Structural Assessment Report For Manchester Court Building – REPORT No. 2

Date	5th October 2010
Author	Warrick Weber BE MIPENZ CPEng (Struct&Civil) IPE
	Gridline Limited
Building Name	Manchester Court Building
Location	Cnr Manchester Street and Herford Street, Christchurch
Legal Description	Pt TS 784 Chch City Lot 2 DP
Construction Date	1906-07
No. of Levels	7
Height	39.65 meters
Heritage Status	Historic Place – Category 1

Introduction

This in an updated report and should be read in conjunction with the Gridline Ltd Report dated 13 September 2010 entitled *'Structural Assessment Report for Manchester Court Building'*

Subsequent to the earlier Report, access to the building has been gained and further invasive investigations have been undertaken.

The purpose of the investigations where to;

1. Determine if or not a robust steel frame existed within the façade walls and piers.
2. Determine the construction of the south and east walls and internal shear walls.
3. View other failed elements.

As discussed in the early Report the existence of a steel frame may have increased the possibility of saving the structure.

Investigation (4th October 2010)

Investigations consisted of drilling piers and walls in a number of locations. A 900mm long x 15mm Dia. drill bit was used.

Drill results were as follows:

Floor	Location	Material	Thickness	Steel Found
Ground	N/E Pier	Concrete	400mm (to resistance)	Yes
	Shear Wall running W/E	Brick	450mm	
	East (external) Wall	Brick	900mm	None
2nd Floor	5 Piers	Brick	800mm (max)	None
	South Wall	Brick	600mm	None
6th Floor	East Wall X2	Brick	330mm	None
	N/E Pier	Brick	N/A	None

In addition to already recorded failures (13 Sept. 2010 Report) the following observations where made:

- 7th floor, south wall part of the lining removed.
- 1st floor, south wall was observed. No Lining, exposed brick.
- Lining stripped on shear walls at ground floor (mezzanine level)
- Stairwell walls where observed, although no lining was removed

Construction Description

The investigation results from 4 October 2010 along with other observations discussed in the Gridline Report dated 13 September 2010 confirms beyond any doubt that there is no robust steel framed (or any steel frame) within the external brick walls and piers.

The construction is confirmed as an unreinforced brick masonry construction with the exception of the ground and 1st floor north and west façade which is concrete. Floors are timber with some steel beams and internal steel columns.

The south and west solid brick walls step down in thickness as they move up the building.

Damage Observations and Assessment

As per Gridline Report dated 13 Sept 2010 and with the following additional observations;

- On the 7th floor the lining to the south wall was removed. Failure on this wall showed a crack with differential movements of 10-15mm out of plane and 20-25mm in plane. This is a significant failure and this wall is in particularly very precarious state.
- 1st floor, south wall. This was confirmed as being brick (not concrete as per the north and west façade walls at this level). Diagonal cracking near the west end observed.

- Lining stripped on shear walls at ground floor (mezzanine level). This found solid brick walls and also showed some cracking.
- Stairwell walls where observed, although no lining was removed significant cracking to linings observed.

Stability Assessment and Options

Currently the building is assessed as significantly unstable having suffered shear failures on all elevations.

In the author's opinion the building is an immediate danger to property and lives (should people be in, around or near to the structure) and should be demolished.

Strengthening Options

Council policy is to strengthen damaged buildings to target 67% of current code. The aim of this policy is to save lives in future earthquake events.

Given that no robust steel frame exists, the observance of other failed structural elements and that load bearing masonry elements have failed on all elevations it is recommended that it is neither a feasible nor a possible proposition to strengthen or save this building.

As discussed in Report dated 13 Sept 2010, the existence of a steel frame would have increased the possibility of saving the building. This is because it would have provided at least a gravity support system to the floors while the façades were rebuilt. It may also have also been possible to strengthen such a frame to bring the building up to 2/3 current code. In any case this would have still required a very large commitment of time and resources and would have been subject to higher levels of risk.

Demolition Options

As per Gridline Report dated 13th Sept 2010

Health and Safety

As per Gridline Report dated 13th Sept 2010

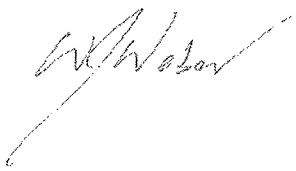
Conclusions and Recommendations

The extent of earthquake damage is significant and the building is considered unsafe and unstable under lateral loading.

In the author's opinion the building is an immediate danger to property and lives (should people be in, around or near to the structure) and should be demolished.

Given that no robust steel frame exists, the observance of other failed structural elements and that load bearing masonry elements have failed on all elevations it is recommended that it is neither a feasible nor a possible proposition to strengthen or save this building.

In undertaking this assessment, Gridline has undertaken an external and internal visual inspection of easily seen structural elements of the property. In addition invasive inspections of only a selection of elements has been undertaken. Gridline's views are based on the presence of visible physical damage and a selection of invasive inspections only. The information contained in this report is accurate to the best of our knowledge at the time of issue.



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Structural Assessment Report For Manchester Court Building

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Introduction

This report is a structural assessment of the earthquake damage sustained by the Manchester Court Building on Saturday, 4 September 2010.

The Earthquake measured 7.1 on the Richter Scale. The epicenter was 40km west of Christchurch (near Darfield) and was at a depth of 10km.

This report discusses the building construction, assesses the damage incurred and gives forward options and recommendations.

Forward options are considered taking into account regulatory requirements.

General Building History and Architectural Description

The following text has been sourced from the New Zealand Historic Places Trust, Author; Melanie Lovell–Smith.

This building was built for the New Zealand Express Company in 1905-1906 and at the time of its construction it was the tallest commercial building in Christchurch. The New Zealand Express Company was a Dunedin-based firm established in 1867, with offices throughout New Zealand. They acted as carriers, and customs, shipping and express forwarding agents, and by the beginning of the twentieth century were a major New Zealand employer. Their Christchurch building was designed by Alfred and Sidney Luttrell, who arrived in New Zealand in 1902, and whose principal contribution to the history of New Zealand architecture was the introduction of the Chicago 'skyscraper'. They were also noted for their use of concrete. The foundation and first two storeys of the New Zealand Express building are

reinforced concrete. This was probably, according to Geoffrey Thornton, the first use of reinforced concrete in a commercial building in Christchurch.

Stylistically, this building is a compromise between British Edwardian architecture and the Chicago skyscraper style of the 1880s and 1890s. One example of this eclecticism can be seen in the corner tourelle, which was unusual in contemporary American architecture, but common within the English tradition. Technically the use of steel ties and standards, combined with the traditional brick masonry of the top five floors shows the same mix of sources. The 'Chicago style' was defined by the use of internal steel frames, which meant that the external walls were no longer load-bearing and therefore the height of the buildings could increase, and windows rather than masonry could dominate the exterior. With the New Zealand Express Company building the Luttrells moved one step closer towards a true 'skyscraper' construction method, which they finally achieved with their design for the same company's head office in Bond Street, Dunedin, two years later.

The New Zealand Express Company building, now known as Manchester Courts, is significant as one of the earliest attempts at the Chicago skyscraper style in New Zealand. The building's combination of contemporary American styles with the existing tradition of British architecture means this building occupies a unique place within the history of New Zealand commercial architecture. The construction of Manchester Courts helped to establish the Luttrell brothers as architects in New Zealand and the magnitude and style of this building reflected the importance and size of the company it was built for.

The foundations and first two stories of this commercial building are made of reinforced concrete and above this base conventional brickwork is strengthened with steel ties and standards. The different modes of construction are visually expressed by a change in the architectural treatment of the two principal elevations. Above the visually emphatic platform created by the ground and first floors, which are styled to imitate rusticated masonry construction, exposed brick piers rise to establish a grid-like intermediary zone between the base and roof. The cement rendered spandrels in this zone are slightly recessed to enhance the verticality of the piers which are terminated by arched window openings, on the fourth, fifth or sixth floors, which also serve to accentuate the building's height.

The cornice and parapet which once crowned the building have since been unsympathetically replaced by a shallow hipped roof of steel and this greatly detracts from the visual impact of Alfred Luttrell's design.

Investigations

No original architectural or structural drawings are available however the overall construction is reasonably well documented in various sources. Extensive investigations have been undertaken to try and obtain the architectural and/or structural engineering plans but without success. Searches have included:

- Christchurch City Council
- Christchurch Museum
- Canterbury University (McMillan Brown Library)
- School of Architecture, Victoria University

Discussions regarding the structure have been undertaken with:

- Spencer Meikle principle of current Alfred and Sidney Luttrell Consultancy
- Geoffrey Thornton
- Current and past Directors of the New Zealand Express Company

There is a part refurbishment plan shown on the ground floor. This is attached to this report.

At the time of writing this report ongoing investigations to obtain further documentation have continued.

Unfortunately, at the time of writing this report access to the Building has been strictly denied by the Building Owner and the Fire Department for safety and liability reasons. The urban search and rescue teams have been prohibited from entering the building by order of the Fire Department.

Internal observations were undertaken by the Author on Tuesday, 7 September 2010 before several more aftershocks produced more damage to the building.

On Tuesday, 7 September 2010 linings were removed on several facade piers and the bricks and failure modes could be observed. The south wall was in many areas striped of lining and the bricks could be observed.

Observation of the street facades from outside the building has been undertaken.

With respect to historical information, two publications (four articles) have been sourced which discuss the building construction. These are:

- Weekly Press, 8 November 1905, p45
- Weekly Press, 21 June 1906, p9
- Progress, 1 June 1906, p197
- Progress, 2 January 1907, pp87-8

The publications include the following references:

Weekly Press

'The construction is a compromise between the American steel construction and the ordinary colonial method'

'A steel frame embedded in concrete extends from the foundations to the top of the first floor and then upward the whole building 'is tied by steel pillars'

Progress

'The foundation and first two stories are of reinforced concrete while steel has been freely used in the upper stories for ties and standards'

Construction Description

Building construction is reinforced concrete foundations, ground floor and first floor. Brick masonry above with 'steel ties and standards' (Ref Progress). Plaster trim and wooden floors.

The walls to the east and south are masonry with two rows of windows located centrally. This arrangement effectively creates a coupled shear wall arrangement.

On the west and north facades the first two storey's are constructed of reinforced concrete and above the second floor conventional load bearing masonry piers are used which are strengthened with ties, likely to be steel U bars, and possibly steel columns.

Internally there are is an arrangement of three 600-700mm wide brick walls which extend to the top of the building. Two of these walls run west to east while the third runs north to south. Two of these walls are shown on a partial refurbishment plan attached.

There is mention in two publications of the time (The Weekly Press 8 Nov 1905 and Progress 1 June 1906) of the use of steel standards and piers. It is unknown if these statements refer to steel columns within the masonry piers or to internal columns within the building. There has been discussion as to whether or not a steel frame exists hidden within the masonry piers and spandrel panels. Without further invasive investigations we are currently unable to determine the extent of the 'steel pillars' and 'standards'. Although the wording in The Weekly Press and Progress suggest there is no significant steel frame further clarification would be useful. This could be achieved by drilling of piers and spandrels. Currently this cannot be undertaken for safety reasons as described above.

The question of whether or not a large robust steel frame exists within the facade piers is important as it would increase the possibility of trying to save the building.

The masonry construction for both piers and walls uses header bricks indicating that these elements are load bearing and confirming the 'original colonial method' of construction. The brick piers also step down in thickness on the higher levels indicating that they are load bearing elements. The internal masonry load bearing walls are also further evidence that there is unlikely to be a robust steel frame as the primary support structure.

If an internal steel frame exists significant investigation and analysis would be required to determine if it remained stable and suitable to be maintained in any proposed strengthening scheme. Such investigation and analysis would be a lengthy process. Initial stabilization of the building and reconstruction /strengthening would still require significant time and resources.

Damage Observations and Assessment

The building has suffered significant structural damage to all elevations. Shear failures of critical elements has occurred.

South and East Elevations Observations

Transfers shear failures to both coupled shear walls has occurred and has been observed from within the building and from outside.

Internally most south walls had exposed bricks and could be easily inspected. Significant transverse shear cracks were found in these walls. East walls were lined and could not be observed.

Externally, significant transverse shear cracks can be observed on all exposed faces.

North and West Elevation

Ground floor and first floor levels appear to have suffered no major structural damage. The construction of these two levels is reinforced concrete and this will account for the lesser damage in this area.

Second and third floors are the most significantly damaged elements of these facades. The Piers on these levels have typical X shaped transverse shear failure or in some cases just one transverse shear failure plane. The plastered spandrel panels between piers are cracked at 3rd,4th and 5th floor level as would be expected.

Stability Assessment and Options

Given the heritage significance of the building it is important that a robust analysis of potential stabilization methods is considered.

If there is a political will to try and save the building then very significant time and resources will be required.

Currently the building is assessed as significantly unstable having suffered shear failures on all elevations.

It has been observed that aftershocks have continued to widen existing cracks and create new ones.

Regulatory Requirements

Council is required under the Building Act 2004 to have a policy on earthquake prone buildings.

Council held an extraordinary meeting on Friday 10 September 2010 with the sole purpose to adopt the revised Earthquake Prone, Dangerous and Insanitary Buildings Policy. The aim of this meeting was to clarify how to handle known Earthquake Prone Buildings in the event that they were damaged by an earthquake and needed to be repaired.

The new policy sets the new target for structural strengthening is 67% of code. That is a target. Assessments will need to be worked through on a case by case basis. It may not be practicable for some repairs to meet that target. Council will work closely with building owners to achieve sensible, safe outcomes.

The policy applies equally to listed heritage buildings and buildings which are not listed

Strengthening Options

Council policy is to strengthen damaged buildings to 67% of current code. The aim of this policy is to save lives in future earthquake events.

The initial stabilization of the building would be difficult to undertake in a safe manner while seismic activity remains. The safety of the general public and workers, the impact of surrounding businesses unable to occupy their offices, insurances and road closures are all factors which will need to be considered carefully.

If initial stabilization was able to be achieved then strengthening work would involve major reconstruction and strengthening of substantial parts/most of the existing building. Strengthening work would require a complete rebuilding of facade piers over at least two levels. Rebuilding of coupled shear walls over a number of levels would be required. All other remaining elements would require strengthening. Such a rebuilding of elements would require a complete facade retention system around the entire building.

To rebuild facade piers would require the temporary propping of floors and piers above. This would be done through the construction of large facade retention structures. These support structures would require minimal movement to the piers above.

Although a small number of the lesser intermediate piers may be able to be saved and strengthened through say wrapping with high strength composite overlays, a large number have suffered significant shear failure.

Damaged spandrels would also require rebuilding.

Structural Elements remaining could be strengthened via a number of well established methods. Strategies for improving structural performance could one or more of the following methods:

- Local Modification of Components - local strengthening could include measures such as ply overlay diaphragm over the existing timber floors of adding concrete facings to the south and east walls. Composite fibre overlays are another option.
- Removal or Lessening of Irregularities and Discontinuities. Possibly squaring off the south east corner of the building.
- Global Structural Strengthening and Stiffening - construction of new braced frames, moment resisting frames (steel or concrete) or shear walls within the existing/rebuilt structure are effective methods for adding both additional stiffness and strength. Care is needed to ensure

the compatible stiffness between the existing and new elements to ensure premature brittle failure is avoided. This can be achieved through yielding braced frames for example.

- Seismic Isolation - this method could be considered but is less effective on relatively tall buildings such as this.
- Supplementary Energy Dissipation - this technique uses different technologies that allow the seismic energy imparted to a structure by ground motion to be dissipated in a controlled manner through the action of special devices such as hydraulic cylinders, yielding plates, yielding braces or friction joints, resulting in an overall displacement of the structure. As with base isolation this is a technically complex strategy that requires specialized analysis for design.
- Seismic Emergency Gravity Support -essentially an internal frame which provides supplementary seismic emergency columns.

Another option, although probably not economically viable, would be to take down the building and rebuild in the same external appearance but with a modern seismic resistant frame internally.

To bring the building up to 2/3 of code would require careful consideration of seismic ductility issues and building regularity. Global FEA modeling combining new and existing elements would be difficult. Modal response spectrum analysis is recommended.

Demolition Options

Demolition shall be undertaken to ensure the safety and protection of the general public, workers and surrounding property.

The demolition would take place at one floor at a time. Three large cranes positioned at safe distance would be employed to take the structure down to 3rd floor. Walls and floors will be dismantled at each level and craned down in skips or as intact elements as practical. The last three floors would be removed by more conventional methods.

Access to the structure will be from the top and by man cage only. Personnel will work in teams of 3. Workers leaving the man cage shall be harnessed to the man cage at all times. Demolition is likely to take 5 weeks.

A draft detailed demolition plan is attached.

Health and Safety

Both Strengthening and Demolition options present significant health and safety risks. Well considered Health and Safely plans must be required and take into account the extraordinary risks the site poses.

Conclusions and Recommendations

The extent of earthquake damage is significant and the building is considered unsafe and unstable under lateral loading.

To initially stabilize the building would be a major construction project in itself and would present major safety issues. Construction times and budget would be significant and would require that all roads and buildings in the vicinity remain unoccupied for an extended period which is likely to run into months. Stabilization of south and east walls would most likely require invasive support structures into neighboring properties or new internal structures into the existing building.

If initial stabilization of the structure could be achieved in a safe manner then strengthening of the structure would require rebuilding of major sections of the building. Again, this would be a major construction project with its own challenges. Facade piers on levels 2 and 3 would require complete rebuilding. Other piers may also require rebuilding. Most if not all failed coupled shear walls would require reconstruction. Any remaining elements would require strengthening. Overall stability, ductility and regularity would be significant design issues which may make any efforts to save the structure and strengthen to 67% of code difficult.

If there is a public willingness to save the building by strengthening then this will require significant time and resources. Invasive investigations will be required, especially to determine whether or not there is an existing internal steel frame. The presence of an internal and robust steel frame may improve the ability to save the building. Regardless of the existence of a steel frame or not significant time and resources would be required to restore and strengthen the building. This option has higher exposure to risk.

Without consideration to heritage or political issues it is recommended that it is not a safe or a feasible proposition to stabilize and strengthen this severely earthquake damaged building.

Information Sources

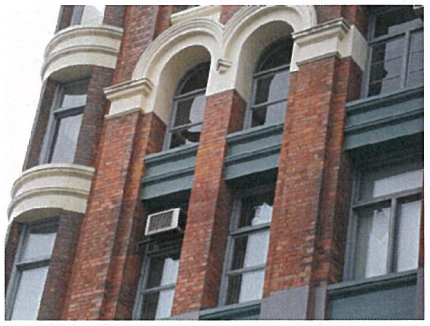
- Ann McEwan, 'The Architecture of A.E. and E.S. Luttrell in Tasmania and New Zealand', MA thesis, University of Canterbury, 1988, pp.75-79
- Geoffrey Thornton, Cast in Concrete: Concrete Construction in New Zealand 1850-1939, Auckland, 1996, p.114
- Canterbury Times, 25 July 1906, p41 21 December 1910, p41
- Weekly Press, 8 November 1905, p45 Press, 21 June 1906, p9
- Cyclopedia Company, Industrial, descriptive, historical, biographical facts, figures, illustrations, Wellington, N.Z, 1897-1908, Vol. 4 Otago and Southland, Cyclopedia Company, Christchurch, 1905, p370
- Progress, 1 June 1906, p197 Progress, 2 January 1907, pp87-8
- Star Midweek, 31 October 1987, p6
- A. McEwan, From cottages to 'skyscrapers': the architecture of A.E. and E.S. Luttrell in Tasmania and New Zealand. M.A. Thesis, University of Canterbury. 1988, pp75-9
- New Zealand Society for Earthquake Engineering, assessment and Improvement of the Structural Performance of Buildings in Earthquakes. June 2006

Appendix A

Photos





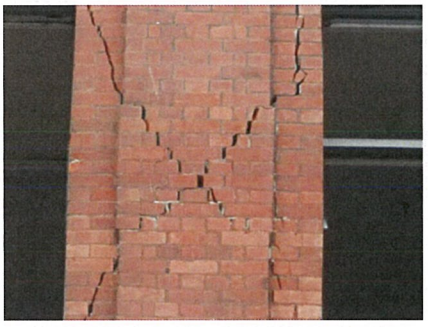


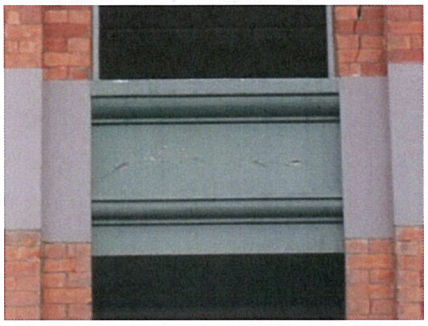




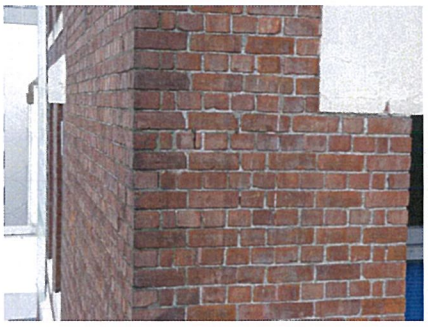


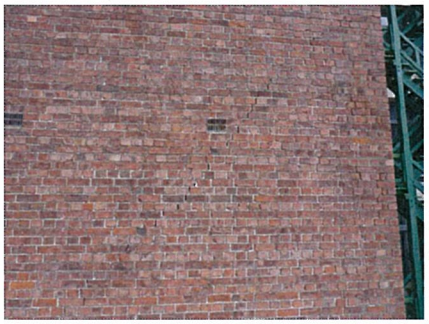



KIWI
HINKING'
GREAT IDEAS
THAT JUST GET



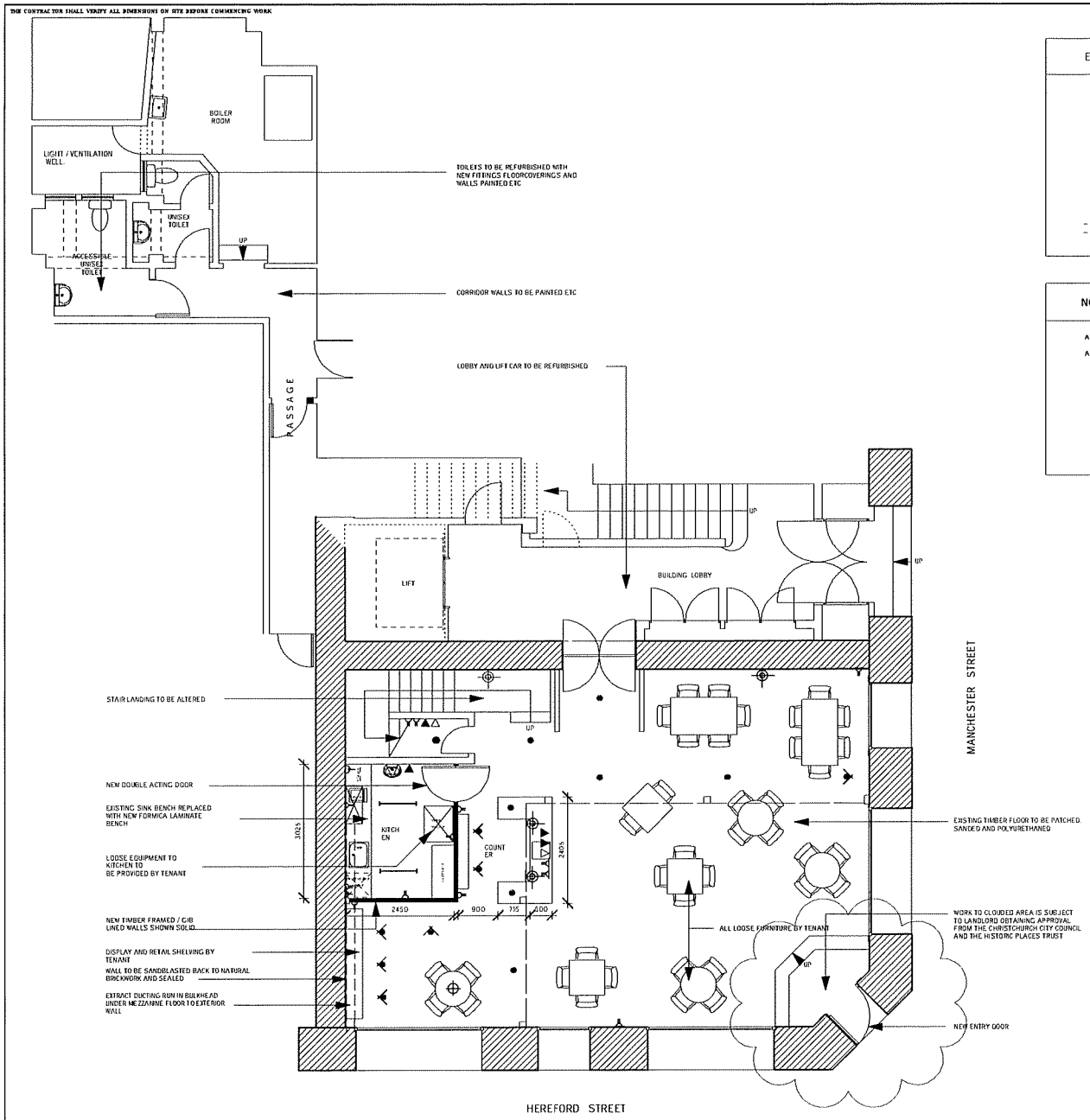


Appendix 2

Ground Floor Part Plan

Appendix

Demolition Plan



GROUND FLOOR PLAN
SCALE 1:50

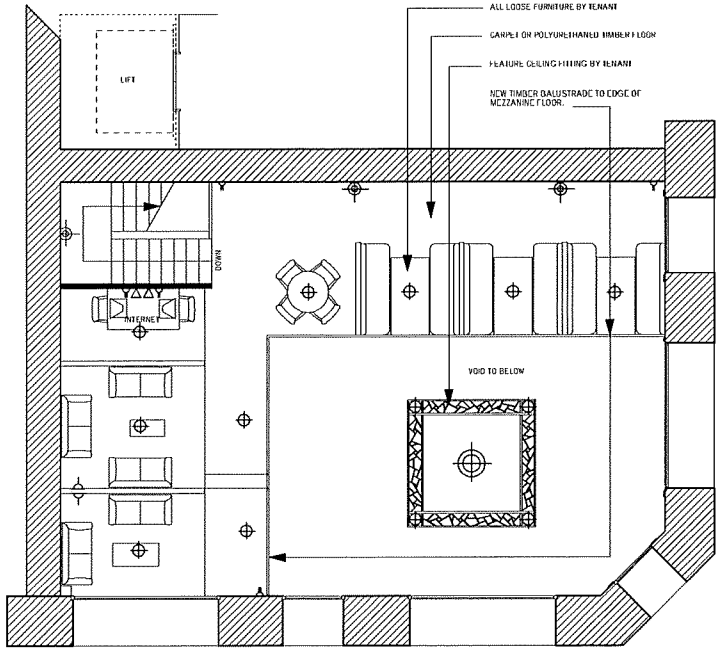
ELECTRICAL LEGEND

- BATTENHOLDER WITH SHADE.
- LOW VOLTAGE HALOGEN DOWNLIGHT.
- ADJUSTABLE HALOGEN SPOTLIGHT.
- FLUORESCENT TUBE LIGHT WITH COVER.
- LIGHT SWITCH.
- EXTRACT FAN AND HOOD DUCTED TO THE EXTERIOR.
- INTERIOR PENDANT CEILING LIGHT.
- INTERIOR WALL LIGHT.
- SINGLE SWITCHED SOCKET OUTLET.
- DOUBLE SWITCHED SOCKET OUTLET.
- DATA OUTLET.
- TELEPHONE OUTLET.

NOTES

ALL WORK TO BE CARRIED OUT BY THE LANDLORD EXCEPT WHERE NOTED OTHERWISE.

ALL WALLS, CEILINGS, JOINERY AND TRIM TO BE PAINTED



MEZZANINE FLOOR PLAN
SCALE 1:50

Michael Cousens DESIGN Ltd.

PROPOSED TEAHOUSE - CORNER MANCHESTER & HEREFORD STREETS

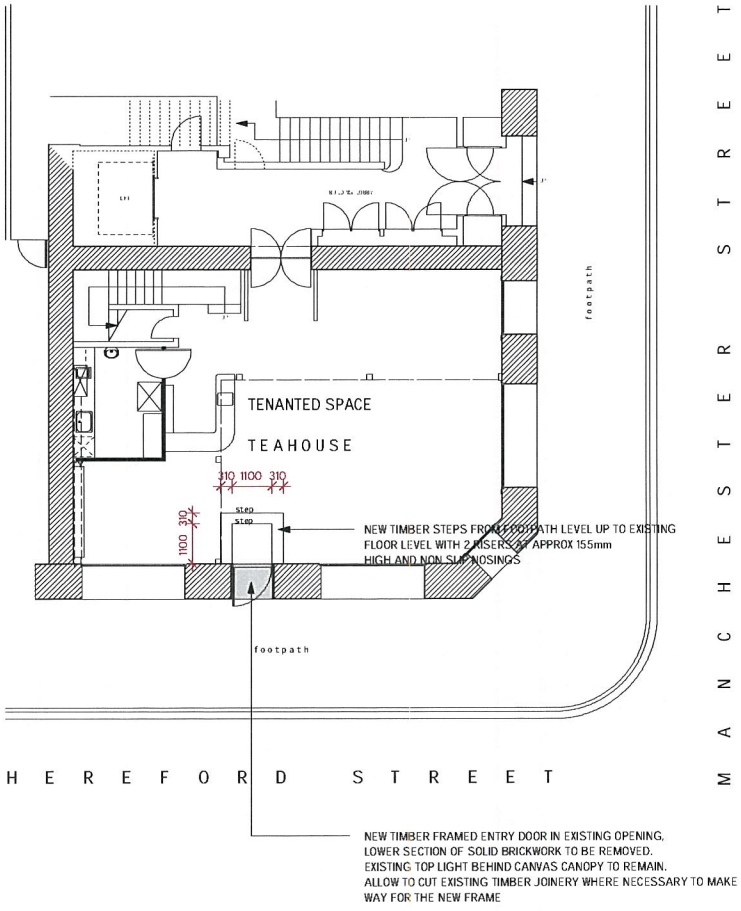
Revisions / Issues
A 07-11-05 LEASE AGREEMENT ISSUE

Drawing Title: NEW FLOOR PLANS

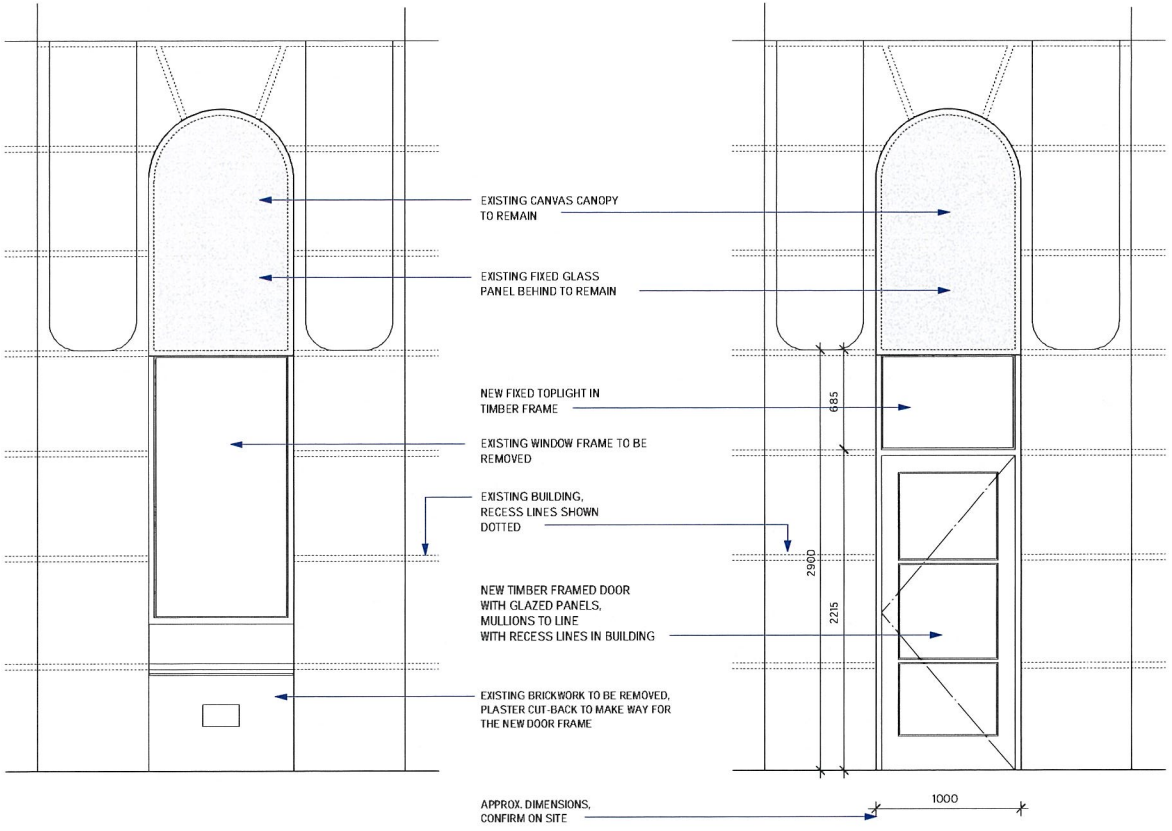
Job No. 1053

Scale: As Shown

Drawing No. & Rev: A-01 A



GROUND FLOOR PLAN
SCALE 1:100



EXISTING ELEVATION
SCALE 1:25

VIEWED FROM EXTERIOR OF BUILDING
- HEREFORD STREET ELEVATION

NEW DOOR ELEVATION
SCALE 1:25

VIEWED FROM EXTERIOR OF BUILDING
- HEREFORD STREET ELEVATION

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NEW ENTRANCE DOOR - CORNER HEREFORD/MANCHESTER ST

160 MANCHESTER CHRISTCHURCH

Revisions / Issues

Drawing Title: FLOOR PLAN & DOOR ELEVATIONS

Job No. 1053

Scale As Shown

Date March '07

Drawing No. & Rev. 1

Drawn by Mike