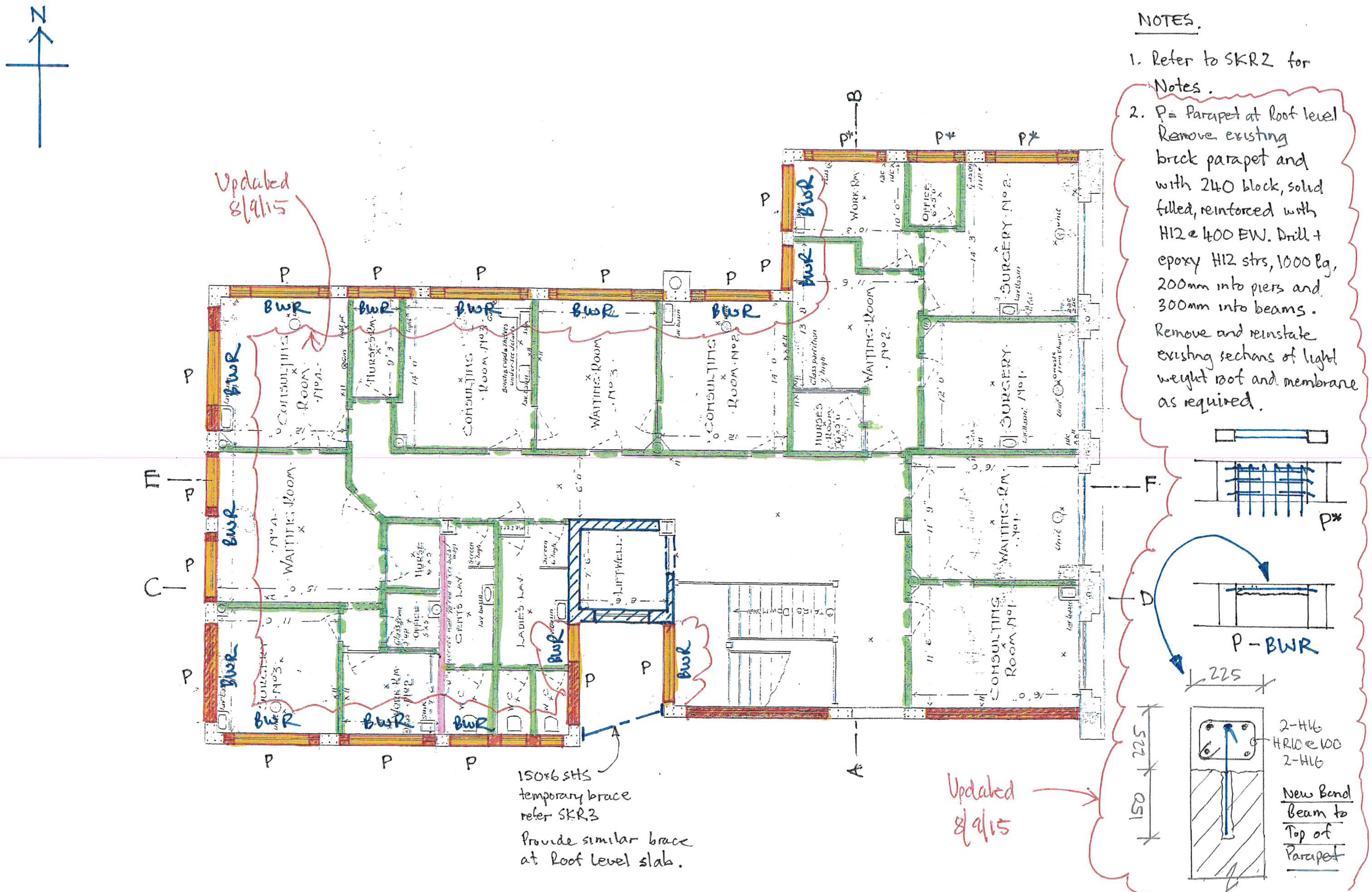
1. Refer to SKR2 for Notes.

Updated 8/9/15



A Issue	Pricing	BG By	Appd.	24-7-2015 Date	BG Drawn	BG Designed	BG Approved	1:100 (A3) Scales	Lee Pee Limited Client	Harley Chambers Project Title	Quoin 03 968 4925 quoin.co.nz

First Floor Plan North Section Drawing Title	SKR3 Drawing No	Project 17490
		Issue A



NOTES.

1. Refer to SKR2 for Notes.
2. P = Parapet at Roof level. Remove existing brick parapet and with 240 block, solid filled, reinforced with H12 @ 400 EW. Drill + epoxy H12 strs, 1000 lg, 200mm into piers and 300mm into beams. Remove and reinstate existing sections of light weight roof and membrane as required.

Issue		By	Auth	Date	Drawn	Designed	Approved	Scales	Client	Project Title			Drawing Title	Drawing No.	
	Pricing	BG		24-7-2015	BG	BG	BG	1:100 (A3)	Lee Pee Limited	Harley Chambers	Quoin	03 968 4925 quoin.co.nz	Second Floor Plan North Section	SKR4	Project 12436 Issue 3

250 THK H16@200 EW, EF

300 THK H16@200 EW, EF

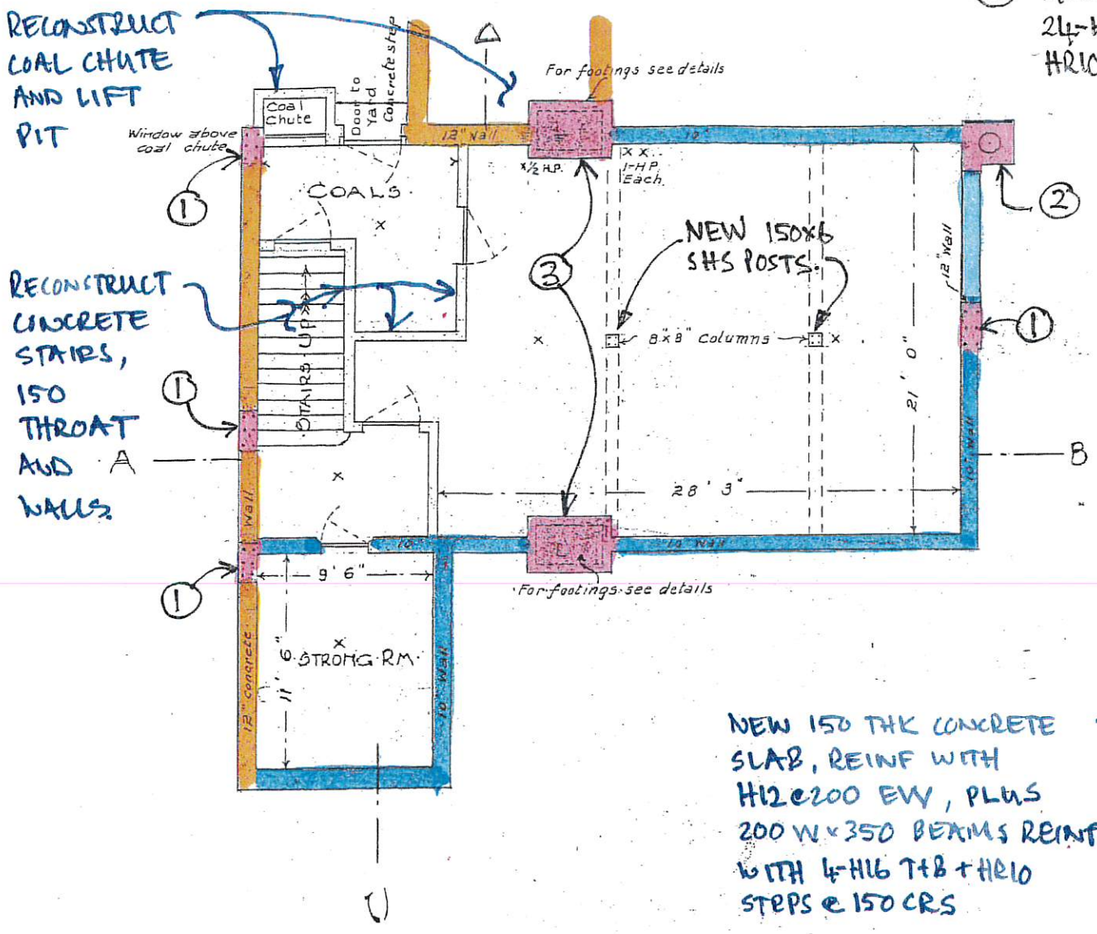
ADD VERTICALS + STRPS AS NOTED

150 THK H12@250 EW CENTRAL

① 6-H20 + HR10@75
300x600

② 800x800
16-H25+HR10@200

③ 1400x900
24-H25+
HR10@200

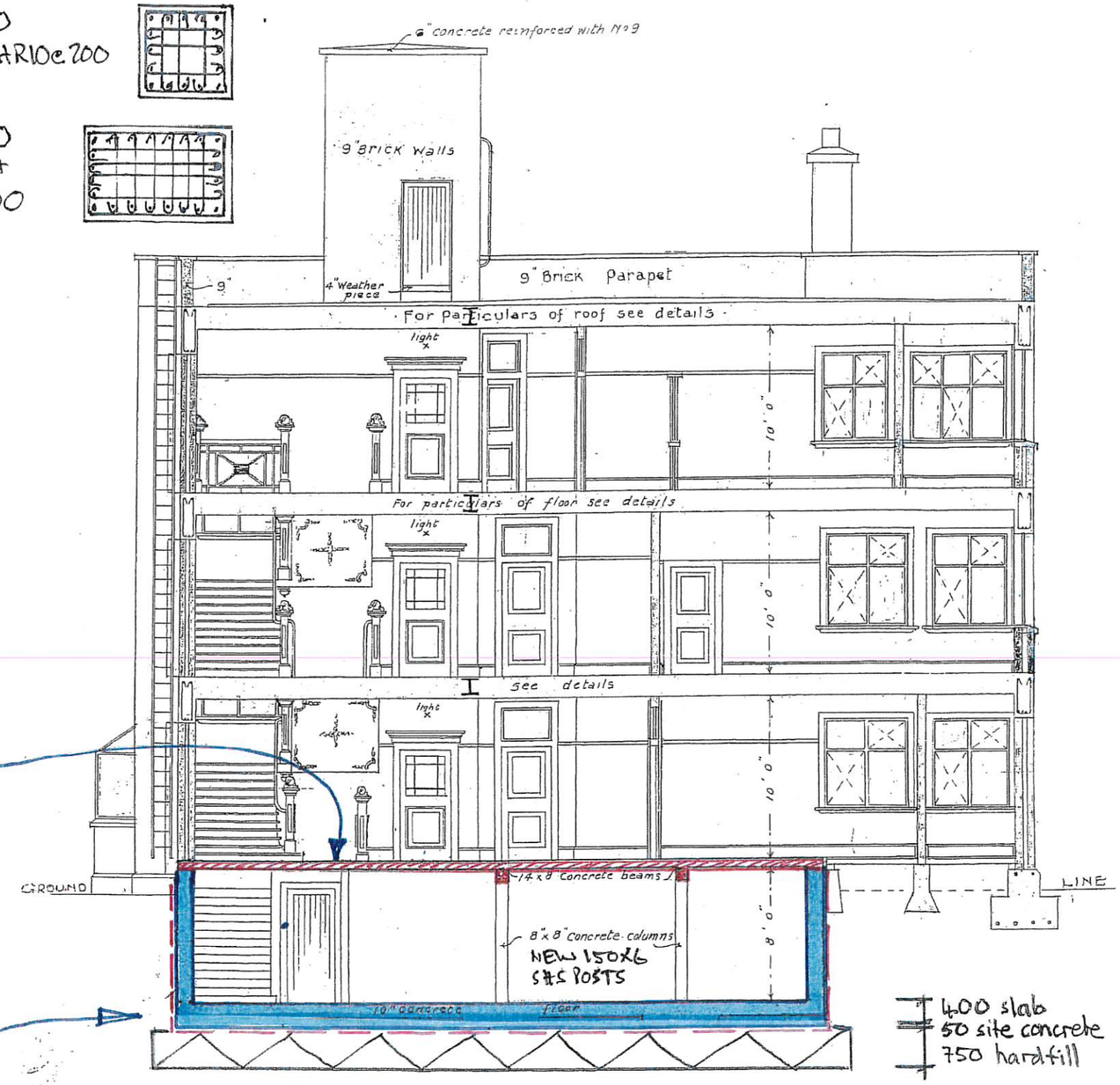


NEW 150 THK CONCRETE SLAB, REINF WITH H12@200 EW, PLUS 200 W x 350 BEAMS REINF WITH 4-H16 T+B + HR10 STIRRUPS @ 150 CRS

400 THK BASE SLAB
H20@250 EW, T+B, ON
TANKING MEMBRANE ON
50 SITE CONCRETE ON
750 COMPACTED HARDFILL.
PROVIDE WATERSTOPS AT ALL JOINTS

BASEMENT PLAN

SCALE 1/8" = ONE FOOT



TRANSVERSE SECTION A B

0 Issue	Pricing	BG By	Appd.	24-7-2015 Date	BG Drawn	BG Designed	BG Approved	1:100 (A3) Scales	Lee Pee Limited Client	Harley Chambers Project Title

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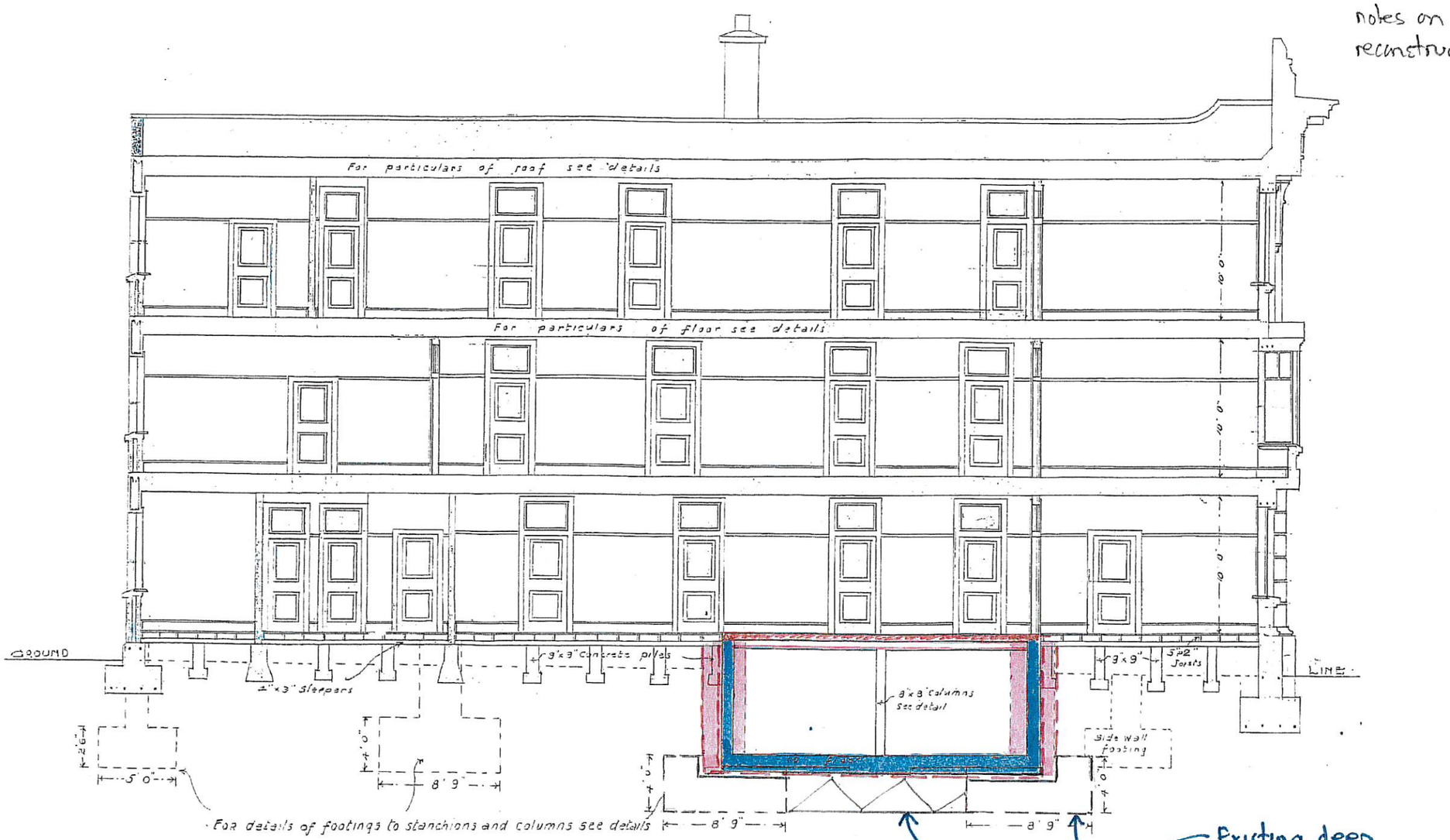
Basement Reconstruction Plan & Section A-B	SKR5	Project 10490
Drawing Title	Drawing No.	0 Issue

NOTES.

1. Refer to SKR5 for notes on Basement reconstruction.

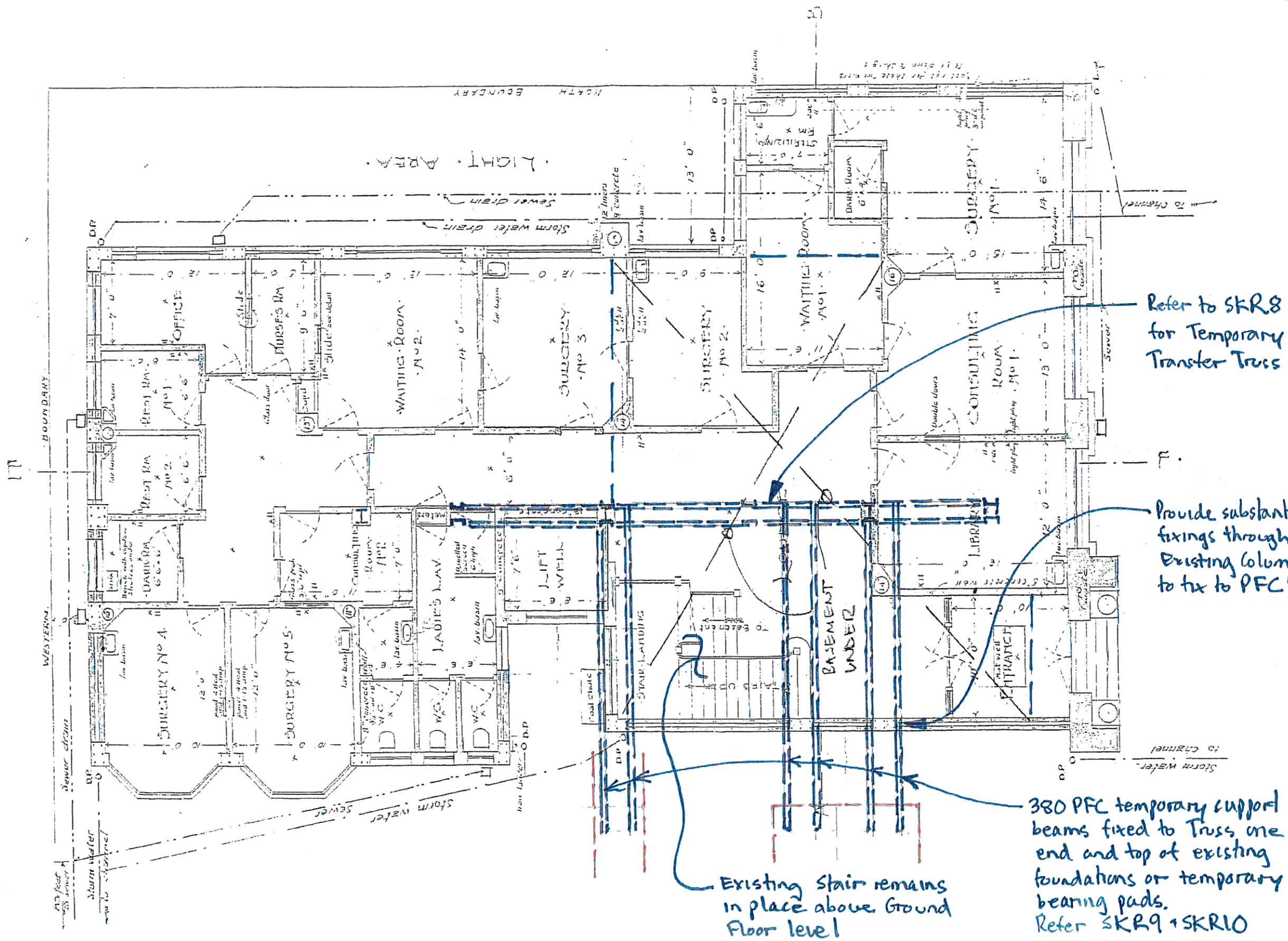


LONGITUDINAL SECTION E-F

Existing deep pads to remain

Allow to remove any loose fill and replace with compacted hardfill.

Issue	Pricing	BG	Appd	24-7-2015 Date	BG Drawn	BG Designed	BG Approved	1:100 (A3) Scales	Lee Pee Limited Client	Harley Chambers Project Title	Quoin	03 968 4925 quoin.co.nz	Basement Reconstruction Section E-F Drawing Title	SKR6 Drawing No.	Project 13490 Issue 0



Issue	Pricing	BG	Issue	21-9-2015	BG	BG	BG	1:100 (A3)	Lee Pee Limited	Harley Chambers
		By		Date	Drawn	Designed	Approved	Scales	Client	Project Title

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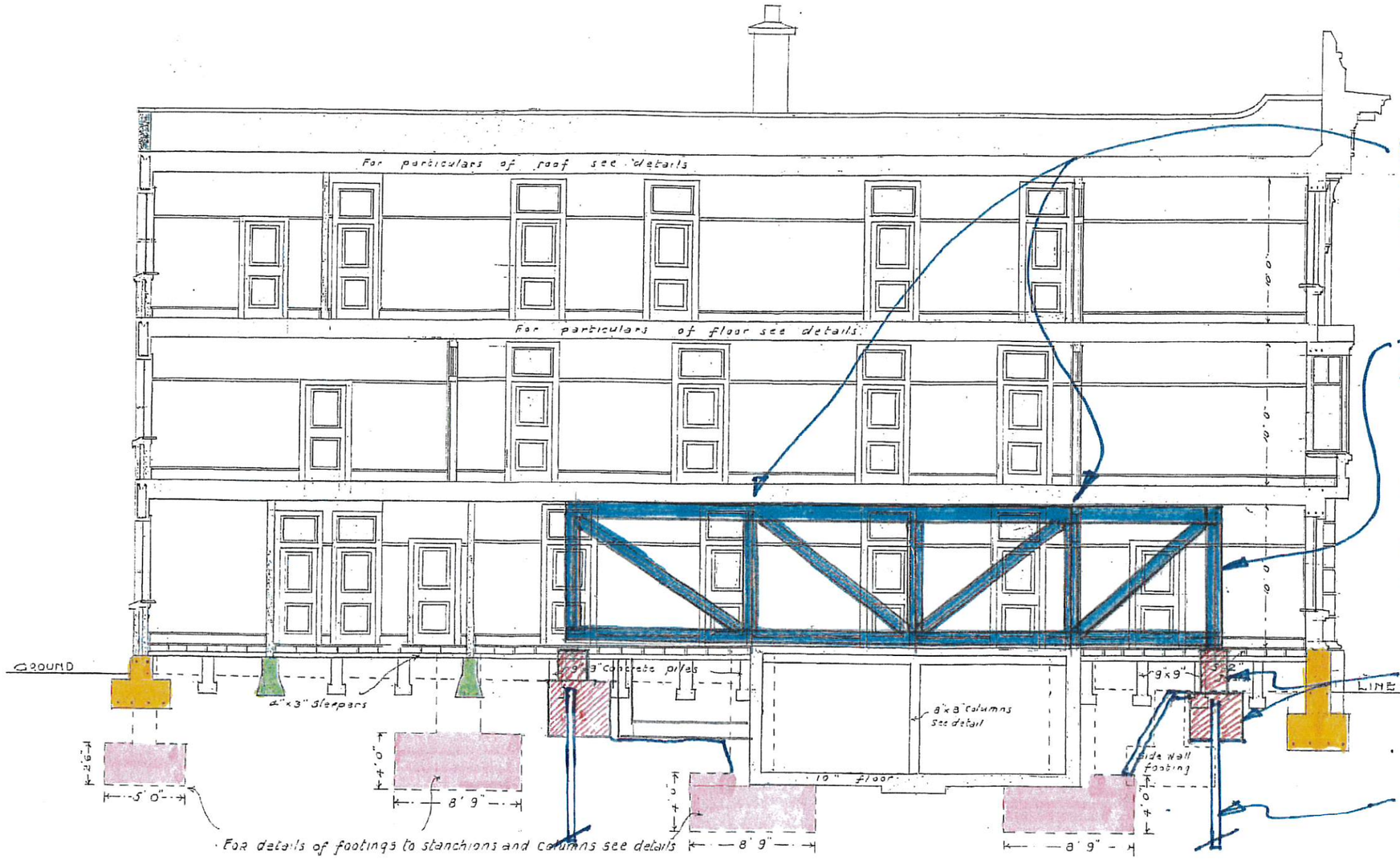
Ground Floor Plan Temporary Transfer Truss and Beams	SKR7	Project 15490 / Issue 1
Drawing Title	Drawing No	



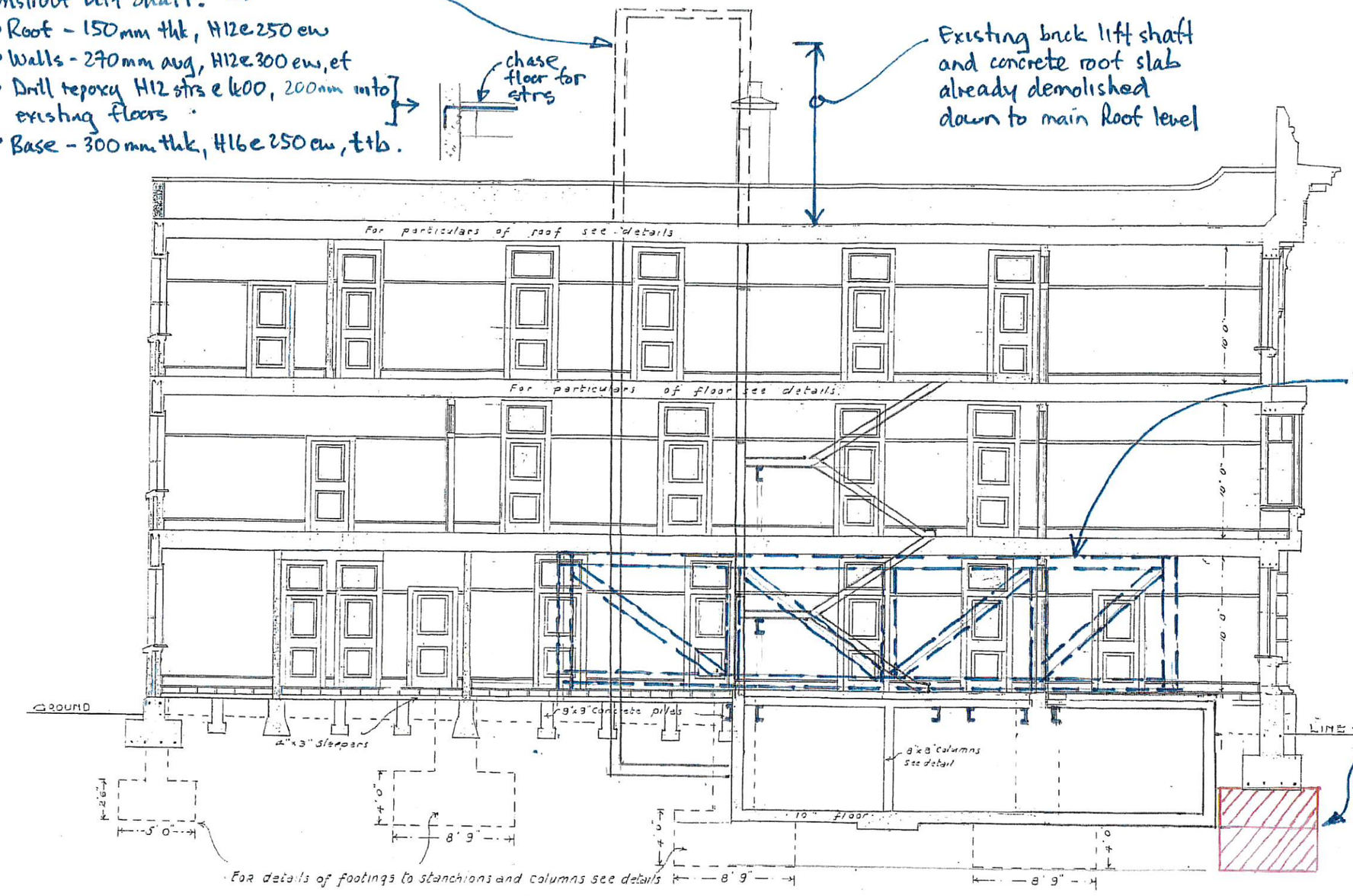
LONGITUDINAL SECTION E-F

3 Issue	Pricing	BG By	Appd	24-7-2015 Date	BG Drawn	BG Designed	BG Approved	1:100 (A3) Scales	Lee Pee Limited Client	Harley Chambers Project Title	Quoin 03 968 4925 quoin.co.nz	Temporary Transfer Truss Section E-F Drawing Title	SKR8 Drawing No.	Project 17490 / 3 Issue

Reconstruct Lift Shaft:
- Roof - 150mm thk, H12 @ 250 ew
- Walls - 270mm avg, H12 @ 300 ew, ef
- Drill tepoxy H12 strs @ 400, 200mm into existing floors
- Base - 300mm thk, H16 @ 250 ew, t+b.

chase floor for strs

Existing brick lift shaft and concrete roof slab already demolished down to main Roof level



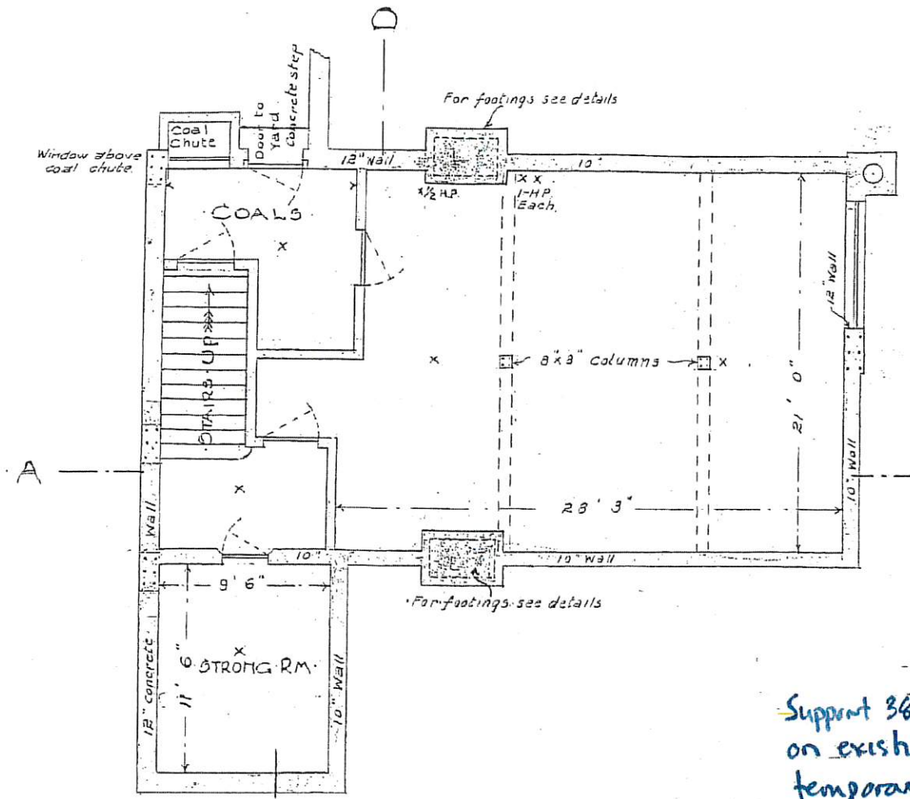
Transfer Truss beyond. Refer SKR8

Underpin existing foundation in 1.2m sections 'Hit + Miss' adjacent to Basement.

LONGITUDINAL SECTION C-D

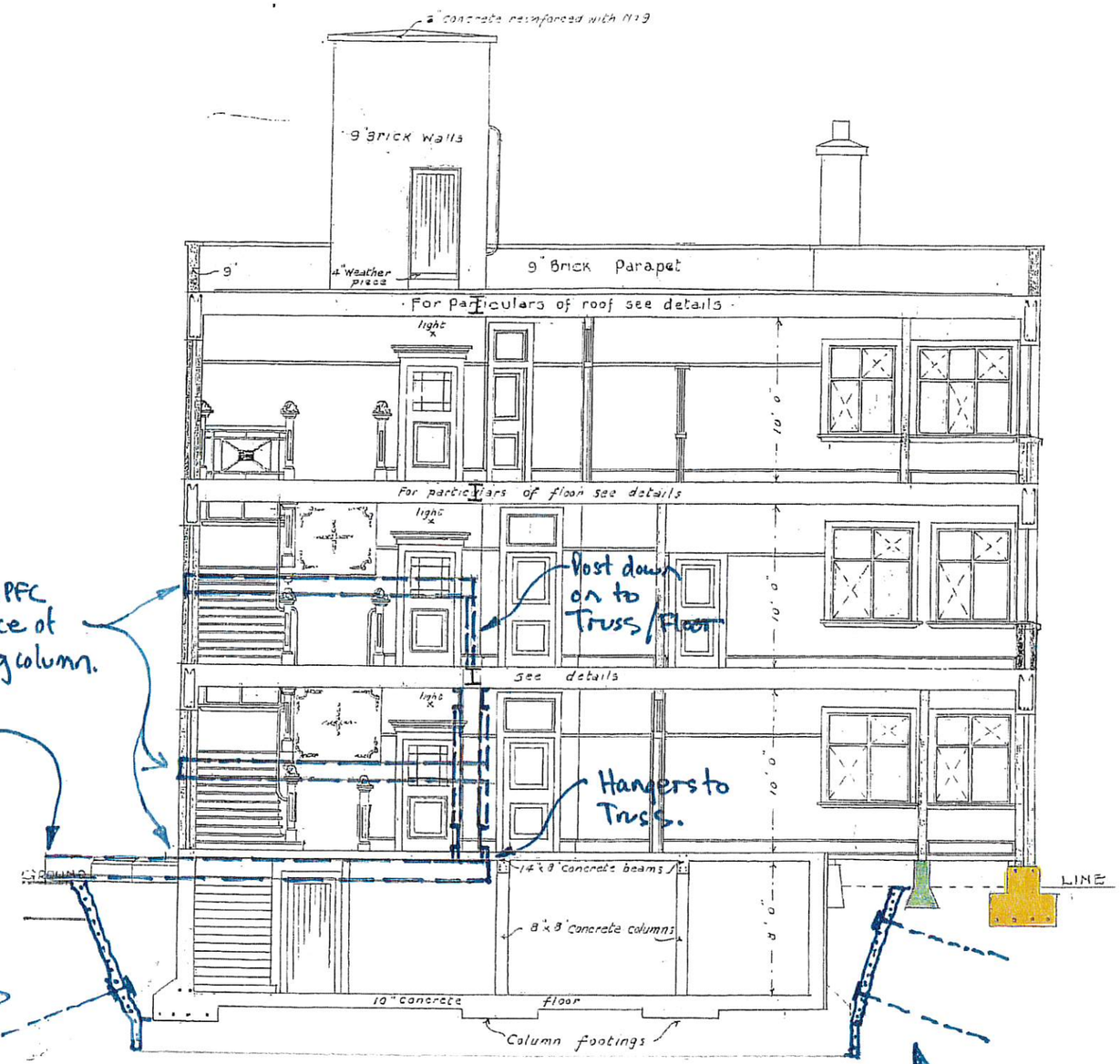
7 Issue	Pricing	BG By	Approved	24-7-2015 Date	BG Drawn	BG Designed	BG Approved	1:100 (A3) Scales	Lee Pee Limited Client	Harley Chambers Project Title	Quoin 03 968 4925 quoin.co.nz

Temporary Transfer Truss & Beams Section C-D Drawing Title	SKR9 Drawing No.	Project 10490 Issue 0



• BASEMENT • PLAN • ¼"

• SCALE • ⅛" = ONE FOOT •



Fix 380PFC into face of existing column.

Support 360PFC's on existing or temporary foundations.

Temporary battered shotcrete wall to main excavation with tie-backs as required

• TRANSVERSE • SECTION • A • B •

7 Issue	Pricing	BG By	Appd	24-7-2015 Date	BG Drawn	BG Designed	BG Approved	1:100 (A3) Scales	Lee Pee Limited Client	Harley Chambers Project Title	Quoin

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Temporary Beams to Support Stair & South Wall - Section A-B Drawing Title	SKR10 Drawing No.	Project 13490
		0 Issue

Sketch SKR11

Basement Reconstruction Methodology

Item 101

(a) A number of strategies to repair the leaks in the basement have been considered, including the epoxy injection of cracks in the walls and floor slab together with the use of moisture resistant products to the inside faces of walls and floor. However, these methods do not return the basement to its pre-earthquake condition and further leaks are possible. These methods are not guaranteed by the contractor and/or waterproofing specialists.

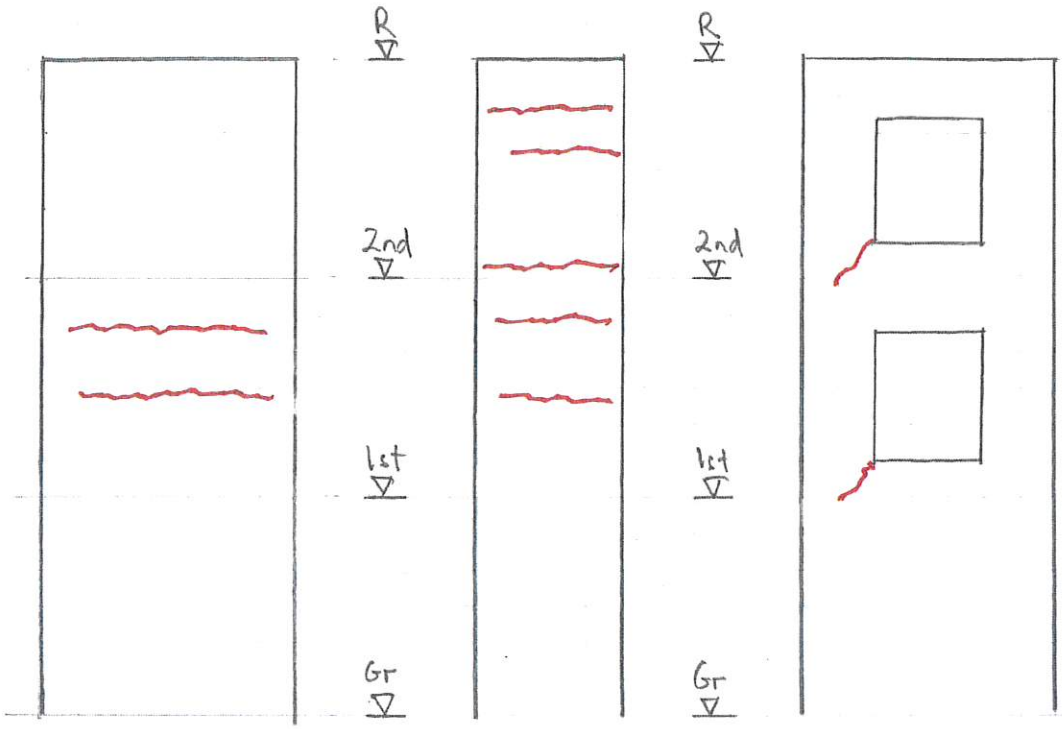
(b) The Basement is to be demolished, removed and reconstructed. This includes the foundation slab and walls, and suspended concrete floor at Ground floor level that extends over the basement. This strategy ensures that the basement is repaired to its per-earthquake water-tight condition.

(c) The reconstruction of the basement will involve the following (refer to Sketches SKR5 to SKR10 inclusive):

(i) Install temporary steel transfer truss, beams, and foundations/piles to redistribute the column loads and weight of the existing stair outside of basement footprint.
(j) Remove existing Bell block infill walls and brick infill walls above the basement area as required.
(ii) Localised dewatering.
(iii) Removal of the suspended concrete floor over the basement at ground floor level.
(iv) Install temporary lateral braces the main columns.
(v) Removal of basement walls and foundation slab.
(vi) Excavate approximately 800mm depth beneath the level of the existing base slab to match the base level of the existing deep foundation pads that are to remain.
(vii) Underpin existing east side foundation adjacent to the basement.
(viii) Install temporary retaining. Allow for 100mm thick reinforcing Shotcrete wall to steep battered slopes with ground anchor ties as required.
(ix) Lay 750mm compacted hardfill in 200mm maximum layers over base of excavation.
(x) Place 50mm site concrete.
(xi) Lay tanking membrane.
(xii) Construct 400mm thick base slab, reinforced with H20 @250mm each way, top and bottom. Cast in waterstops at wall junctions. Use 40MPa concrete with Sika 1 waterproof additive.
(xiii) Construct 250/300mm thick walls, reinforced with H16 @ 200mm each way, each face. Use 40MPa concrete with Sika 1
(xiv) Construct columns integral with walls, similar to existing. Install 200 x 9 steel SHS interior columns in lieu of 200mm x 200mm concrete columns. Fire rate for 60 minutes.
(xv) Install tanking to rear face of walls.
(xvi) Construct reinforced concrete steps, lower flight and internal walls.
(xvii) Backfill as required with compacted hardfill.
(xviii) Reconstruct suspended concrete slab and beams over the basement.

project HARLEY CHAMBERS date 15-6-15

file 12088 by BAG ref SKR12



NORTH WEST SOUTH

LIFT SHAFT WALLS - CRACKS

(INSIDE FACE)

- East wall not accessible

project HARLEY CHAMBERS date 24-7-2015

file 12088 by BAG. ref SKR19

Quoin

Item 129: Repairs to Main Stairs.

Agreed general scope of repairs as per Endel Lust scope March 2013 as follows.

(ii) Carry out concrete repairs to underside of stairs (e.g. 'Fosroc Renderoc' or 'Sika Mono Top' system).

Install steel plates to underside of stair/floor connection with plates bolt fixed to underside stair and to underside floor slab and connections. Specific design will be required for these plates.

} Endel Lust

The following is a copy of Ian Harrison & Assoc Ltd estimate for the above, that includes further description.

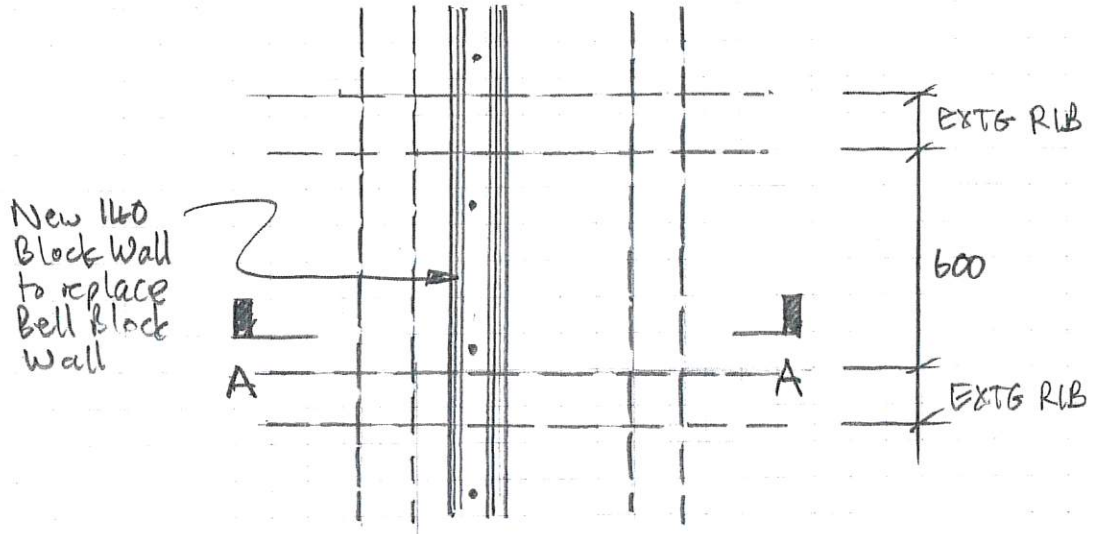
Trade : ***Main Stairs - remedial***

Main Stairs Remedial								
Allowance for steel plate connectors to underside of flights at landings and slabs - 800 x 200 x 16 ms bent flats - 2 per connection.	12.00	no	708.00		11.80	141.60	56.00	16,425.60
Rake out, and Epoxy connections to existing floors at each level	12.00	sets	650.00		6.00	72.00		11,832.00
Possible Reinstatement of marble finishes with alternative product (PC Sum for Supply $400m2)	20.00	m2	575.00		4.00	80.00	56.00	15,980.00
Provisional Allowance for SHS support posts at connection to upper floor slabs	1.00	sum	14,676.80		103.64	103.64	56.00	20,480.64
						Main Stairs - remedial Total :		**64,718.24**

Also refer to Item 304 for allowance to install glass panels to sides of stairs to achieve compliance for Building Consent.

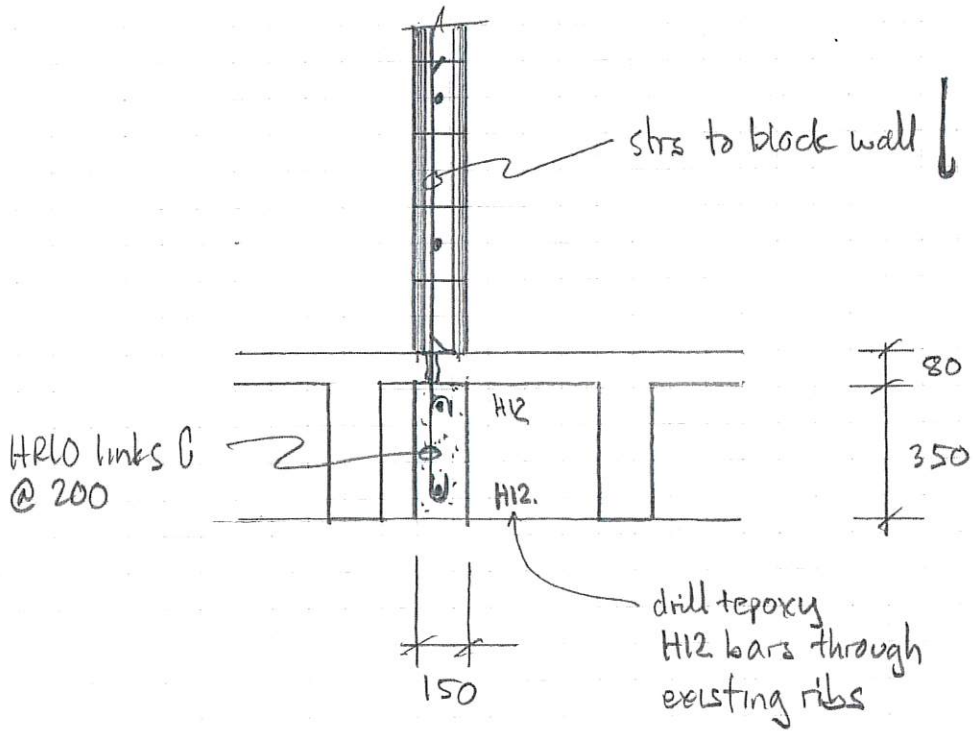
project HARLEY CHAMBERS date 24-7-2015

file 12088 by BAG ref SKR 20



PART PLAN

FLOOR DETAILS FOR NEW BLOCK PARTITION WALL



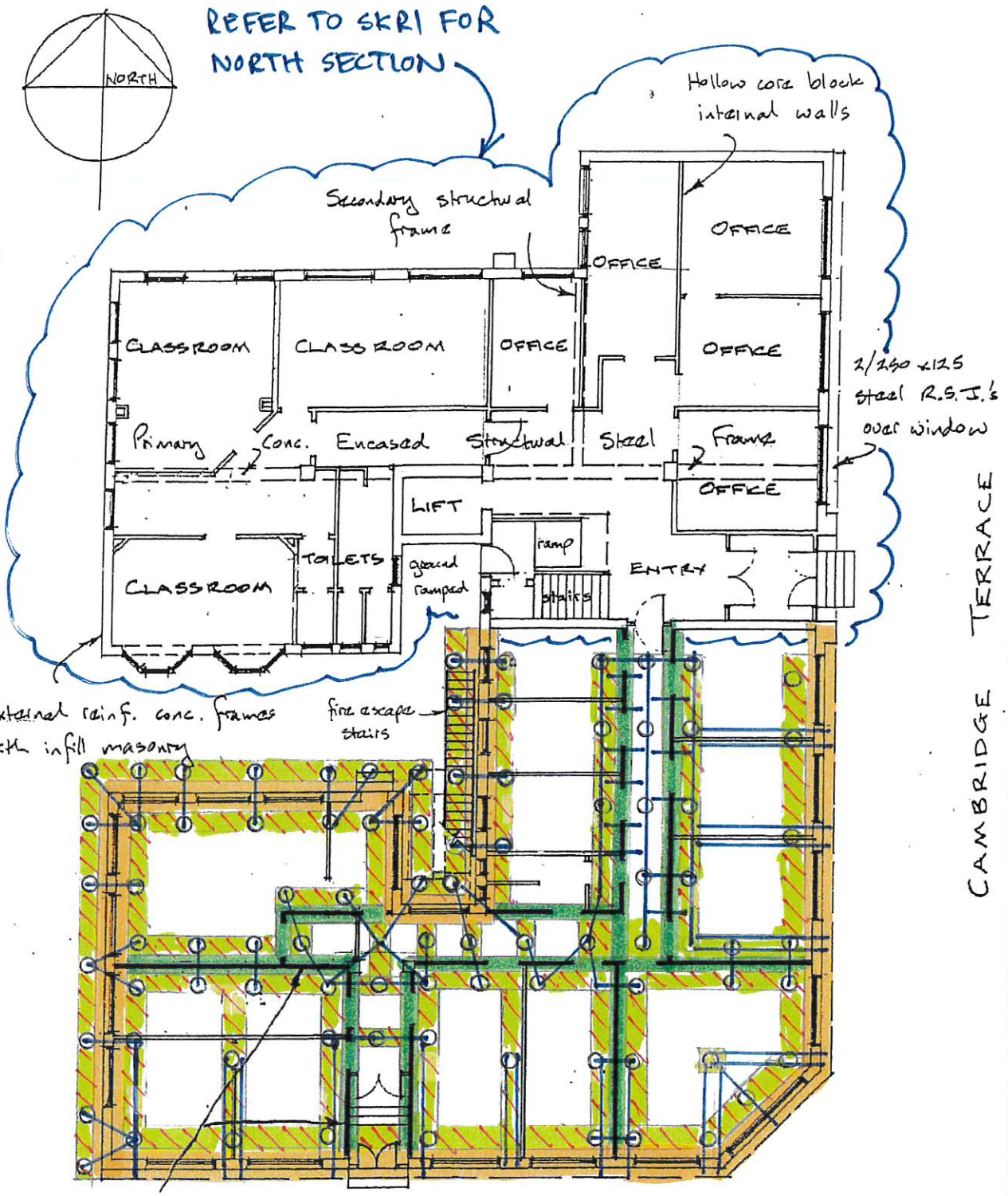
A – A

Appendix F: South Section Repair Sketches

Harley Chambers

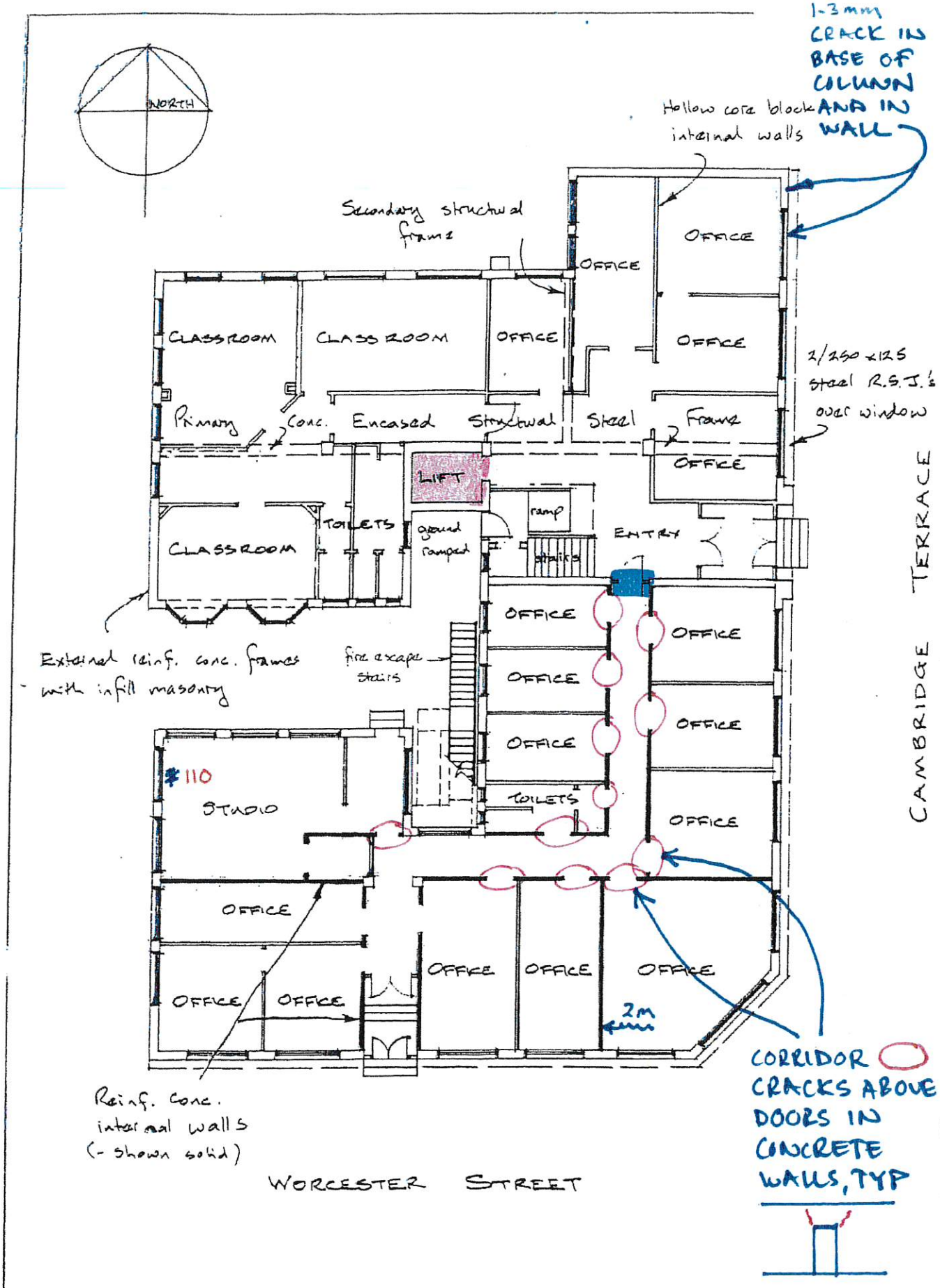
South Section Repairs Sketches (Scale 1:200 @ A4)

- SKR13 Pile Underpinning & Foundation Plan
- SKR14 Ground Floor Plan - Cracks in Concrete Walls and Columns



'HARLEY CHAMBERS' - Pile Underpinning & Foundation Plan South Section

Quoin 03 968 4925 quoin.co.nz	SCALE: 1:200	DRAWN:	BAG	SKR13
	DATE: 24-7-2015	APPROVED.		



'HARLEY CHAMBERS' - GROUND FLOOR PLAN
CRACKS IN CONCRETE WALLS + COLUMNS

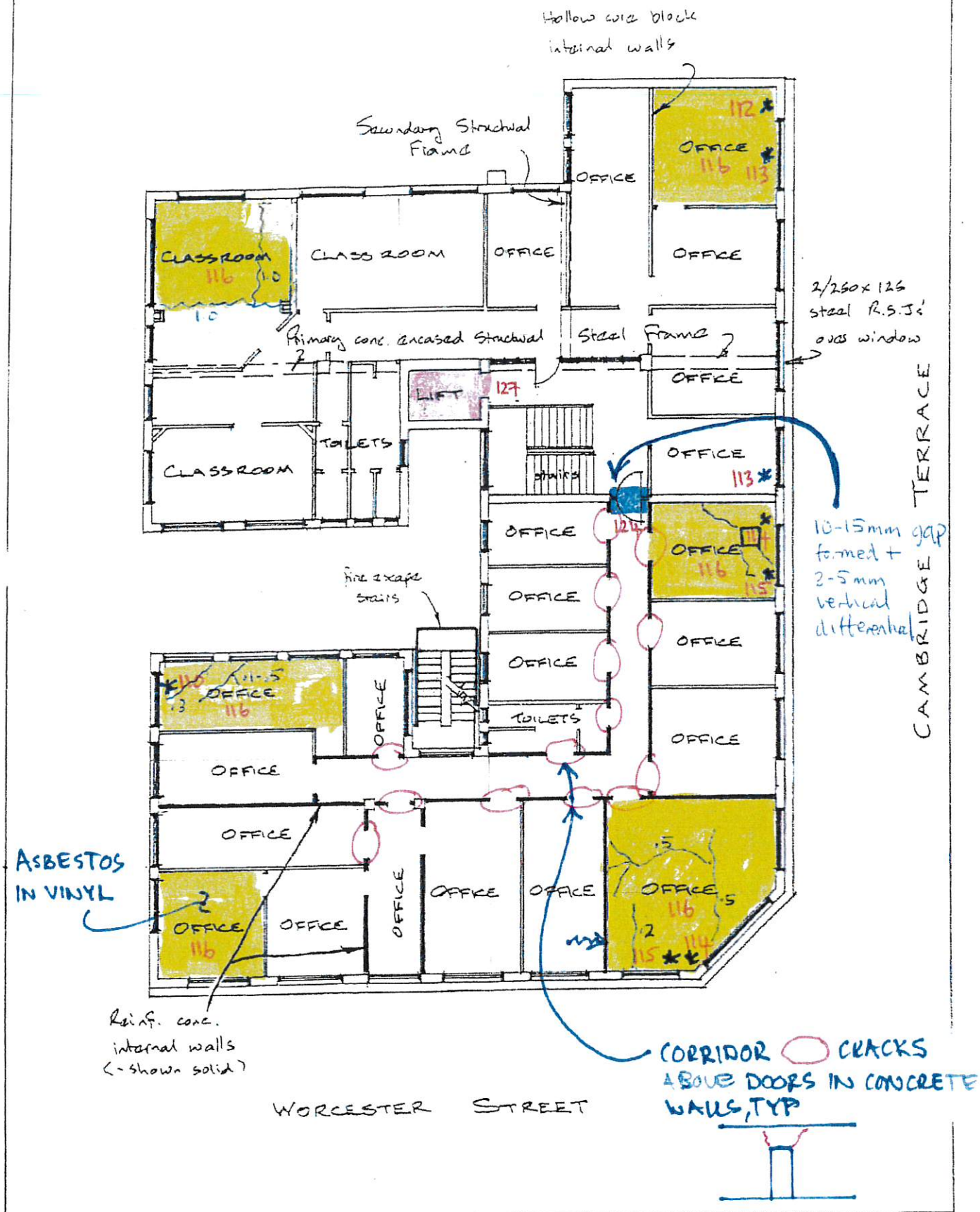
Quoin 03 968 4925 quoin.co.nz	SCALE: 1:200	DRAWN:	BG	SKR14
	DATE: 28/5/15	APPROVED:		

Appendix G: Building General Repairs

Harley Chambers

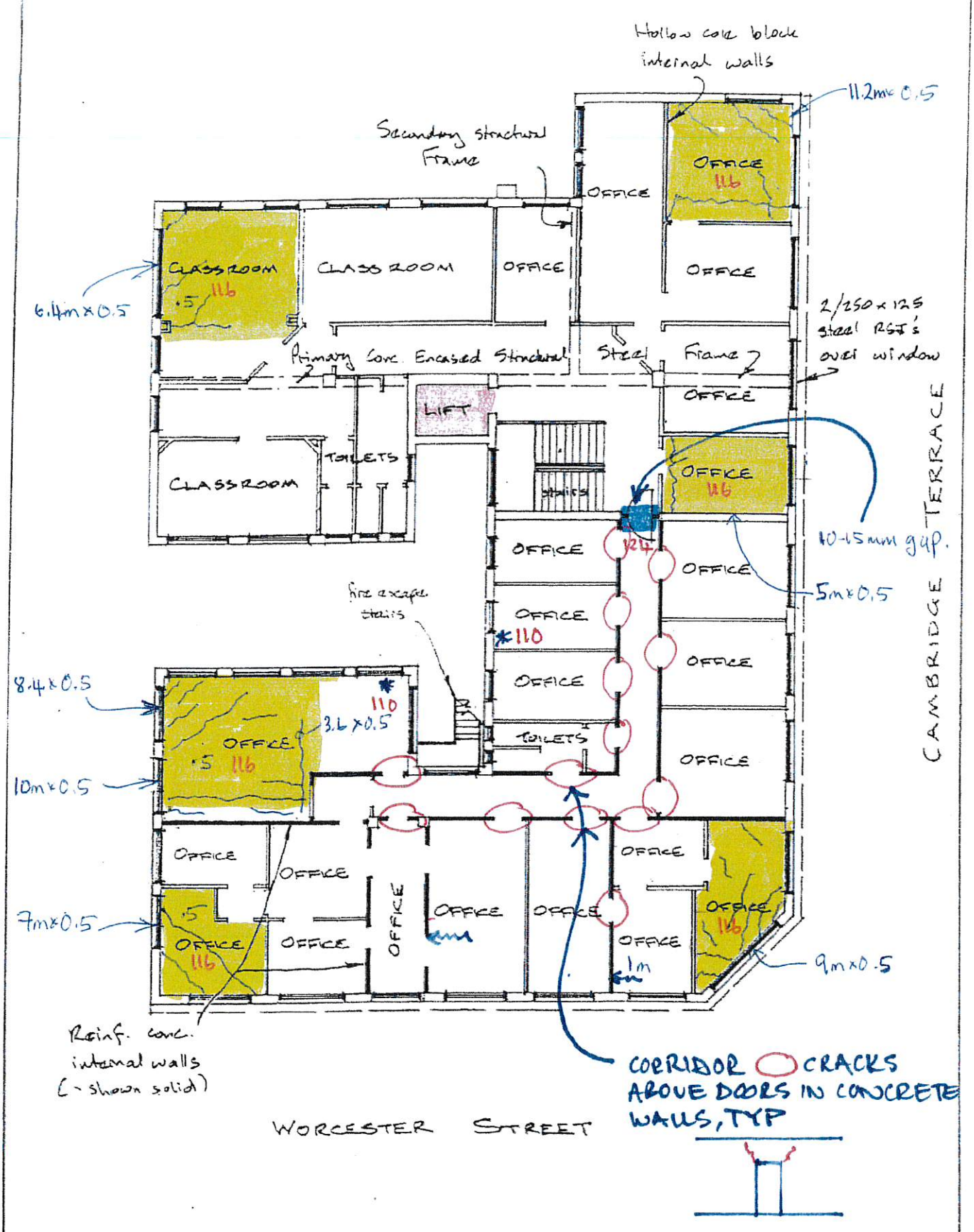
Repairs - General

- SKR15 First Floor Plan - Cracks in Concrete Floors and Walls
- SKR16 Second Floor – Cracks in Concrete Floors and Walls
- SKR17 Floor and Wall Joint Repair to North-South Sections
- SKR18 Floor and Wall Joint Repair to North-South Sections
- SKR21 Relevelling Methodology
- SKR22 Relevelling and Underpinning Plan
- SKR22A Relevelling and Underpinning Plan
- SKR23 Relevelling and Underpinning Details
- SKR24 Relevelling and Underpinning Details
- SP1-SP11 Steel Screw Pile Information



'HARLEY CHAMBERS' - FIRST FLOOR PLAN
CRACKS IN CONCRETE FLOORS + WALLS

Quoin 03 968 4925 quoin.co.nz	SCALE: 1:200	DRAWN.	BG	SKR15
	DATE: 28/5/15	APPROVED		



'HARLEY CHAMBERS' - SECOND FLOOR PLAN
CRACKS IN CONCRETE FLOORS + WALLS

Quoin 03 968 4925 quoin.co.nz	SCALE: 1:200	DRAWN:	BG	SKR16
	DATE: 28/5/15	APPROVED		

project HARLEY CHAMBERS date 24-7-2015 Quoin

file 12088 by BAE ref SKR17

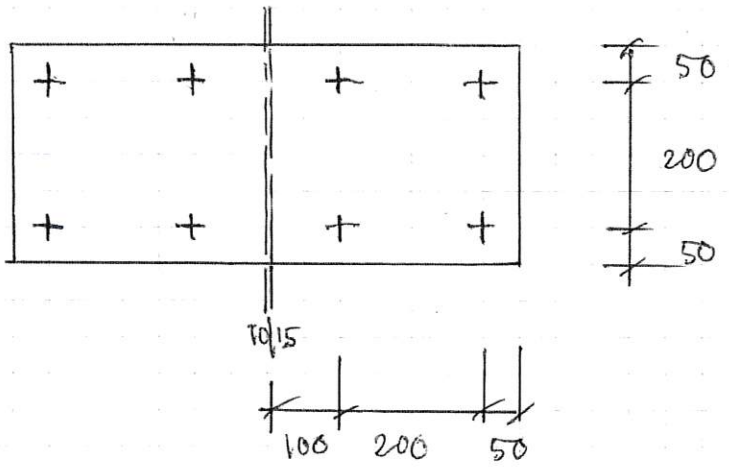
Items 122, 123, 124

Agreed general scope of repairs to tie the North & South sections together, similar to Endel Lust scope March 2013 as follows:

(iv) Remove loose plaster bricks etc in vertical separation gaps between North & South buildings. Connection detail between the two will require more detailed investigation and design. For pricing purposes a suggested connection system is to use 150 x 150 x 10 steel angles or 300 x 10mm steel flats, each 300mm long with 4 – 18mm dia holes for M16 bolts to be epoxy fixed into either side of the gap, that is into either building half. It is estimated three such connections at each wall join for each floor plus at least two such joins into the parapets. That is approx 40 such connections in total. } Endel Lust

Quoin recommends the following adjustments to the above proposed repairs:

(a) Use 300x10mm steel flats, each 700mm long. The additional length is to ensure suitable edge distance to the bolts, plus have 4 bolts each side of joint



project HARLEY CHAMBERS date 24-7-2015 Quoin

file 12088 by BAE ref SKR18

(b) Bolts to be epoxied 200mm into concrete beams and columns. Use Hilti RE500.
At locations where bolts coincide with the floor slab and not the beam, extend bolt through slab and provide 80x80x6 washer and nut

(c) Allow to recess the steel plates into the concrete and have top of bolts flush with floor slab or column/beam face.
Recess approximately 30mm, typical. Grout till recess.

(d) Further to (b) & (c) above, estimate that have: 16 into columns (including parapet piers)
24 at edge beam / floor slab

(e) Allow to remove and reinstate roof cladding and membrane, and reinstate at roof level.

(f) The following copy of Ian Harrison & Assoc estimate to be updated for the above Quoin adjustments

Junction of North and South Wings								
300 x 300 x 10mm plates bolted with M16 chemsets to concrete as connectors	40.00	no	224.00		2.40	96.00	56.00	14,336.00
Allow to epoxy inject gap between concrete frames (both sides)	44.00	m	400.00		1.00	44.00		20,064.00
Allow for plaster repairs both sides of junction	44.00	m	180.00					7,920.00

Relevelling Methodology (Draft) SKR 21

The draft methodology for the re-levelling works is as follows:

1. Strip out ground floor area.

2. Disconnect/cap-off services.

3. Remove ground floor framing adjacent to foundations.

4. Carry out level survey.

5. Install piles.

6. Rib the piles with 5mm fillet weld in rings around the circumference of the pile over the foundation depth at 200mm pitch.

7. Construct new foundations ensuring:

   (a) endplate and threaded rods associated with jacking detail are cast in.

   (b) piles wrapped in 10-15mm of polystyrene.

   (c) pockets left at pile locations for re-levelling.

   (d) reinforcing and starters to existing structure are provided as specified.

   (e) engineer inspects prior to casting concrete.

8. Place transducers to measure displacement and re-level building utilising an 8 zone synchronous lift system. Each zone is to be 6.0m long, where the maximum amount of total lift is required. The re-levelling process is as follows:

   (a) Ensure all zones are primed 0.25mm at a time until movement is shown on the system transducers. It is critical to ensure that the building is 'free' from ground suction at all locations.

   (b) Raise Zone 1, 1mm at a time. Hold the structure at each millimetre to allow ground resistance to dissipate. Continue to lift Zone 1 until a pressure drop is recorded in Zone 2 or the maximum allowable lift per any one zone is reached. The maximum single lift value is 25mm.

   (c) Raise Zone 2 until the load is shared between Zones 1 and 2, or the 'maximum single lift value' is reached.

   (d) Raise Zones 1 and 2 as per points 8b and 8c until a pressure drop is recorded in Zone 3 or the 'maximum single lift value' is reached.

   (e) Zone 3 is then included in the lifting sequence above and the procedure is continued until all zones are in the sequence.

9. Provide engineer with final levels of the building foundations for review and approval.

10. Grout fill beneath re-levelled foundations.

11. Trim piles that protrude past the top of the foundation beams. Remove top plate of jacking system and trim threaded rods which protrude past the top of the foundation beams.

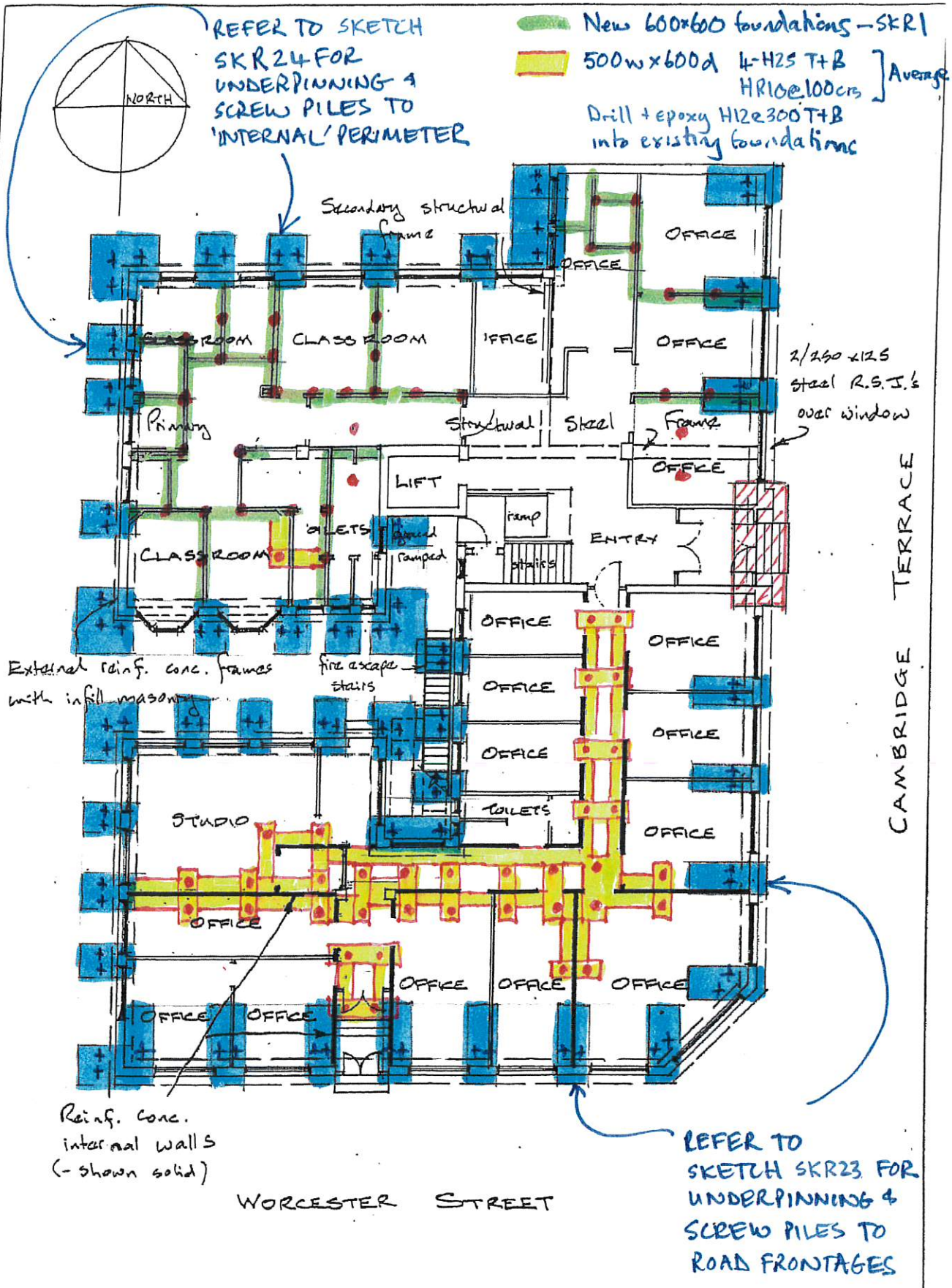
12. Burn out polystyrene from around the piles and fill with high strength grout.

13. Grout up jacking recess.

14. Reconnect services.

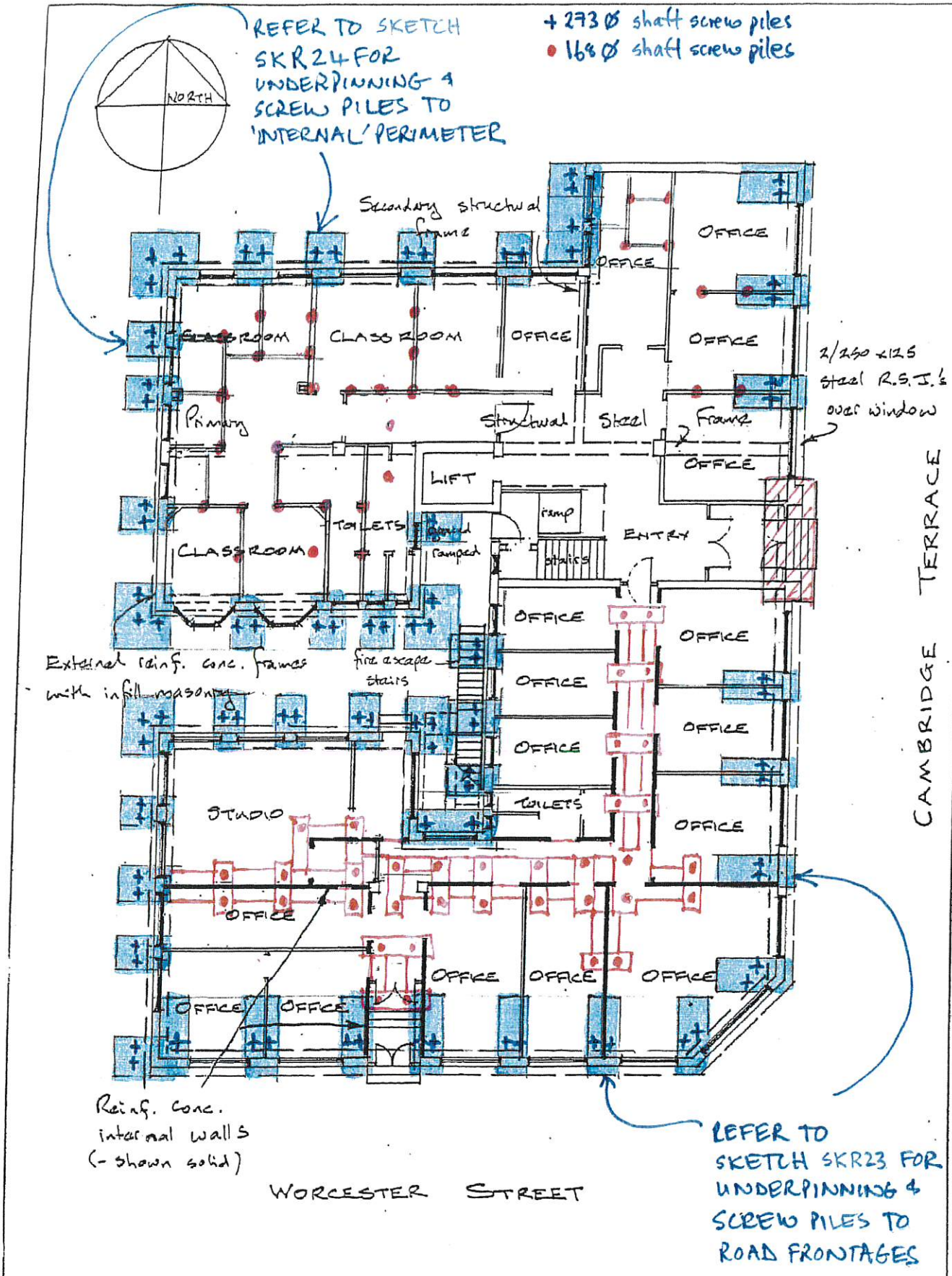
15. Repair and make good in the remainder of the building following a detailed dilapidation survey.

Revisions to the proposed methodology may be provided subject to the engineers review and approval.



'HARLEY CHAMBERS' - GROUND FLOOR PLAN

Quoin 03 968 4925 quoin.co.nz	SCALE: 1:200	DRAWN:	B.G. E.L.	1774
	DATE: ~~24/6/2002~~ 4/11/2015	APPROVED:		SKR22



'HARLEY CHAMBERS' - GROUND FLOOR PLAN

Quoin 03 968 4925 quoin.co.nz	SCALE: 1:200	DRAWN:	B.G. E.L.	1774
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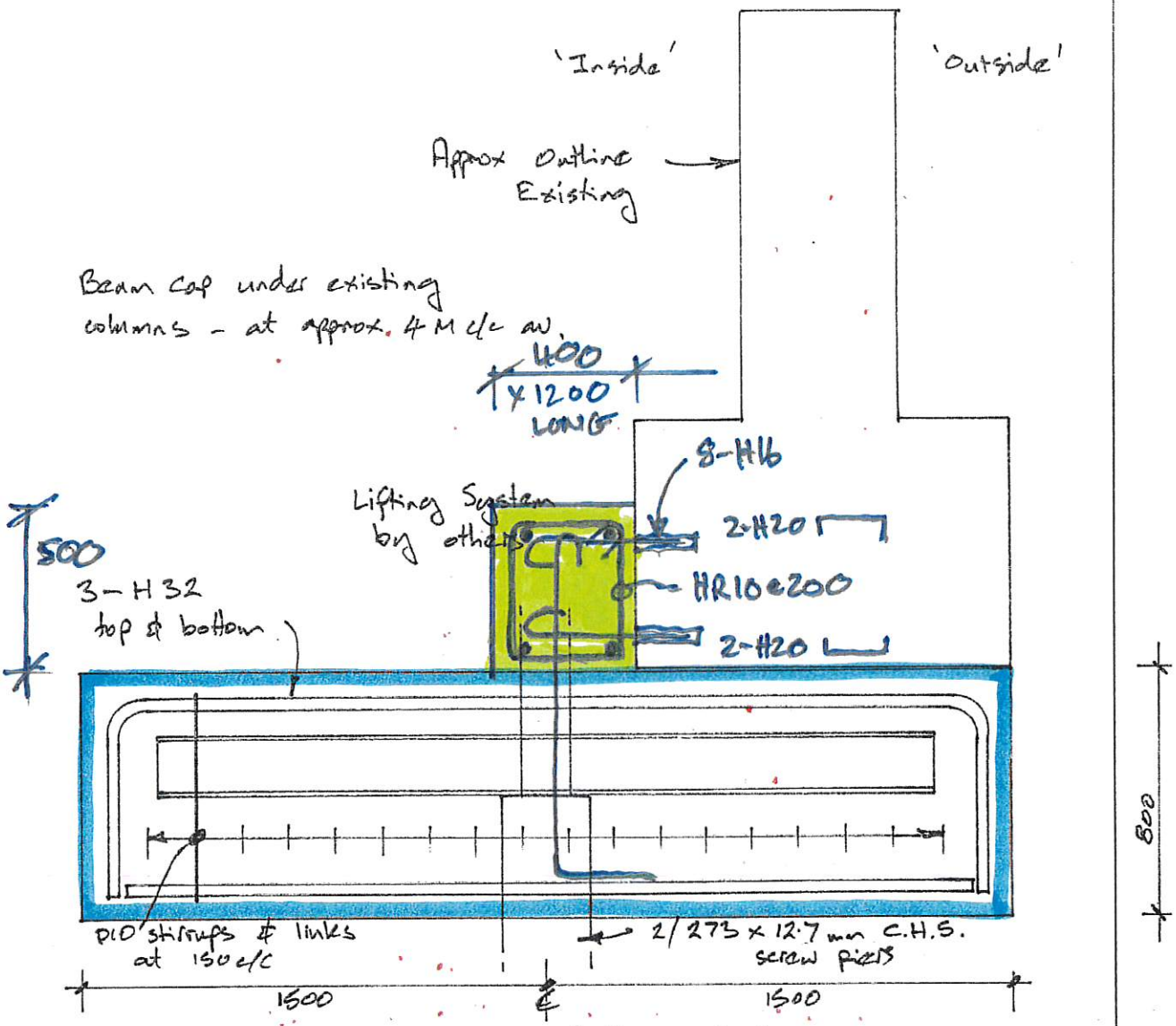
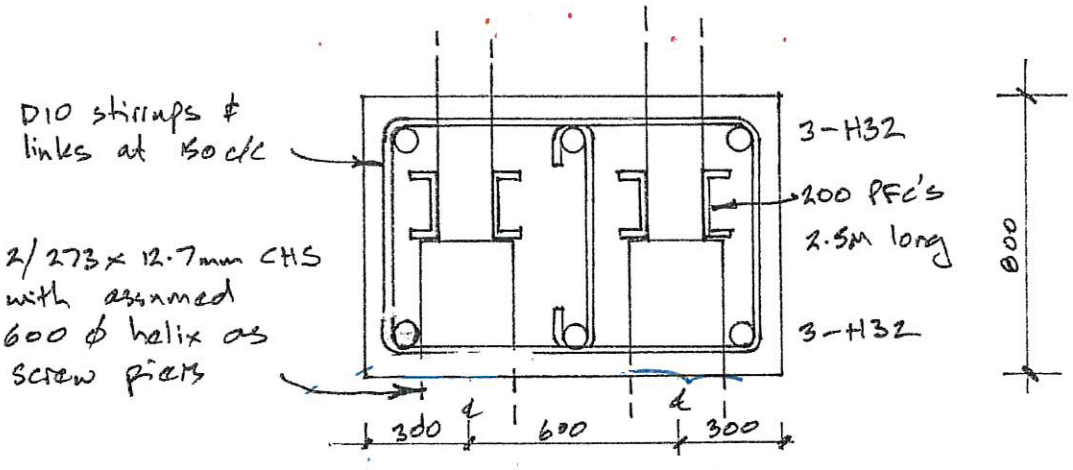


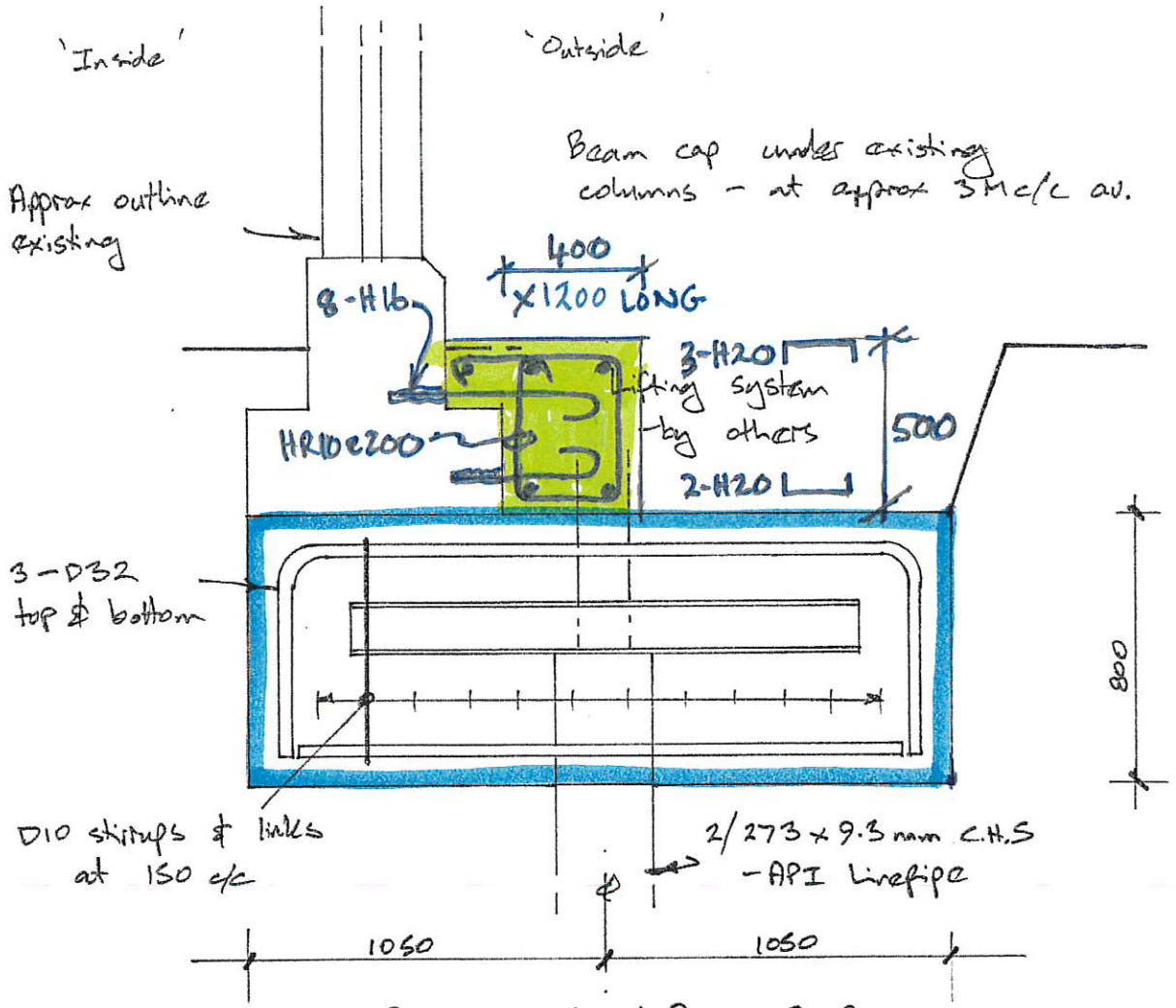
SECTION THRO' PILES CAP



SECTION THRO' CAP BEAM

HARLEY CHAMBERS - SKETCH DETAIL UNDERPINNIG & SCREW PIERS ALTERNATIVE TO ROAD FRONTAGES

Quoin 03 968 4925 quoin.co.nz	SCALE: 1:20 ~~approx~~	DRAWN:	B.G E.L.	2901
	DATE: ~~6/10/2015~~ 4/11/2015	APPROVED:		SKR23



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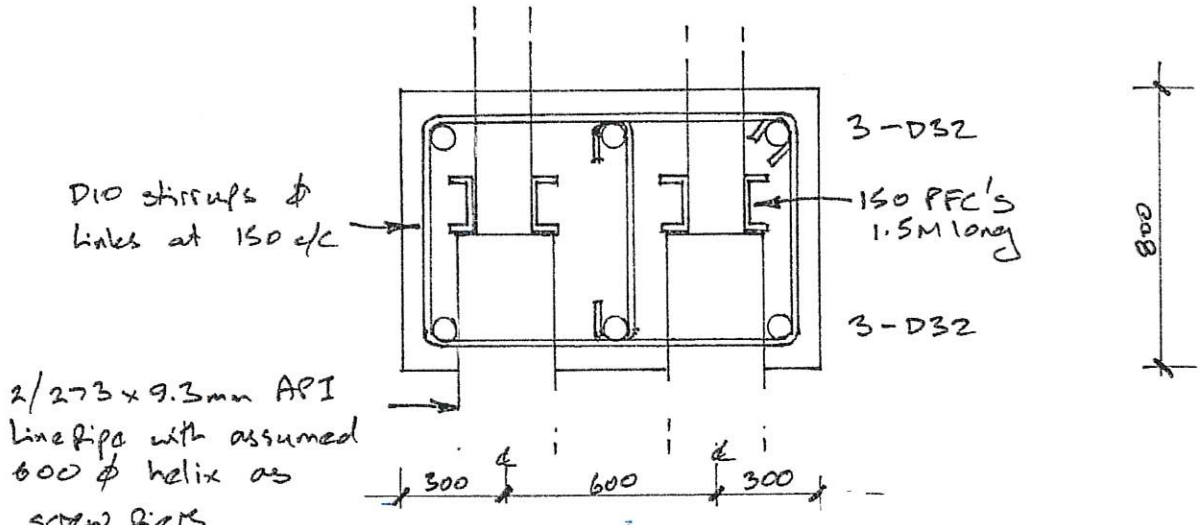
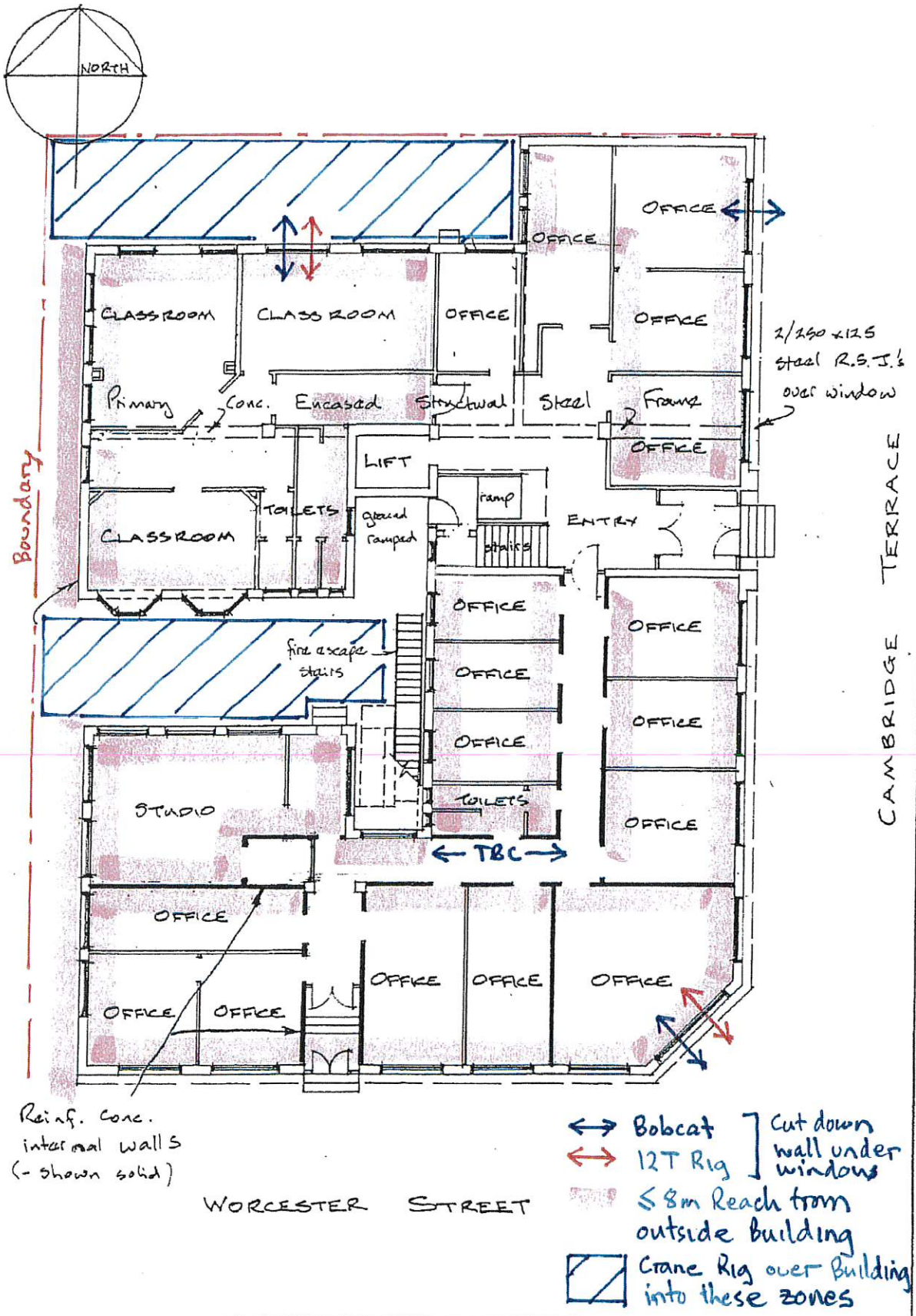


SECTION THRO' CAP BEAM

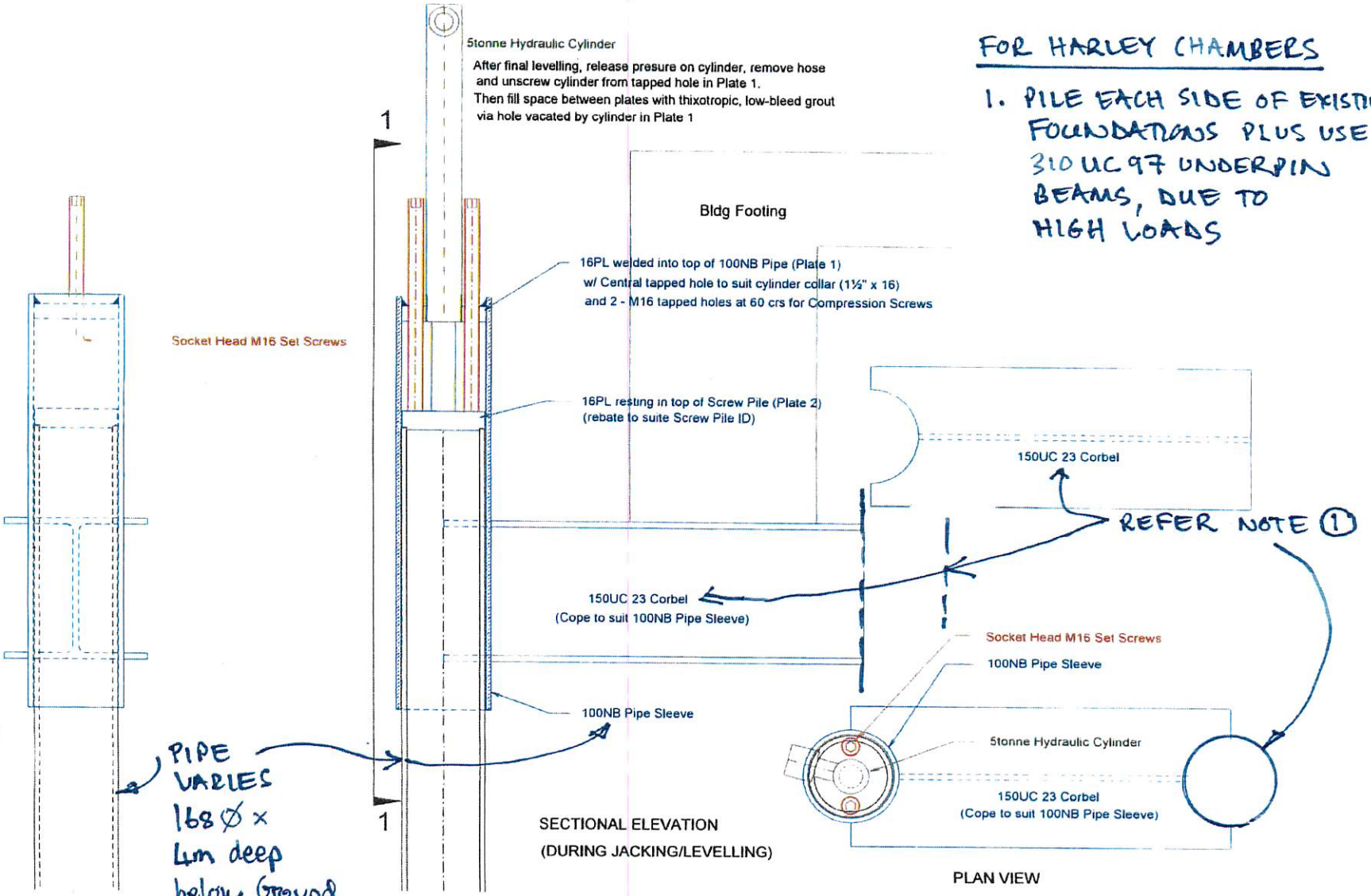
HARLEY CHAMBERS - SKETCH DETAIL UNDERPINNING & SCREW PIERS ALTERNATIVE TO 'INTERNAL' PERIMETER

Quoin 03 968 4925 quoin.co.nz	SCALE: 1:20 approx	DRAWN:	E.L.	2901
	DATE: ~~8/10/2015~~ 4/11/2015	APPROVED:		SKR24



'HARLEY CHAMBERS' - GROUND FLOOR PLAN
PILE RIG ACCESS

Quoin	03 968 4925 quoin.co.nz	SCALE: 1:200	DRAWN:	BAG	SP1
		DATE: 23/7/2015	APPROVED.		



FOR HARLEY CHAMBERS

1. PILE EACH SIDE OF EXISTING FOUNDATIONS PLUS USE 310 UC 97 UNDERPIN BEAMS, DUE TO HIGH LOADS

Quoin

Job No: 120582

Date: 23/7/2015

Sketch: SP2

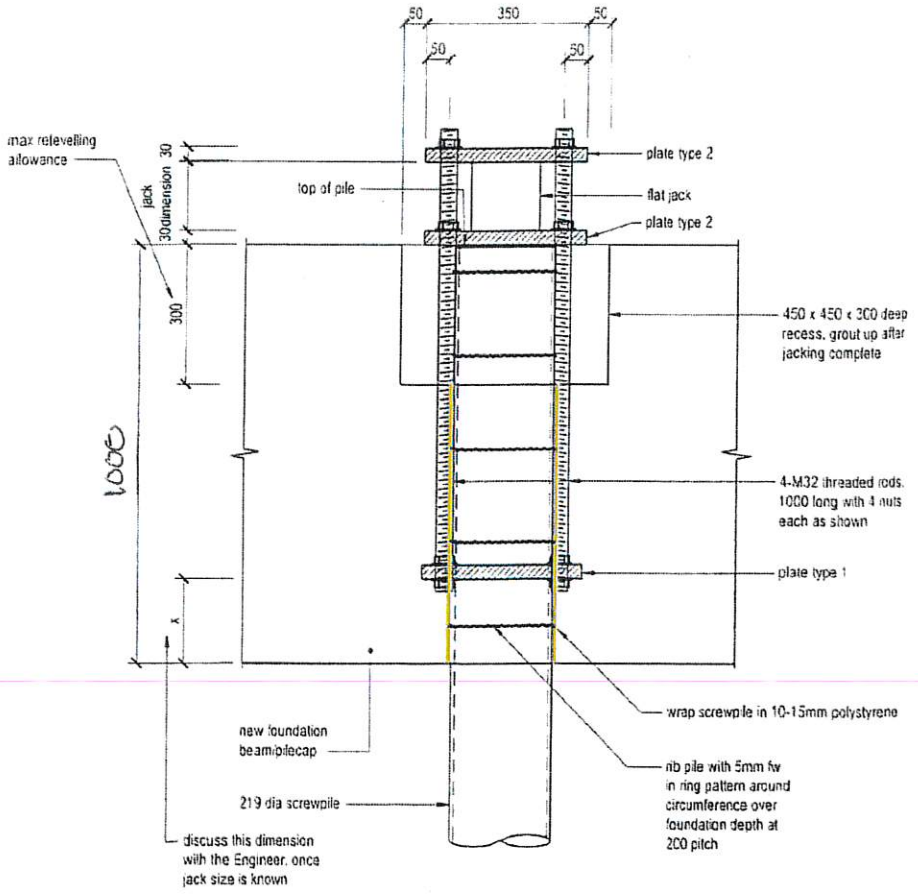
SH 1

PILETECH UNDERPINNING -HYDRAULICALLY ADJUSTABLE HEIGHT CORBEL

Sketched: Graham Frost - 20101116

project HARLEY CHAMBERS date 23/7/2015

file 12088 by BAG ref SP3



jacking detail

note adjust bolt lengths if required to suit jack dimension and dimension 'x'

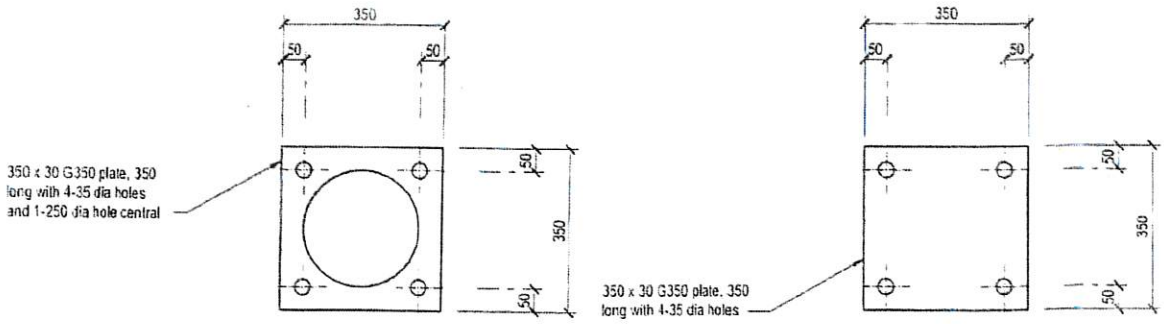
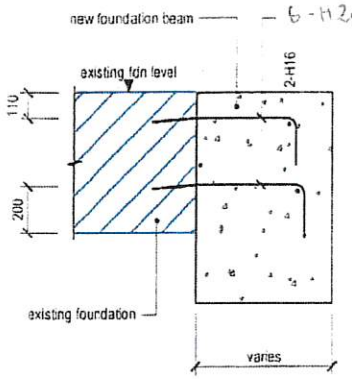


plate 1 plate 2

TYPICAL JACKING DETAILS

project HARLEY CHAMBERS date 23/7/2015

file 12088 by BAG ref SP4



existing foundation to one side, starter type

6-H20 at each existing pile location T+B

otherwise H20 @ 400 T+B into existing foundation between piles

typical starter details

note - all starters to be drilled and epoxied into existing foundations 200mm with Hilti HIT RE 500 epoxy

SP5

Brett Gilmore

From: Glen Budden [Piletech] <GlenB@piletech.co.nz>
Sent: Tuesday, 21 July 2015 5:45 p.m.
To: Brett Gilmore
Subject: RE: Structex query
Attachments: 15-07-21 pile capacity vs rig size chch GAB.pdf

Hi Brett,

Further to our discussion please find attached access requirements versus achievable pile capacities for piles founding in the intermediate gravels in Christchurch. Note that these values should be used as an indication only as capacities will be dependent on the site specific geotechnical information which does vary considerably in CHCH.

Cheers
Glen

Glen Budden
Senior Design Engineer – Piletech

The Fletcher Construction Company Ltd trading as Piletech
16 Diesel Drive, Wiri – PO Box 97250, Manukau 2241
Ph: 09 259 1503 Mob: 021 234 1178 Email: GlenBudden@piletech.co.nz

From: Brett Gilmore [mailto:BGilmore@structex.co.nz]
Sent: Tuesday, 21 July 2015 5:03 p.m.
To: Glen Budden [Piletech]
Subject: Structex query

Hi Glenn.

Good to talk to you. This to confirm my email.

cheers

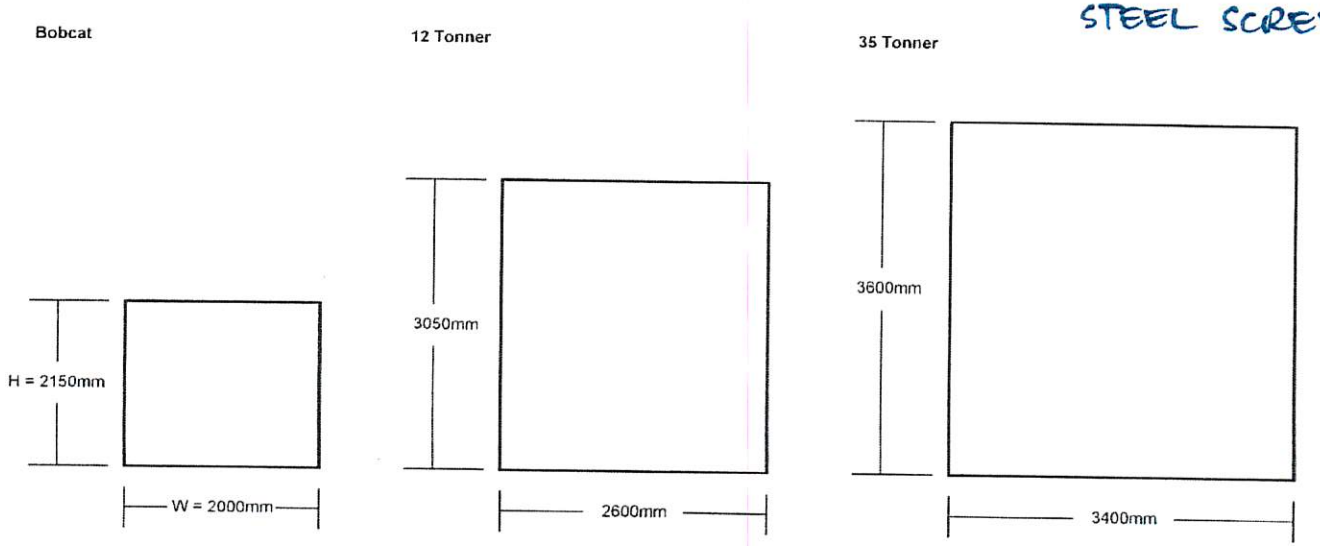
Brett Gilmore (CPEng)
bgilmore@structex.co.nz

structex

Structex Metro Limited, Level 1, 575 Colombo Street
PO Box 25438, Christchurch, New Zealand
Tel: +64 3 968 4925, Fax: +64 3 968 4927, Mobile 021 435 525

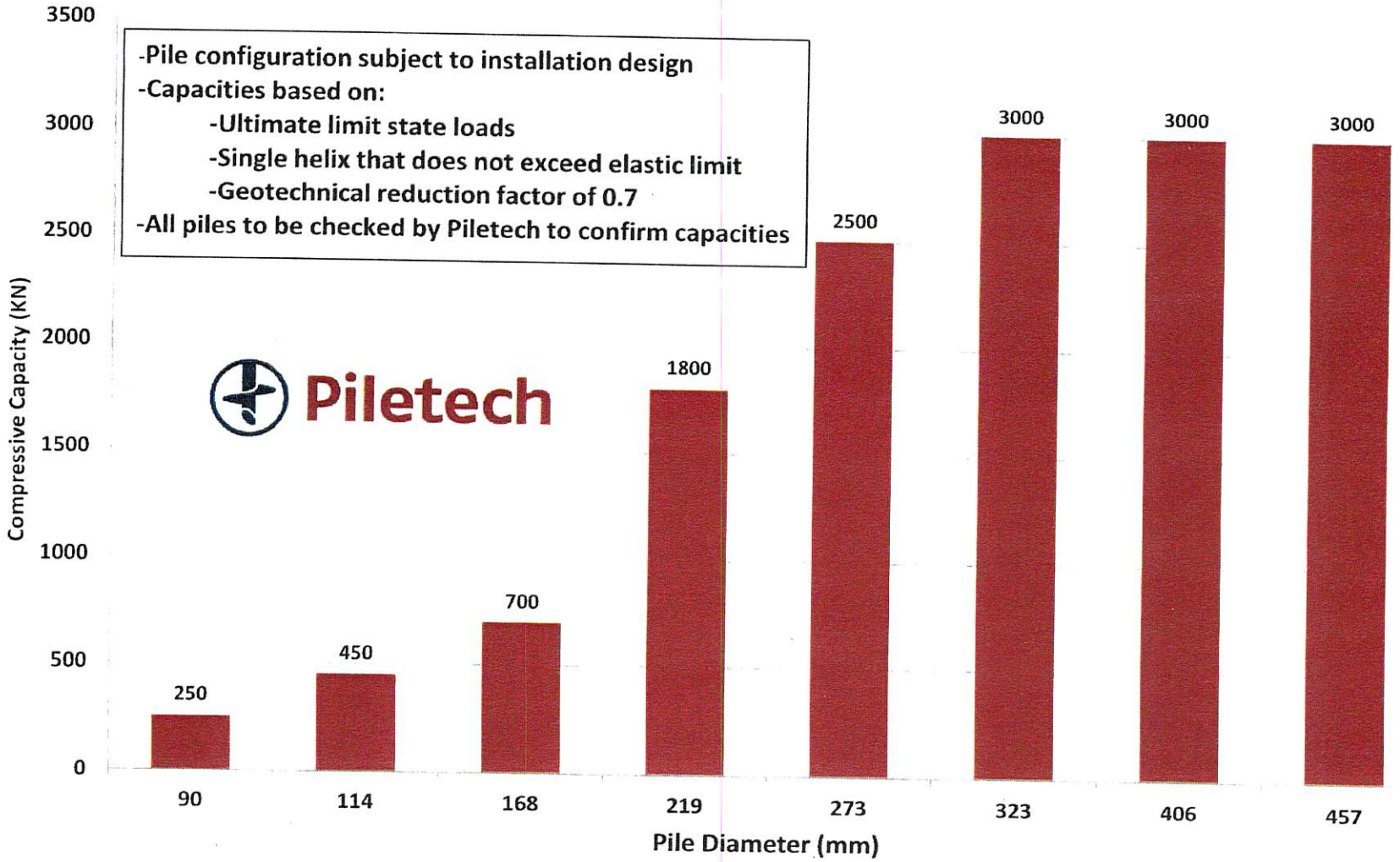
ACCESSIBILTY OF RIGS TO INSTALL STEEL SCREW PILES

INSIDE STRUCTURES - PILE CAPACITIES - CHRISTCHURCH INTERMEDIATE GRAVELS

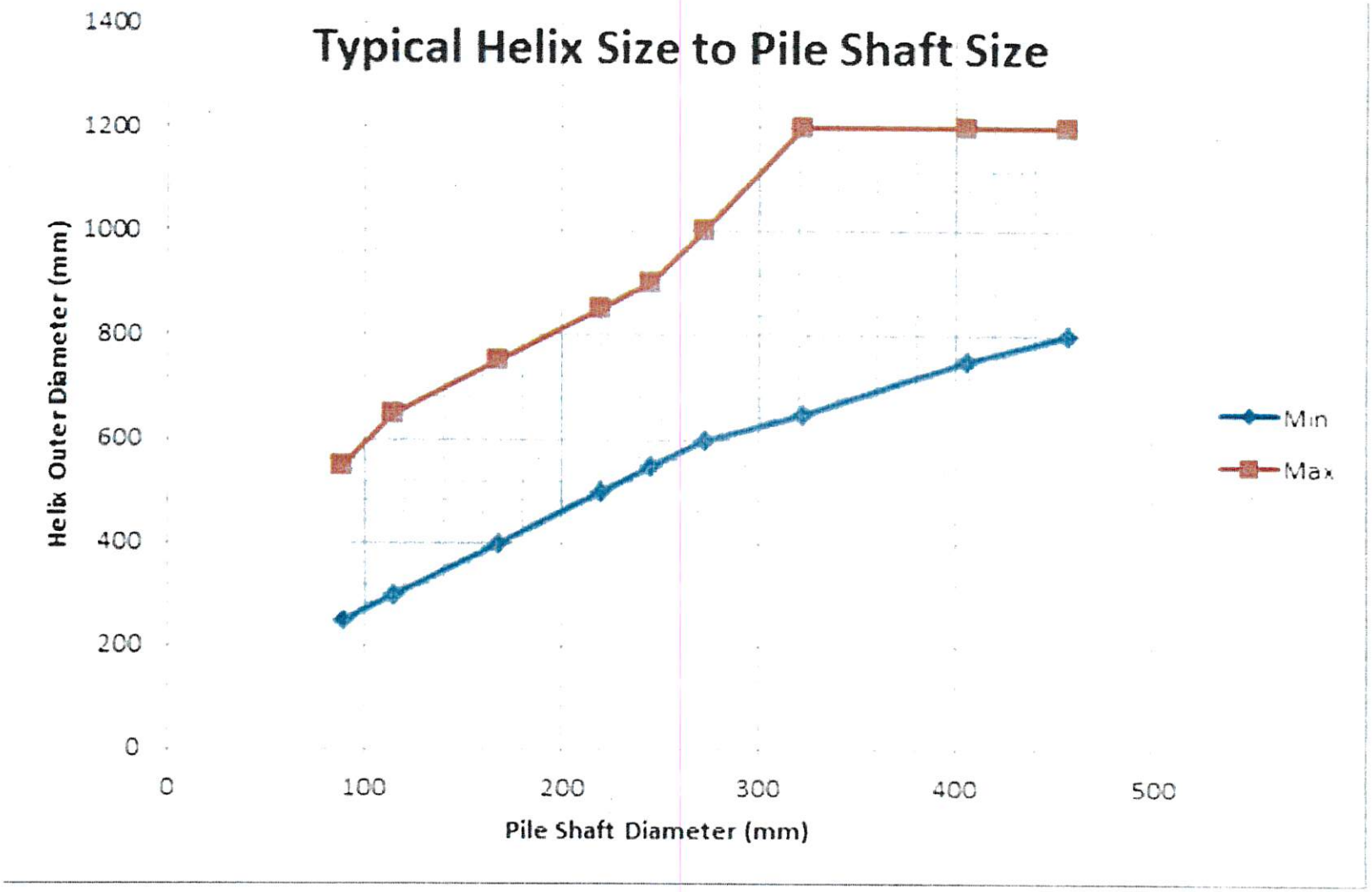


	Bobcat	12 Tonner	35 Tonner
COMPRESSION			
Ultimate Geotechnical Compression Strength (Rd,ug)	357 kN	1071 kN	2083 kN
Achievable ULS Compression Load (ϕ_g = 0.4)	143 kN	429 kN	833 kN
Achievable ULS Load Compression (ϕ_g = 0.7)	250 kN	750 kN	1458 kN
TENSION			
Ultimate Geotechnical Tension Strength	200 kN	600 kN	1061 kN
Achievable ULS Tension Load (ϕ_g = 0.4)	80 kN	240 kN	424 kN
Achievable ULS Load Tension (ϕ_g = 0.7)	140 kN	420 kN	742 kN

Compressive Load Capacity in Cohesionless Soils



Piletech


Typical Helix Size to Pile Shaft Size
Helix Outer Diameter (mm)
1400
1200
1000
800
600
400
200
0
0
100
200
300
400
500
Pile Shaft Diameter (mm)
Min
Max

SP9

SP10


SP11

Appendix H: Concepts for Strengthening

Harley Chambers

General

- SK13 Ground Floor Plan Eastern Concrete Walls
- SK14 First Floor Plan Eastern Concrete Walls
- SK15 Second Floor Plan Eastern Concrete Walls

34% x NBS

- SK11 Ground Floor Plan North Section

67% x NBS

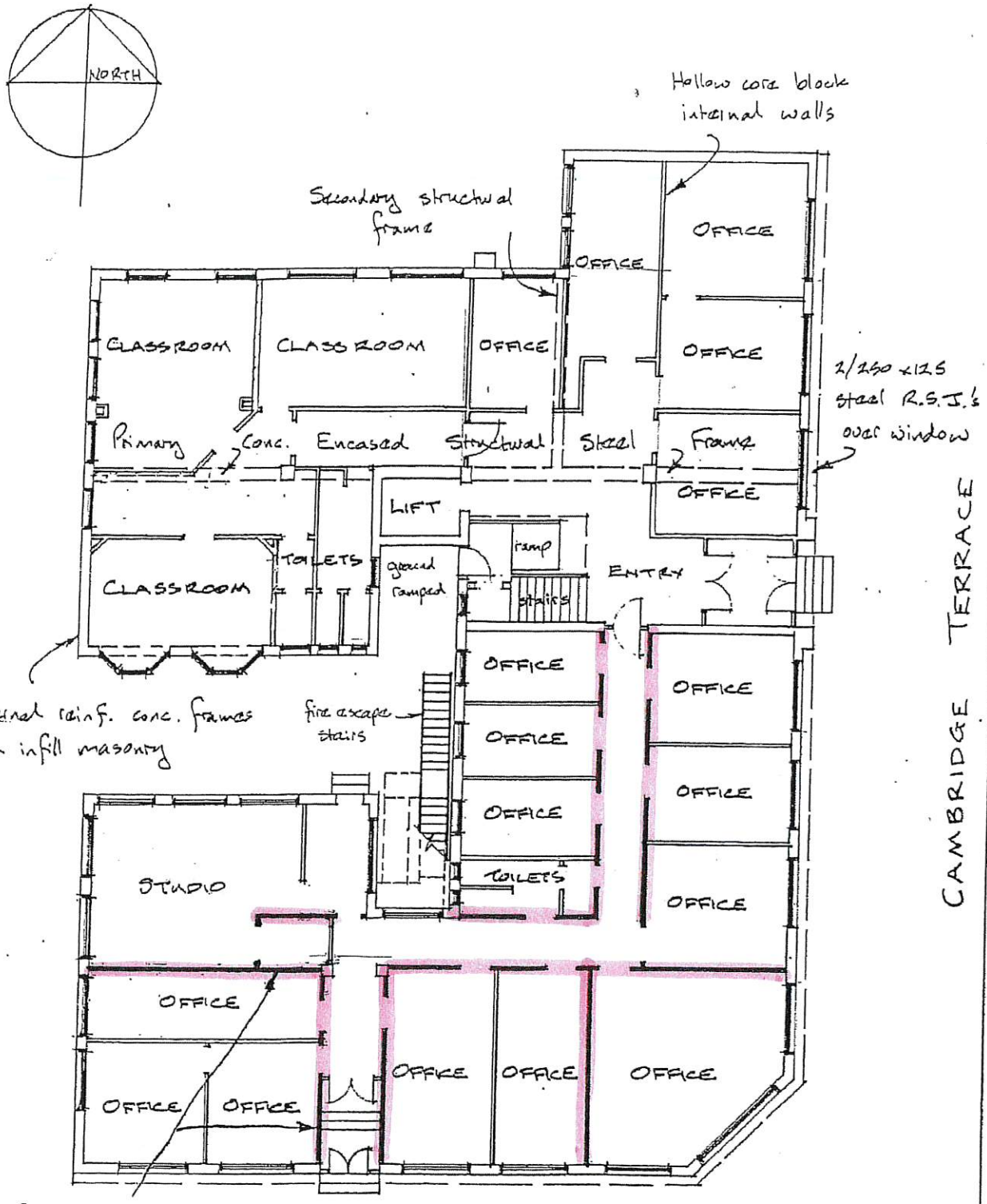
- SK16 Ground/First/Second Floors New Skin Walls to South Section

100% x NBS

- SK12 Ground Floor Plan North Section
- SK17 Ground/First/Second Floors New Skin Walls to South Section

Perimeter Column Strengthening to Façade

- SK18 Perimeter Column Strengthening



NOTES:

1. Existing concrete walls

'HARLEY CHAMBERS' - GROUND FLOOR PLAN
SOUTH SECTION - EXISTING CONCRETE WALLS

Quoin
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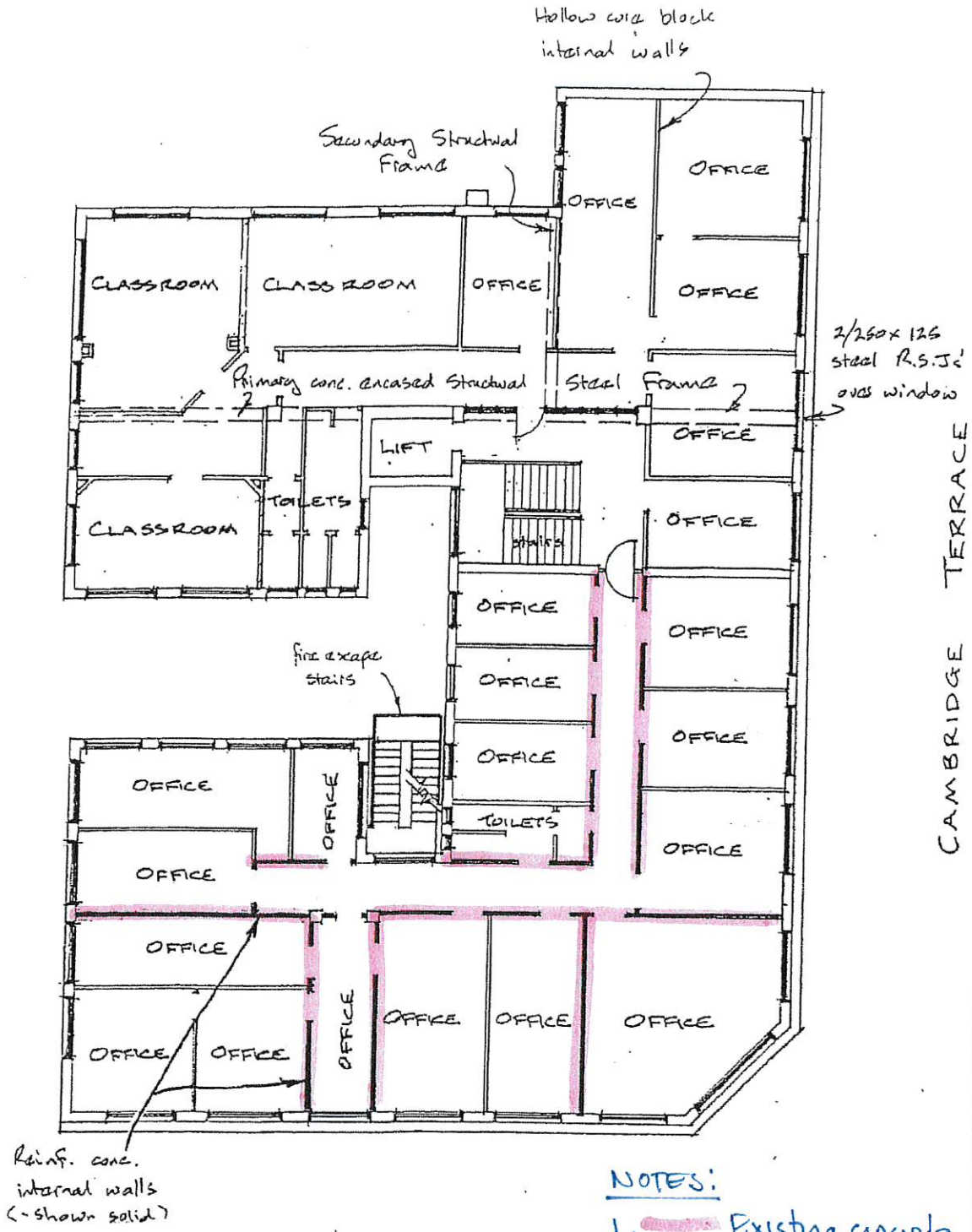
SCALE: 1:200 (A4)	DRAWN:	BAG	SK13
DATE: 31-7-17	APPROVED:		



NOTES:

1. Existing concrete walls

'HARLEY CHAMBERS' - FIRST FLOOR PLAN
SOUTH SECTION - EXISTING CONCRETE WALLS

Quoin
03 968 4925
quoin.co.nz

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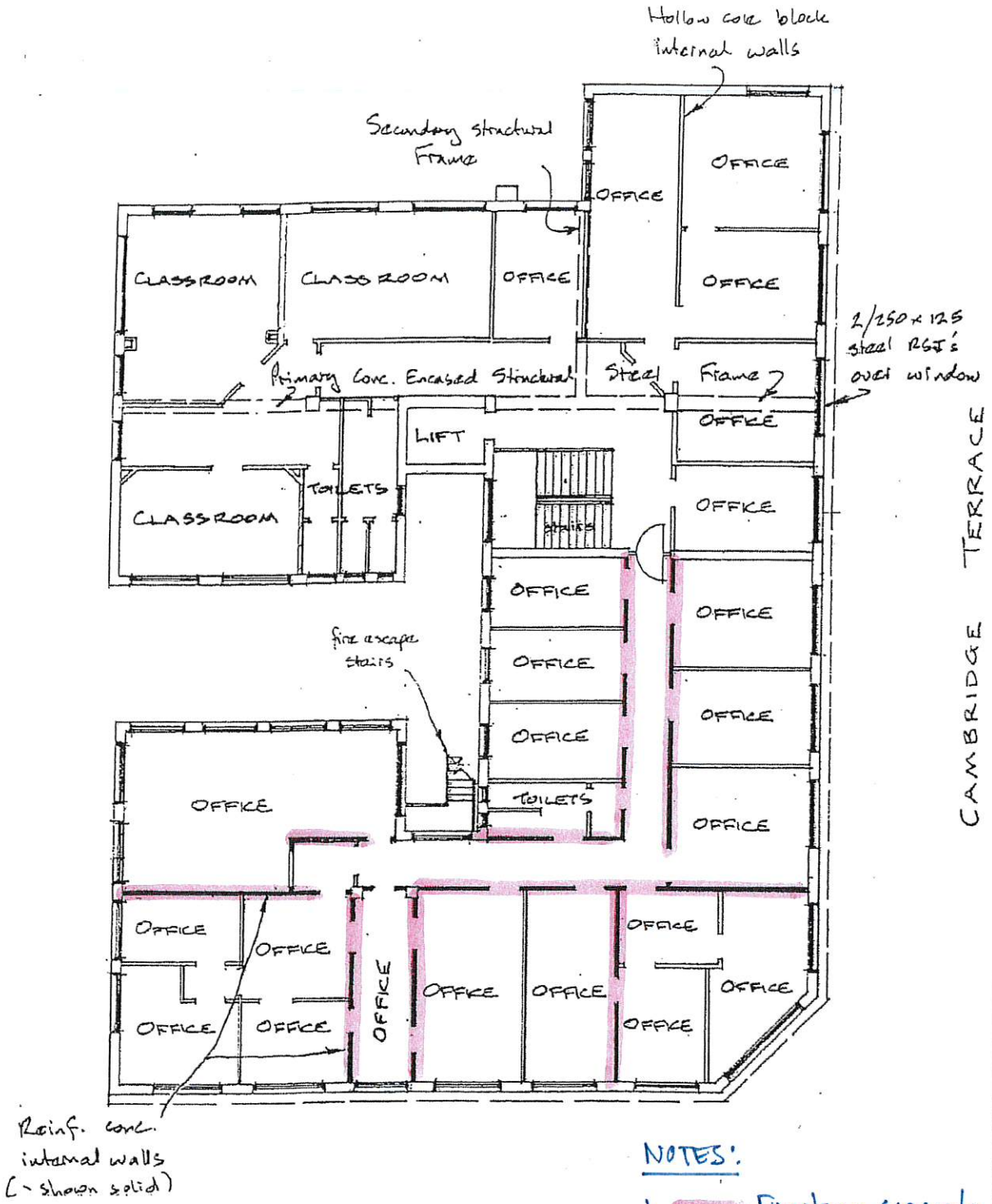
DATE:	APPROVED:		



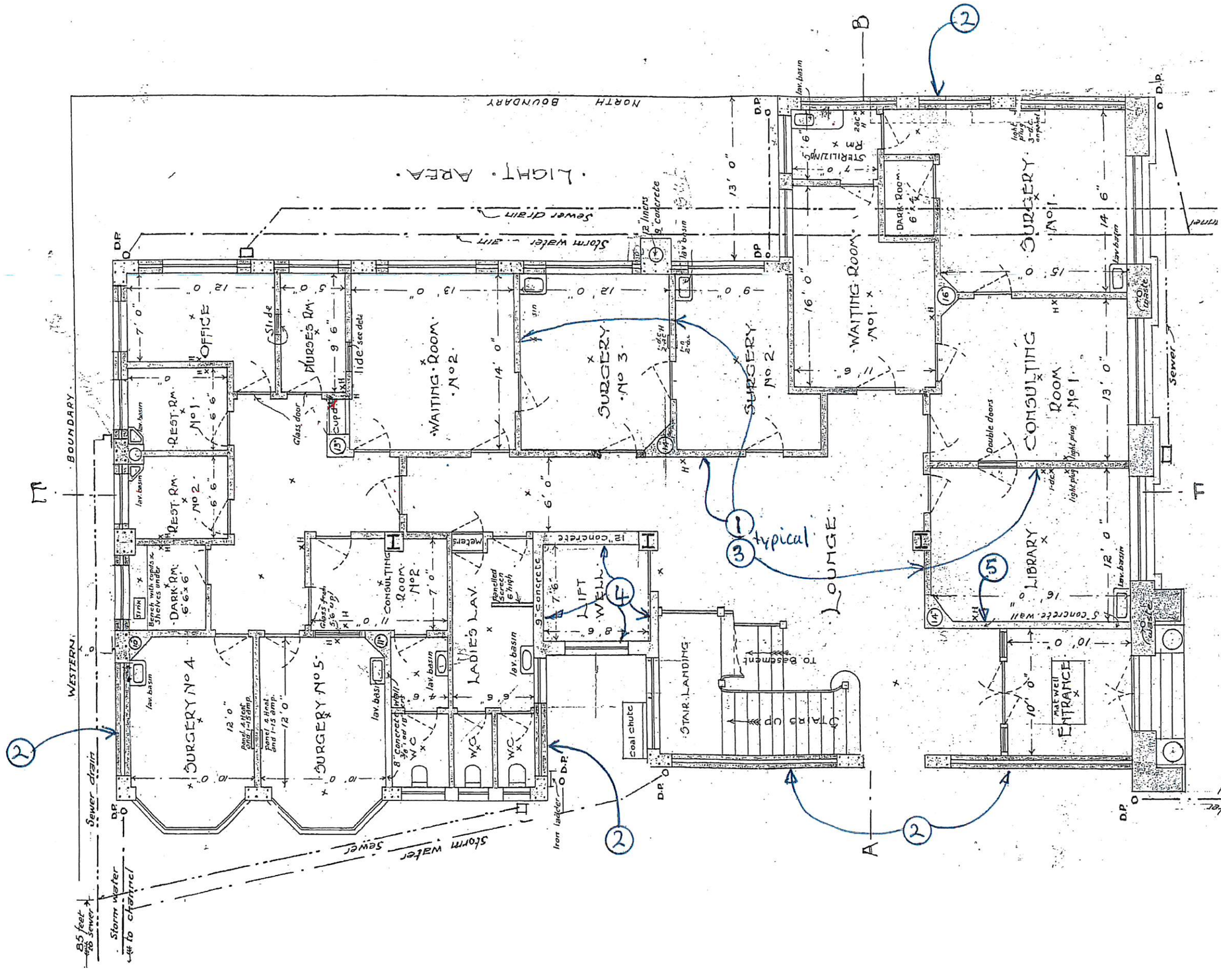
NOTES:

1. Existing concrete walls

'HARLEY CHAMBERS' - SECOND FLOOR PLAN
SOUTH SECTION - EXISTING CONCRETE WALLS

Quoin
03 968 4925
quoin.co.nz

SCALE: 1:200 (A4)	DRAWN:	BAE	SK15
DATE:	APPROVED:		



Notes

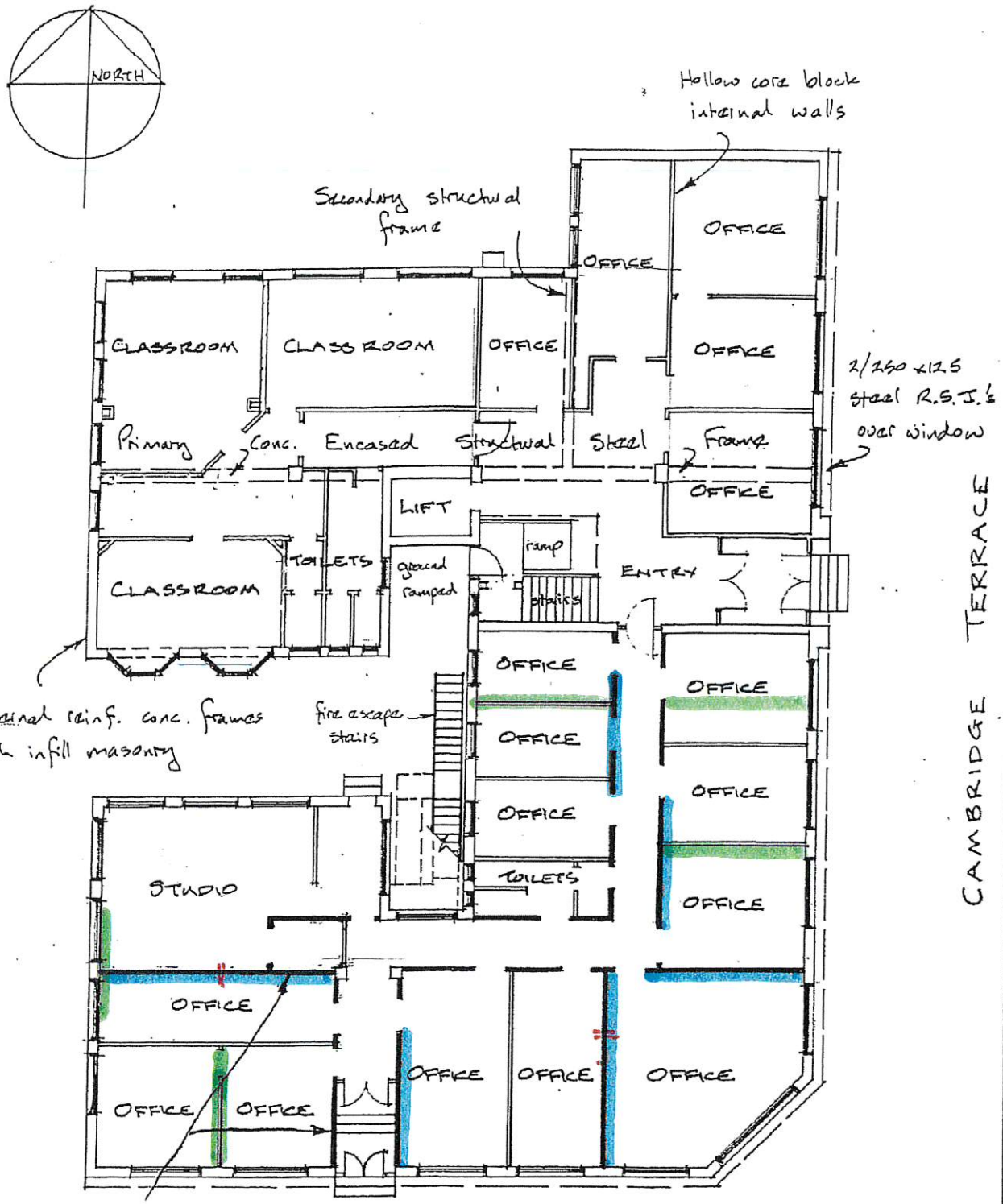
1. Remove all hollow masonry block partition walls and reinstate with 190 solid filled masonry block, reinforced, at locations where the walls align above/below floors. Elsewhere, replace with light weight non-structural walls. This occurs at all floors.
2. Remove double brick walls over full height and reinstate with 240 solid filled masonry block, reinforced.
3. Refer to SK10 for extent of hollow brick partition walls.
4. Provide new reinforced concrete lift shaft walls above Level 2 floor.
5. Deconstruct concrete wall and reinstate with new 200mm thk concrete wall

N

0 Issue	Preliminary Information	BG By	Appd.	23/09/2011 Date	BG Drawn	BG Designed	BG Approved	1:100 Scales	Lee Pee Limited Client	Harley Chambers Project Title	

Quoin 03 968 4925 quoin.co.nz

Ground Floor Plan North Building EQ Strengthening Option - 34% x NBS Drawing Title	SK11 Drawing No.	Project 10490	0 Issue



NOTES:

1. New 150 thk skin wall (H12 c 200 ew)
2. New 250 thk shear wall (H16 c 200 ew, ef)
3. Cut back extg wall 400mm each side and reform with new 20mm gap
4. Strengthen all perimeter columns with Sika CarboDur. Refer SK

'HARLEY CHAMBERS' - GROUND FLOOR PLAN

67% x NBS

- FIRST & SECOND FLOORS SIMILAR

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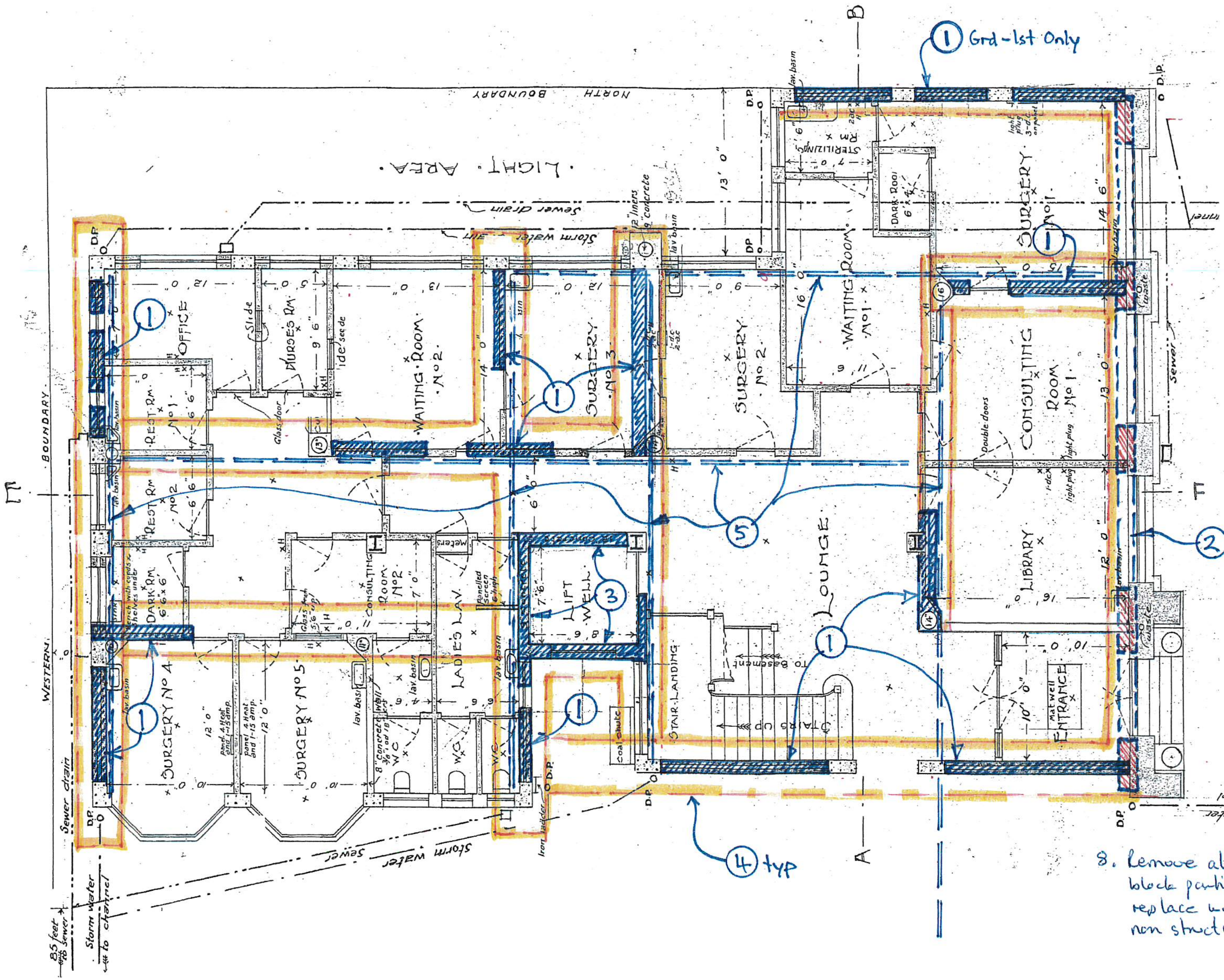
03 968 4925
quoin.co.nz

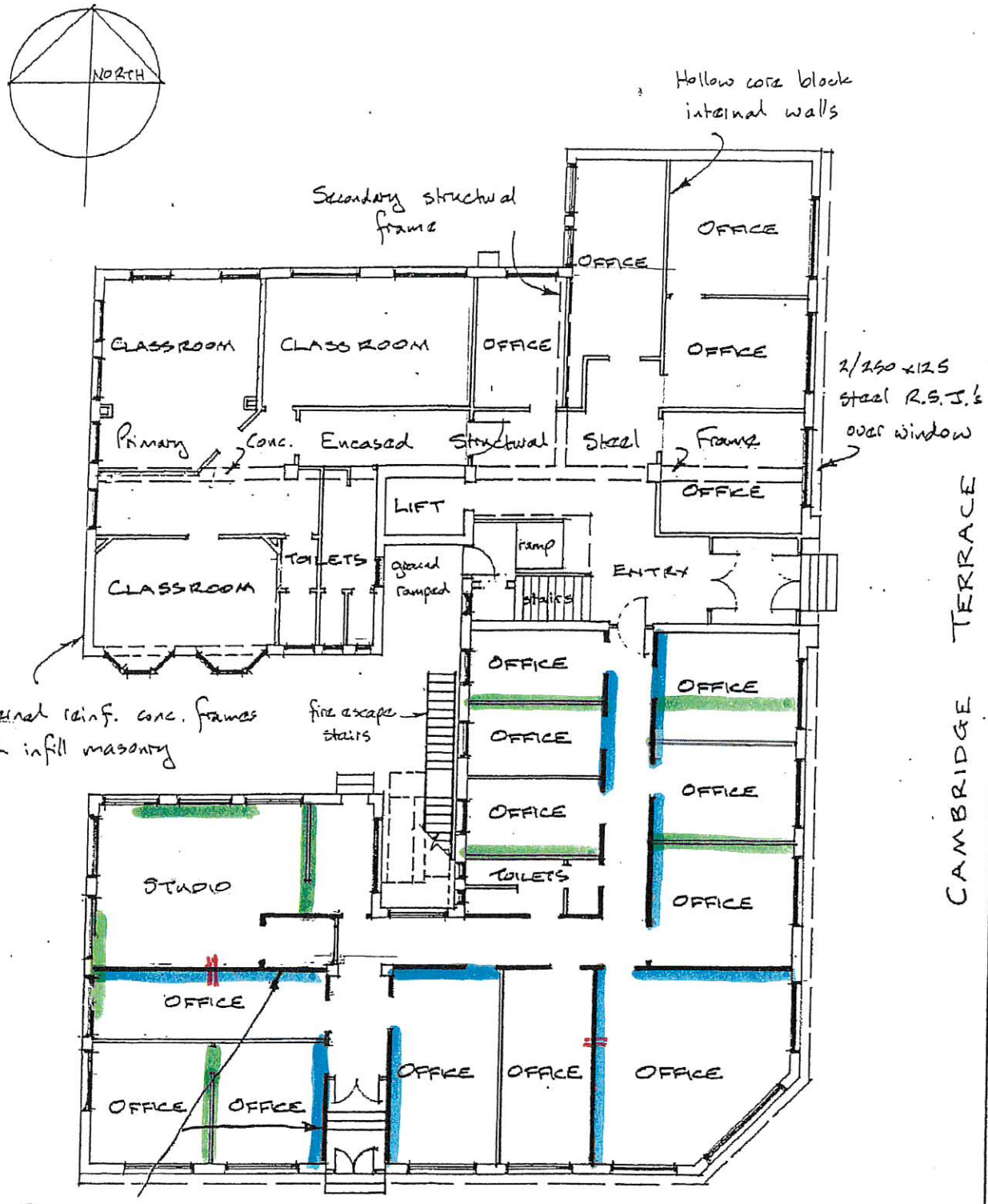
SCALE: 1:200 (A4)	DRAWN:	BAG	SK 16
DATE: 31-7-17	APPROVED:		



Notes:

1. Provide new 300mm thk reinforced concrete shear wall at locations shown, full height of building, unless noted otherwise
2. Provide new 400mm thk insitu concrete frame columns + beams
3. Reconstruct lift core walls as new, including lift pit
4. Provide new foundations for the above as shown dotted, Allow for 1000mm deep, typ.
5. Provide enhanced floor diaphragm ties as shown (reinforcing epoxied into chases in floor slab and/or carbon fibre reinforced polymer strips (CFRP))
6. A strengthening scheme for 67% x NBS is similar to 100% x NBS accept that reinforcing may be reduced by 30% and foundation depth reduced by 20%. Some wall thicknesses may be reduced.
7. Strengthening option(s) require further detailed investigation, analysis and design.
8. Remove all hollow masonry block partition walls and replace with light weight non structural partitions.

Issue		By	Appd.	Date	Drawn	Designed	Approved	Scales	Client	Project Title			Drawing Title	Drawing No.	Project / Issue
0	Preliminary Information	BG		23/09/2011	BG	BG	BG	1:100	Lee Pee Limited	Harley Chambers	Quoin	03 968 4925 quoin.co.nz	Ground Floor Plan North Building EQ Strengthening Option - 100% x NBS	SK12	10490 / 0



NOTES:

1. New 200 thk skin wall (H1 & 2 00 ew) + infill doors where shown
2. New 250 thk shear wall (H1 & 2 00 ew)
3. Cut back exty wall 400mm each side and reform with new 20mm gap
4. Strengthen all perimeter columns with Sika CarboDur.

'HARLEY CHAMBERS' - GROUND FLOOR PLAN

100% x NBS

- FIRST & SECOND FLOORS SIMILAR

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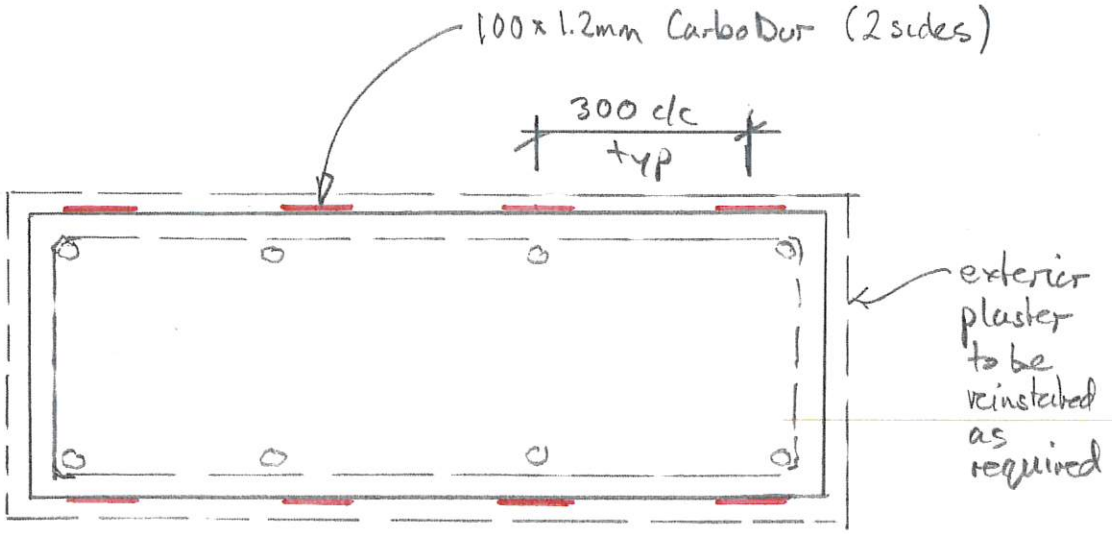
quoin.co.nz

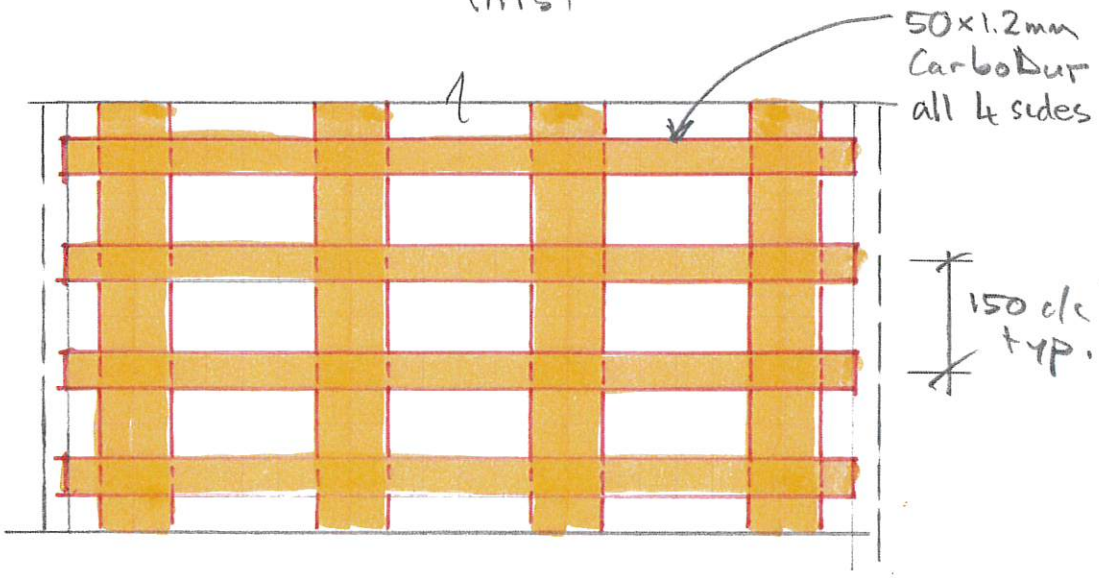
SCALE: 1:200 (A4)	DRAWN:	BAG	SK 17
DATE: 24-7-2015	APPROVED:		

Quoin

Project	HARLEY CHAMBERS.		
Reference	12088 - SK18		
Date	31-7-17	Author	BAG



PART PLAN - COLUMN
(nts)



PART ELEVATION - COLUMN
(nts)

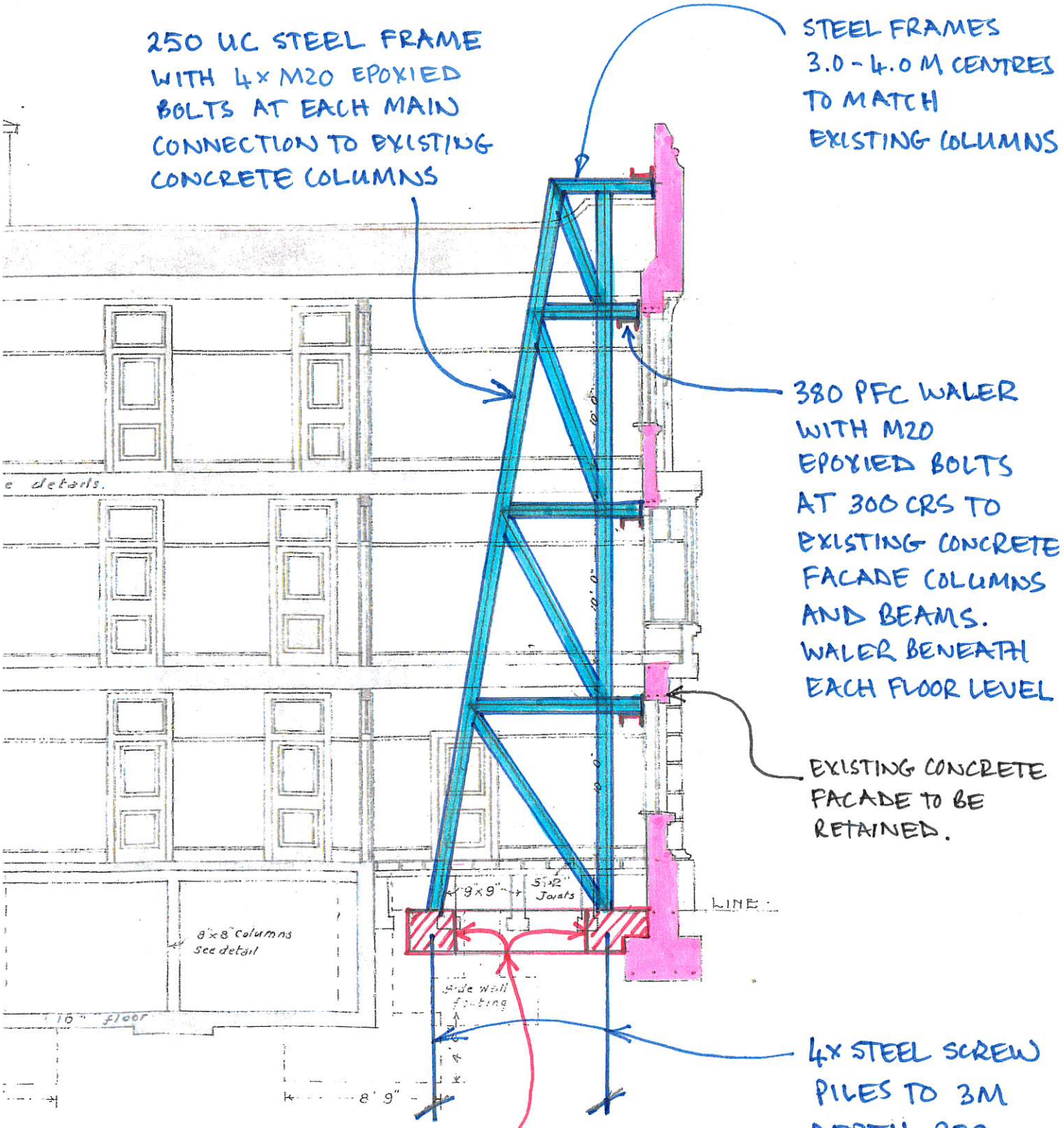
PERIMETER COLUMN STRENGTHENING

Appendix I: Façade Retention

Harley Chambers

General

- SKF1 Temporary Steel Frame Lateral Support for Harley Chambers Façade.



TEMPORARY STEEL FRAME LATERAL SUPPORT FOR HARLEY CHAMBERS FACADE

Name	HARLEY FACADE		
Project no.	12088		
Date	8-9-2017		
Sketch no.	SKF1	Revision no.	A

Quoin
03 968 4925
quoin.co.nz

Appendix J: Draft Construction Management Plan

Cambridge-Worcester Hotel Development

Contents

1. Site Address & Consent

The site is located at the corner of Cambridge Terrace and Worcester Boulevard, Christchurch, and includes the sites at 137 Cambridge Terrace, 69 Worcester Boulevard and 65-67 Worcester Boulevard.

Resource Consent [RMA] has been issued by the Christchurch City Council for the redevelopment of the site.

The conditions of Resource Consent [RMA] are to be complied with at all times by the contractor. A copy of the Resource Consent is included as Appendix A to the Construction Management Plan [CMP]

2. Contact Details

The Contractor is ……..

The Site Manager is ……..

Contact phone number is ……..

After hours contact number is ……..

3. Responsibilities

The site manager is responsible for the implementation of this CMP.

The engineer to the contract is [TBC] who will have an overseeing role for ensuring the site manager complies with the CMP, health and safety policy and procedures, engineering design and all regulatory consents.

4. Time Frame

The project will be undertaken in stages over a period of approx. 2.5 years. A preliminary programme is attached [TBC by contractor].

5. Description of Work Activities

(a) The project works includes the construction of a new hotel adjacent to the Worcester Chambers building as indicated on the Concept Architectural drawings. The hotel includes the construction of the underground carpark, and low height glazed atrium directly adjacent to the east, north and west sides of Worcester Chambers. A brief description of the main works is set out as follows.

(b) Carefully deconstruct Harley Chambers and rear section of Worcester Chambers

(c) Install a permanent ground retention system around the perimeter of the Worcester Chambers building and overall site to allow construction of the basement. This would likely involve the following, subject to detailed design:

- Retention system likely to be installed approximately 0.6m-1.0m away from Worcester Chambers.

- Steel sheet piling using low vibration equipment.
- Install near horizontal ties beneath the foundations of Worcester Chambers to tie the top of the sheet pile walls together.
- Part excavate and install horizontal steel walers near the top of the sheet piling, and temporary braces that extend from the walers down to temporary foundations at the level of the new basement.
- Complete full excavation for the basement, construct the foundations, and utilise the steel sheet piling as permanent formwork to construct the concrete walls to the basement.

(d) Construction of concrete foundations to the basement.

(e) Tie the foundations of Worcester Chambers to be laterally tied into the new ground floor level slab and beams to the new building as construction of the building(s) proceed.

(f) The design of the basement structure adjacent to Worcester Chambers to incorporate laterally stiff elements on all sides of Worcester Chambers (eg walls and/or steel braced frames) so that the performance of Worcester Chambers remains unchanged.

(g) Typically provide seismic joints and gaps between Worcester Chambers and the new building, above ground floor level only. There may be sections of Worcester Chambers where the new building adjoins via flashings, sliding joints, corbels etc.

At times, the work will involve the use of heavy machinery to carry out earthworks and compaction. Heavy machinery is most likely to be utilised at the commencement of the construction period and will likely involve creation of some noise, vibration and dust effects. These effects will be minimised as described in the following sections.

6. Site Inspections

A weekly formal site meeting will occur. Present at the meeting shall be:

- The engineer to the contract and/or his representative
- The contractor, ……..
- Any other personnel considered necessary

The contractor is to keep minutes of the meeting and provide copies to each party by email within 48 hours. The agenda for the meeting will include:

- Those present
- Any apologies
- Work carried out in the previous week
- Review of the programme
- Any quality issues
- Any material supply issues

- Any site instructions required
- Any variations to be issued
- Construction Drawing register update
- Weather conditions over the last week
- Any delays to the work
- Health & Safety Matters
- Council Inspections
- General matters

7. Noise, Dust & Vibration

Where required, machinery is to be muffled so that they comply with the limits for construction noise as set out in the Christchurch City Plan. Construction noise and vibration is to comply with New Zealand Standard NZS 6803:1999 'Acoustics – Construction Noise.

The contractor is to provide the engineer with certification for each heavy machinery and its compliance with the relevant noise limits.

No work is permitted on Sundays or Public Holidays.

The contractor is to have a water cart and/or water sprinkler equipment available during the earthworks activities to be used to supress dust during dry/windy periods.

Vibration from earthworks machinery is to be monitored by the site manager and engineer and if found to be excessive then alternative methods of construction employed. This is to be discussed between the engineer and site manager at the time of the works.

8. Complaint Protocol

A register is to be kept by the site manager of any complaints received from the public or the Council. This register is to be available for viewing by the engineer and the Council.

The site manager is to investigate each complaint made and make recommendation to the engineer on how to rectify the problem. The engineer will then, if necessary, instruct the site manager to undertake the work as appropriate.

If a complaint is received from or via the Council then the site manager is to keep Council and the engineer informed of the rectification measures taken, where required.

9. Notice Board

A notice board is to be erected next to the site entrance. The notice will identify the site manager, telephone number and address of service.

10. Access to Site

Access to site is to be provided off Worcester Boulevard. Due to the nature of the area care is to be taken for the establishment of large equipment and the delivery of bulk materials.

11. Site Maintenance

The site is to be maintained in a tidy state at all times. Any rubbish is to be removed on a weekly basis. Materials are to be stored in tidy stockpiles. The engineer will inspect the site on a weekly basis and will instruct the site manager to rectify any areas of the site that is left untidy.

12. Contractors Facilities

The contractor is to provide a temporary site office on the land next to the site entrance. Port-a-loos are to be provided for the contractor's staff during the works.

13. Sediment Control

A sediment control plan is to be submitted to the engineer for approval and submitted to CCC before construction works commence. The sediment control plan is to follow ECAN Erosion & Sediment Control Guideline 2007.

14. Traffic Management

A traffic Management Plan (TMP) is to be developed by the contractor identifying how material supplies and mechanical plant are to be delivered to site. A copy of the TMP is to be held on site. The TMP is to be submitted for approval by CCC before construction works commence.

15. Health & Safety

The contractor shall comply with enactments, regulations and working rules relating to safety, health and welfare for both workmen and members of the public, and in particular the requirements of the Health and Safety in Employment Act 1992 (The Act), amendments and regulations of 1995, and the requirements of the Occupational Safety and Health Authority (OSH) and as current at the date of the contract.

The contractor will take all practical steps necessary to assist the principal to comply with the provisions of the Act and advise the engineer immediately of any obligations under the act that are not being fulfilled by any party.

STUDIO 21
ENDEL LUST
CIVIL ENGINEER LTD

284 Kilmore Street P: 03 366 9989
E: endellust-engineer@clear.net.nz
PO Box 21121, Christchurch

Quantitative Engineering Evaluation Report
'Worcester Chambers' – 69 Worcester Street
for '69 Worcester Limited'

Quoin

Quantitative Engineering Report
'Worcester Chambers' – 69 Worcester Street
For '69 Worcester Boulevard Limited'

1. Preliminary

This Report is a reworking of previous Reports issued by this Consultancy but now in the format that was published by the Engineering Advisory Group – 'Guidance on Detailed Engineering Assessment of Earthquake Affected Non-Residential Buildings in Canterbury – Part 2 Evaluation Procedure'.

The original magnitude 7.1 earthquake in the Christchurch area on 4 September 2010 resulted in superficial damage to the above building and it was continued to be used as an English School. The magnitude 5.5 aftershock on Boxing Day 2010 caused slightly more superficial damage.

The magnitude 6.3 aftershock on 22 February 2011, while of a lesser magnitude, caused considerably more damage in the Christchurch area than the September 2010 earthquake. This caused more damage in the above building but the basic structure was still safe. The loss of services (power, water and sewer) and the location of the building in the CBD Red Zone, at that time, meant that the building could not be occupied. It was also not possible to gain access to commence remedial work.

Remedial work was finally commenced in May 2011. This will be described later in this report.

The double aftershock (magnitudes 5.7 & 6.2) on 13 June 2011 caused little or no extra damage although the remedial work was well underway. The remedial work was nearing completion at the end of August 2011 however the demolition of the neighbouring building, 'York House', at 67 Worcester Street resulted in some damage to 'Worcester Chambers'. This was mainly broken windows, broken service pipes and guttering. This was not 'structural' damage but has resulted in a delayed reopening for Worcester Chambers.

The building has been inspected at various dates after the earthquake and aftershocks and during the remedial works.

The inspections and this report were concerned primarily with structural elements of the building and, while other elements may be discussed, this is not intended as a full Building Report.

This Report plus the attached calculations constitute a quantitative DEE for the building. A qualitative DEE comprising a Report on the building and a completed IEP on the CERA spreadsheet format was submitted to CERA and this was accepted in August 2012. That DEE determined the building to be about 69% NBS.

2. Address

The address of the property is 69 Worcester Boulevard, Christchurch.
The legal description of the site is Part Lot 2 DP 9096 plus Lot 2 DP 6773.
There is only one building on this site.

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3. Site

The site is flat.
A typical soil profile, based on shallow investigations carried out by this Consultancy would comprise topsoil down to approx 0.30M overlay medium silty-sands to a depth of approx 2M. Below this are relatively hard sandy gravels down to a depth of approx 8-10M.

The subsoils for this site would be classified as 'Subsoil Class D' as categorised in NZS/AF 1170.

The site is not close to a cliff-top or base.

The nearest waterway (Avon River) is approx 50M distance away to the East of this site.

There was no evidence of any liquefaction of the site subsoils throughout the period of significant seismic activity in the Christchurch area from 4 September 2010 through to about the end of 2011.

4. Description Building

Worcester Chambers was built in 1928 and extended in the 1950's and has a Group 3 Heritage classification in 'The City Plan' and is registered with the New Zealand Historic Places Trust. The building is a two storey structure with a light weight) roof supported on timber trusses. The external walls to the first floor are double brick construction. The first floor is a suspended reinforced concrete slab that spans between insitu reinforced concrete walls and reinf. concrete beams and columns on the ground floor. External walls are still clad in brick to match the first floor. The ground floor is timber on joists, beams and concrete piles with a concrete perimeter foundation to the 'front' two-thirds with a concrete floor to the rear section.

Extensive alterations were carried out in 2007 and earthquake strengthening was carried out on the first floor of the structure. This involved the installation of structural steel frames to support the external brick walls, provide bracing frames, and independently support the roof structure. The 'strengthening' was designed and supervised by this Consultancy and a Construction Review was issued on completion of the works.

The entire building has been used as an English Language School and offices. This use would be classified as IL2 in the Standard NZS/AS 1170.

Copies of floor plans for the current layout of the building are attached to this Report.

5. Structure

The gravity structure comprises roof load supported on roof trusses that transfer the roof loads to the external walls. External walls are now 'strengthened' by structural steel frames that prop the first floor brick walls and independently support the roof trusses. The first floor loads are carried by a reinforced concrete suspended floor slab that spans between reinforced concrete walls and reinforced concrete beams and columns in both the North-South and the East-West directions. The ground floor external walls are clad in brick to give the appearance of an all brick building.

The ground floor 'structural' walls are supported on concrete foundations with the timber ground floor supported on timber joists and bearers and on sub floor piles. A small semi basement is on the East side of the building and this is an all reinforced concrete 'bunker' that used to house a boiler. Similarly the reinforced concrete columns are supported on concrete pads integrated into a concrete floor at the rear of the building.

The 'lateral' structural system comprises structural steel frames in both directions to the first floor with internal, sheet braced, walls at relatively regular spacing 'across' (East-West direction) the building. The ground floor lateral structural system comprises reinforced concrete walls, at regular intervals, in both directions with a robust reinforced concrete diaphragm to the first floor, and reinforced concrete beams in two directions in a symmetrical grid supported on reinforced concrete columns to the rear of the building.

6. Foundations

Foundations comprise reinforced concrete foundation beams under the perimeter walls and under the reinforced concrete ground floor walls, and to the reinforced concrete frames.

There was no evidence of earthquake induced settlement due to the earthquake and aftershocks in the seismic period from 4 September 2010 through to the end of 2011.

7. 'Damage'

The 'damage' listed here is the total observed after the September 2010 earthquake and the various aftershocks through to June 2011. Most (80 – 90%) of the 'damage' was as a consequence of the February 2011 aftershock.

The list that follows is a broad outline of damage that occurred –

(i) A brick chimney to an old coal boiler was seriously weakened at the roof level but did not actually collapse.

(ii) Plaster dislodged from a curved soffit over the front (South) wall.
This revealed a timber structure with lathes.
A decorative plaster chalice fell to ground on the East side of the front to the building. A matching chalice on the West side was not secure.

(iii) Some minor cracking following mortar courses in brick work to 'front' (South) wall and side (East) wall. These were partly historic.

(iv) Some bricks in the top course around the stairwell and kitchen alcove had come loose. There was deterioration in the mortar but no actual bricks dropped. Inspection of cavity ties confirmed there to be old wire ties at relatively wide spacings. Existing ties had corroded noticeably and were of minimal use.

(v) Slight settlement in the edge of the stairwell. This was relatively close to the neighbouring building (York House) and as such this area was seldom checked. Investigation confirmed a downpipe had been discharging direct to ground at this corner for some years. The bearing substrata had therefore been weakened and while this was consequential damage it was not considered to be due to possible liquefaction of subsoils.

(vi) A number of windows were broken. These were in steel frames and this would not have been unexpected as steel window frames hold the panes rigid and have no tolerance for movement.

(vii) The soffit movement in the front (South) wall had resulted in damage to a large built in tray gutter. The gutter had been constructed with copper.

(viii) Internally there were cracks in some perimeter brick walls. Usually below windows in a diagonal stepped pattern or over some windows in the 'front' wall by the damaged soffit.

(ix) The counter-balanced fire escape stair at the rear of the building has some damage to the handrails and treads. This was partly historic but the February 2011 aftershock did appear to contribute to further damage.

(xi) Light fittings in most rooms were damaged by excess swaying, some had semi collapsed and most had lost some part of the fittings.

Power to building was turned off by Supplier almost immediately. Power was not turned back on until April-May 2011.

(xii) Floors were checked and confirmed as level. Walls were checked and confirmed as plumb. There was no evidence of any liquefaction and therefore no earthquake induced settlement in the building.

All the damage was minor or superficial with no 'structural' damage and the building was assessed as 'safe' for access for repairs and restoration.

A yellow placard was placed on the building after the February 2011 aftershock as there was a risk of falling plaster over the entry. This was subsequently removed when the earthquake repairs were completed.

8. Remedial Work

(i) Remove brick chimney down to ceiling level. Make good roof structure and clad over opening.

(ii) Remove loose plaster, check lathes and timbers and replaster curved soffit to match original.

An heritage architect was involved in the project and he produced a detail for a new pedestal for the chalices of framed timber with ply sheeting over and plaster render to match existing. New decorative 'chalices' to be turned in treated timber, fixed to pedestal and painted to match original finish.

(iii) All cracks in brick work to be tied across cracks with Helicoil reinforcing on every fourth mortar course. Helicoil bars to extend 500mm past cracks in each direction. Mortar courses then to be relaid so as to match original.

(iv) Relay loose bricks and repoint mortar courses that have deteriorated.

As there is a concern that the original ties may have lost their structural integrity all first floor exterior cavity brick walls to be tied using Helifix ties. Ties to be at approx 400mm c/c horizontally and vertically but so as ties are in the middle of whole bricks.

(v) Underpin stairwell edge with a simple reinforced concrete pad/beam tied to the original foundation. The soft, semi saturated soil, extended down a depth of approx 500mm below underside of foundation. Site instruction issued to Contractor. Basically underpin beam was 500mm x 500mm in section and reinforced with 4 - D16 bars and D10 stirrups at 200 c/c with D16 ties epoxied into the existing concrete foundation at approx 500mm c/c. Length of foundation to be underpinned was approx 3.0M long.

(vi) Reglaze windows as required.

(vii) Reline gutter. This could be done with a fibreglass (Chevaline Dexx) lining.

(viii) 'Stitch' across internal cracks with Helicoil reinforcing cut into every fourth mortar course. Set in place with Helifix mortar. Finish off internal plaster render to match existing.
Similarly for horizontal cracks cut in slots vertically across cracks and reinforce as described.

(ix) Replace hand rails and treads to fire escape with suitable timber. Finish off treads with suitable non slip finish.

(x) Remove one sheet Gib by East wall in each butting wall.
Redo stud connections to brick wall with Chemset anchors.
Replace removed sheet with a sheet of Gib Braceline fixed in accordance with Gib requirements.
Repair all cracked Gib board linings in accordance with Gib publication *'Guidelines for Repairing Gib Plasterboard Linings in Wind or Earthquake Damaged Properties'*.

(xi) Electrician to repair all light fittings and check all electrical circuits including fire alarms and emergency lighting, and provide a Producer Statement at completion of works.

(xii) All rooms will require extensive redecoration to match the original finishes.

All of the remedial work described above was completed in May 2011 and the building was reoccupied about June 2011.

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9. Assessment

Attached are copies of structural calculations for a recent quantitative assessment of the building. This assessment is of the building at the date of this Report.

The building assessments are summarised as follows –

First Floor 'along' the Building (North-South)	87.7% NBS
First Floor 'across' the Building (East-West)	84.8% NBS
Ground Floor 'along' the Building (North-South)	88.8% NBS
Ground Floor 'across' the Building (East-West)	73.2% NBS

Ground Floor rear section with reinforced concrete frames is 82.9% NBS in both directions

The Building 'strength' is then taken as 73.2% NBS based on a quantitative assessment

10. Conclusions

The building at 69 Worcester Street has been assessed as not 'earthquake prone' as defined in the 2004 Amendment to the Building Act.

As the building assessment is greater than two-thirds NBS the structure is assessed as not a 'potential earthquake risk'.

The building is assessed as safe for public occupation.

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