386 – 388 FERGUSON DRIVE
UPPER HUTT
DETAILED SEISMIC ASSESSMENT

Kevin O'Connor & Associates Ltd Reference: 113400

Report prepared by	GL
Reviewed by	AJP
Prepared for	Edwards Family Trust
Date	March 2014
Report Status	Final
Revision	

Kevin O'Connor & Associates Ltd
71 Pitt Street
P O Box 600
Palmerston North 4440
P 06 356 7000 E info@koa.co.nz
W www.koa.co.nz

Contents

1. Introduction

Kevin O'Connor & Associates Ltd (KOA) was appointed to complete a detailed seismic assessment that confirms the expected seismic performance of the building located at 386 – 388 Ferguson Drive, Upper Hutt.

The purpose of this detailed seismic assessment is to determine the probable seismic strength of the existing building relative to new building standards (NBS). The calculated strength is expressed as a percentage. Buildings with less than 34% NBS are assessed as earthquake prone buildings and have a risk of failure during earthquake 20 times higher than buildings designed to meet current standards.

2. Description of Building

386-388 Ferguson Drive comprises 2 buildings linked by a low level link corridor. Both buildings are of unknown construction date, the front hall was originally a church and built prior to the rear hall. Both hall spaces were constructed prior to 1969 as all records contain imperial measurements.

Tables 1.1 and 1.2 below summarise the main structural aspects of each building based on existing documentation and site investigations carried out by KOA staff.

Table 1.1. Front Hall

Structural System	Description	
Ground floor	Timber Sub Floor	
Roof	Heavy tile construction supported on steel portal frames	
Foundations	Concrete Perimeter Sub-floor wall and concrete piles	
Main gravity load resisting system (GLRS)	Steel Portal Frames	
Main lateral load resisting system (LLRS)	Longitudinal direction	Plasterboard lined walls
	Transverse direction	Steel Portal Frames

Table 1.2. Rear Hall

Structural System	Description	
Ground floor slab	Timber Sub Floor	
Roof above level 2	Lightweight construction, supported on steel portal frames	
Foundations	Concrete sub-floor walls and concrete piles	
Main gravity load resisting system (GLRS)	Steel portal frames	
Main lateral load resisting system (LLRS)	Longitudinal direction	Partially Filled Blockwork External Walls
	Transverse direction	Steel Portal Frames

3. Detailed Seismic Assessment

3.1 Method of Assessment

The structure was seismically analysed in accordance with current New Zealand loading standards NZS 1170.5:2004 [1]. The seismic actions resulting from the analysis were compared with the structural capacities calculated in accordance with guidelines of the New Zealand Society for Earthquake Engineering (NZSEE) for the assessment of existing structures [2] and the MoE guidelines for the seismic assessment of timber frames school buildings [3].

The main seismic parameters used in the assessment are summarised in Table 2 below. These are in accordance with current Loading Standards NZS1170 [2] and NZSEE guidelines.

Table 2. Seismic parameters

Importance level of primary structure	2 (normal structures)	
Design working life	50 years	
Site subsoil class	D (soft soils)	
Site hazard factor, Z	0.42 (Upper Hutt)	
Natural period of structure, T	Deemed to be less 0.4s in both directions for both buildings	
Estimated Ductility	Front Hall	Steel Portal Frames & plasterboard walls – Max. Ductility =3
	Rear Hall	Steel Portal Frames – Max. Ductility =3
		Partially filled blockwork – Ductility = 1.25

3.2 Material Properties

Material properties used in the assessment are shown in table 3 below.

Table 3. Material properties

Material	Building	Original design strengths
Structural Steel	Both	300MPa (assumed due to date of construction)
Wall Linings	Plasterboard	50BU's/m as per MoE guidelines [3]
	Blockwork	12MPa - Assumed

3.3 Assessed Hierarchy of Response Mechanisms and Critical Structural Weaknesses

<u>Front Hall</u>

Along direction:

The seismic strength provided by the lightweight, lined walls running full length and height of the building were calculated to be approximately 40% NBS.

Across direction:

In the event of earthquake the steel portal frames will deflect and dissipate the forces. Assessment of the existing portal frames returned a result of approximately 40% NBS. It should be noted that the probable deflection of the portal frames under the assessed loadings was also carried out, although the results returned were in excess of the limits for new construction, excessive deflection was not deemed to be critical as it would not lead to catastrophic failure of the structure.

Rear Hall

Along direction:

The seismic strength provided by the blockwork walls along both sides of the hall was assessed for in plane and out of plane performance. Out of plane assessment was found to be in excess of 100% NBS. In plane assessment was found to be around 60%NBS

Across direction:

In the event of earthquake the steel portal frames will deflect and dissipate the forces. Assessment of the existing portal frames returned a result of 60% NBS. It should be noted that the probable deflection of the portal frames under the assessed loadings was also carried out, although the results returned were in excess of the limits for new construction, excessive deflection was not deemed to be critical as it would not lead to catastrophic failure of the structure.

4. Results of the Assessment

The results of the detailed seismic assessment are summarised in the table below:

		Element	Aspect	%NBS	Comments
Front Hall	Across	Portal Frames	Strength	~40%	New portal frames or additional steel to existing frames
		Floor Diaphragm	Bracing	~70%	Deemed acceptable risk
	Along	Walls	Bracing	~40%	Re line walls with braceline (88%)
Rear Hall	Across	Portal Frames	Strength	66%	Deemed acceptable risk
	Along	Partially Filled Block Walls	In Plane	60%	Deemed acceptable risk
			Out of Plane	<100%	Acceptable

5. Conclusions

In accordance with the NZSEE, High Risk or Earthquake Prone buildings (EPB) fail to meet 34% NBS; Medium Risk or Earthquake Risk buildings range between 34% and 66% NBS; and Low Risk buildings achieve 67% NBS or more.

Front Hall

Based on the results shown in the tables above, the front building is considered Medium Risk in both directions with a seismic strength of approximately 40% NBS. This corresponds to the building having around 9 times the risk of its strength being exceeded due to earthquake actions than an equivalent fully compliant new building.

Rear Hall

Based on the results shown in table above, the rear building is considered Medium Risk with a seismic strength of approximately 60% NBS. That corresponds to the building having around 6 times the risk of its strength being exceeded due to earthquake than an equivalent fully compliant new building.

6. Other observations

No additional observations to report.

7. Recommendations

A strict interpretation of the Building Act indicates that only earthquake prone buildings require strengthening work to achieve at least 34% NBS. According to this neither building require urgent remedial actions. However NZSEE and increasingly Local Authority requirements, particularly after the Canterbury earthquakes, are calling for buildings to be able to resist seismic demands corresponding to at least two-thirds of new building standards (67% NBS) which corresponds to a relative risk of 5 times the risk of an equivalent new building. In this case we agree with NZSEE and would recommend that the front hall be strengthened accordingly. The strength of the rear hall has been assessed to be 60% NBS, which is close to the recommended minimum of 67%, this may be considered an acceptable risk level with no strengthening required.

8. Structural Strengthening Schemes

Technically feasible strengthening schemes are presented in Appendix C for initial guidance and rough order of cost estimate. These schemes are based on what we consider would be a least cost approach. Final schemes and costs may also be affected by, but not be limited to, architectural, fire, and tenancy requirements or upgrades which are outside the scope of this assessment. The next step is to appoint a team of consultants to develop the design.

9. References

[1] New Zealand Society for Earthquake Engineering (NZSEE) 2006, "Assessment and Improvement of Structural Performance of Buildings in Earthquake". Recommendations of a NZSEE Study Group on Earthquake Risk Buildings.

[2] AS/NZS 1170.0:2002, Structural Design Actions, Part 0: General requirements – Aust/New Zealand, Part 5: Earthquake actions – New Zealand, Standards New Zealand.

[3] Ministry of Education, "Guidelines for the Seismic Evaluation of Timber Framed School Buildings, Version 2: June 2013.

10. Disclaimer

Kevin O'Connor & Associates Limited (KOA) undertakes reasonable and random investigations and testing procedures. It is foreseeable that construction materials in parts of a building differ from other parts and differ from those parts investigated and/or tested. It is also possible that the building constructed differs from plans and specifications available, which differences may not be identified by inspections and/or testing. KOA is not liable to the Client (or anyone else) for all such differences. KOA has no liability to the Client (or anyone else) should it transpire that any building is constructed of materials and/or is a design different from those materials investigated or tested and/or different from those in the plans and specifications.

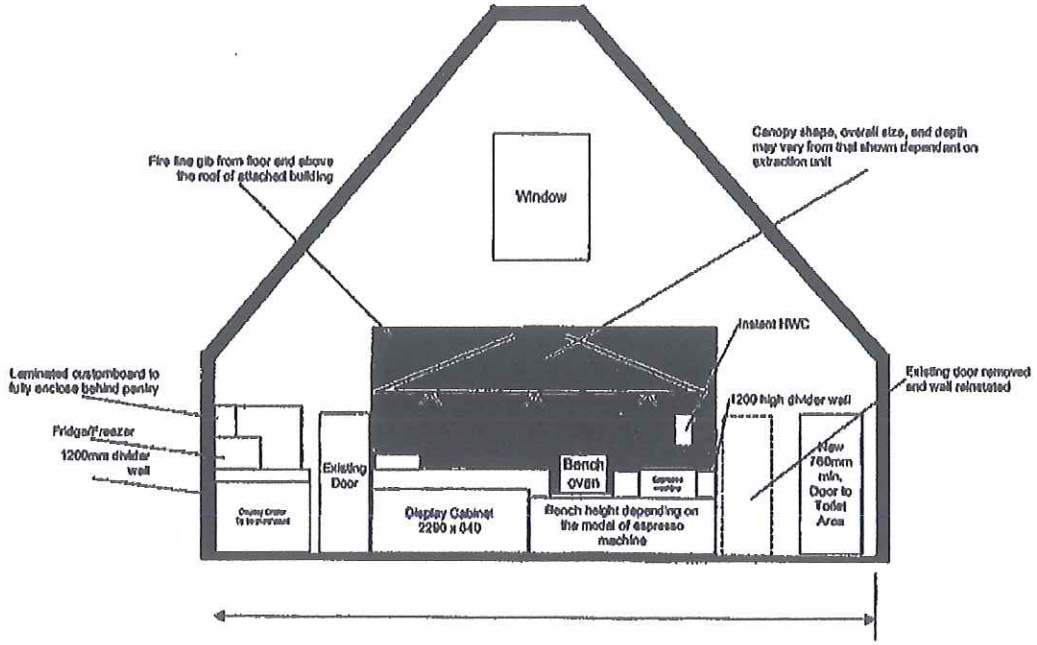
11. Appendix A: Structural Calculations

Available on request.

12. Appendix B: Relevant Existing Drawings

13. Appendix C: Concept Strengthening Schemes

N.B. Pitch of roof and window is not to scale



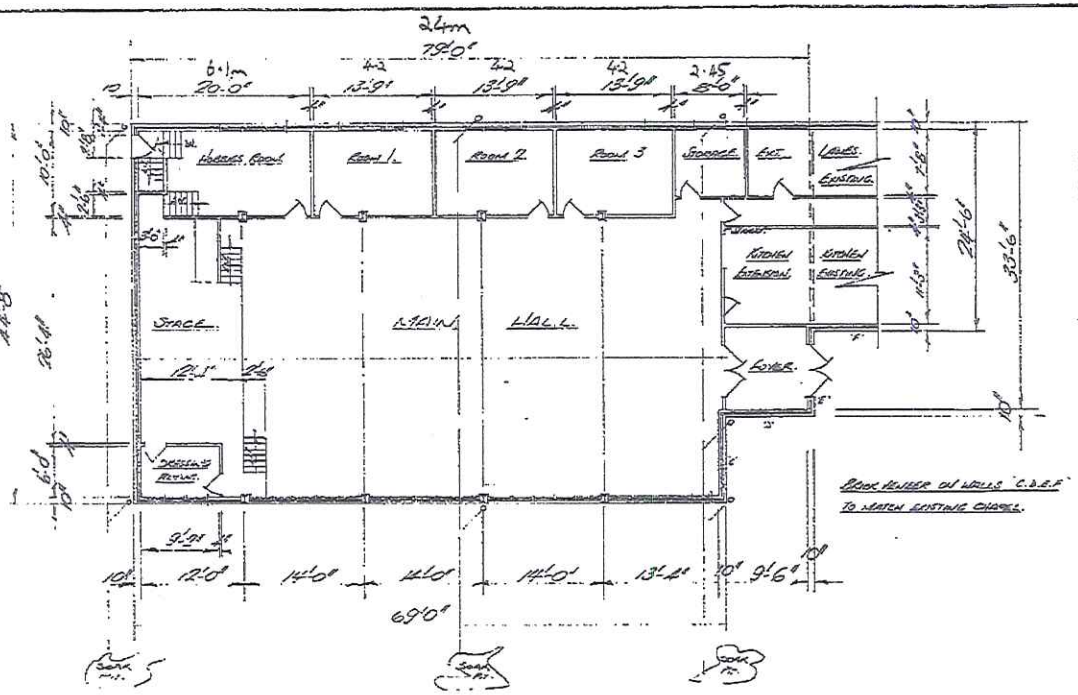
9.45 m

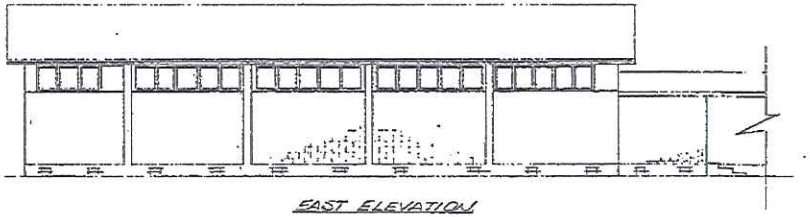
BUILDING CONSENT

BUILDING INSPECTOR	DATE

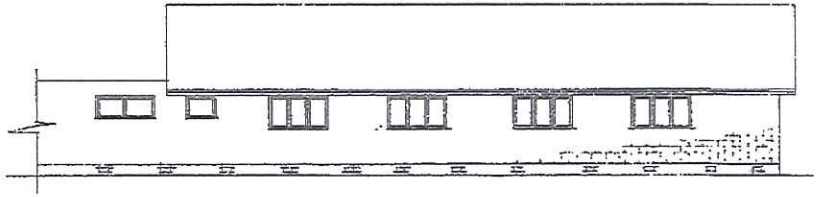
REVISED INTERIOR ELEVATION FROM FRONT OF BUILDING	Drawn by: Amanda Lockyer			
	PROPOSED FIG TREE CAFE AND LARDER 386 FERGUSSON DRIVE HERETAUNGA			
	SIZE	FBCM NO	DWG NO TWO (2)	REV
	SCALE 1:100	Dated 22/01/02	SHEET 5 OF 6	

113400 'REAR' HALL

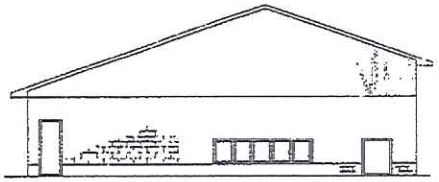




EAST ELEVATION

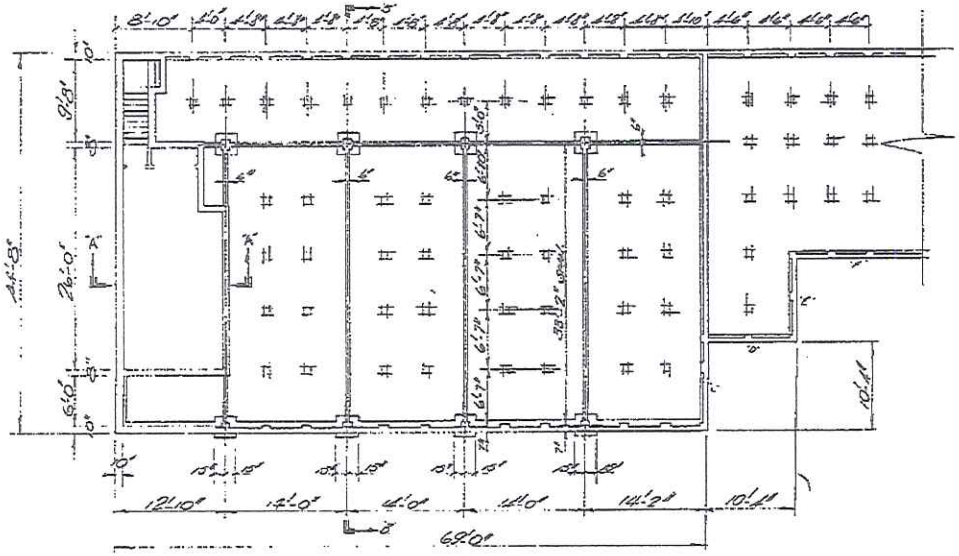


WEST ELEVATION



SOUTH ELEVATION

NORTH ELEVATION

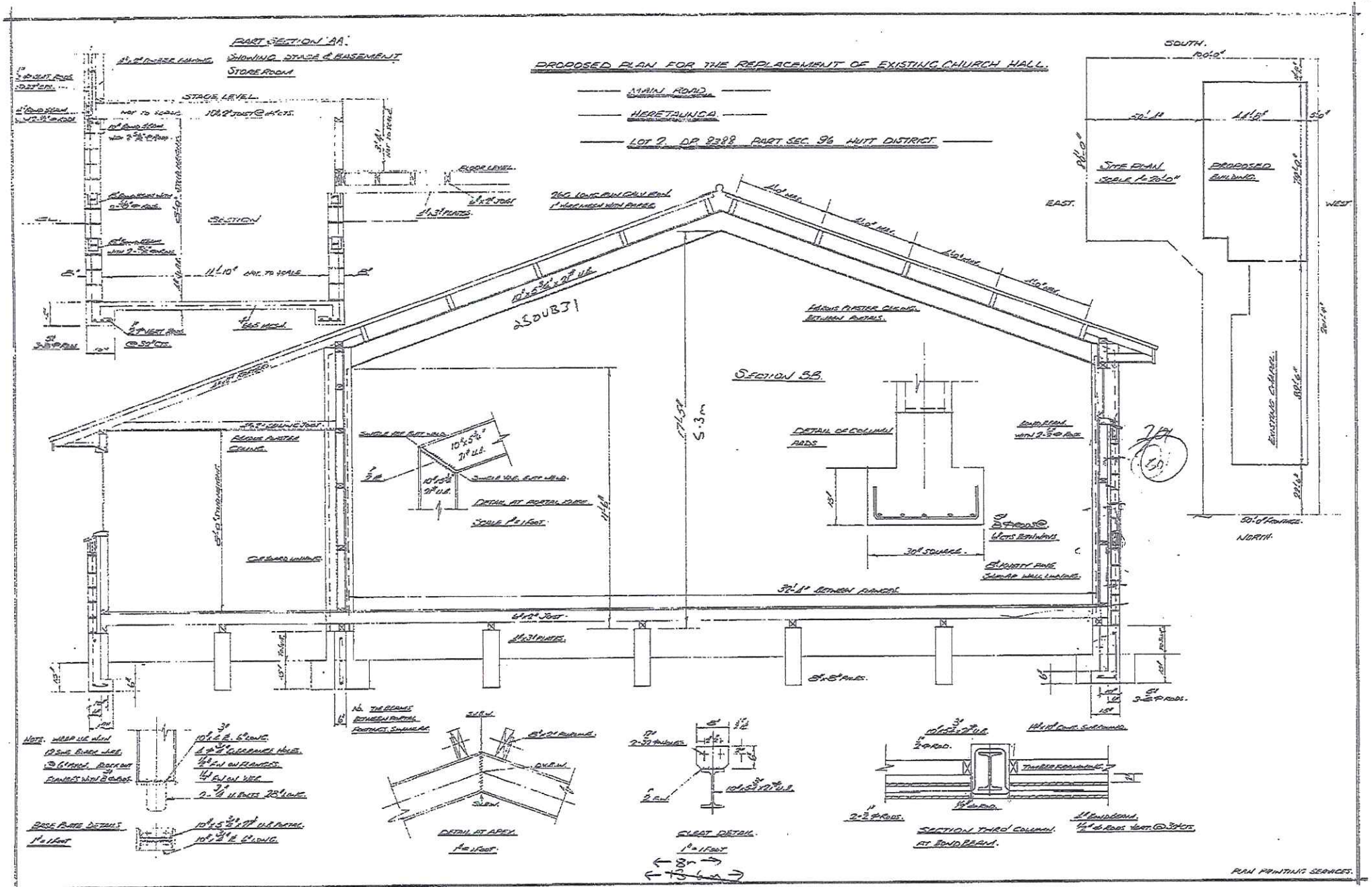


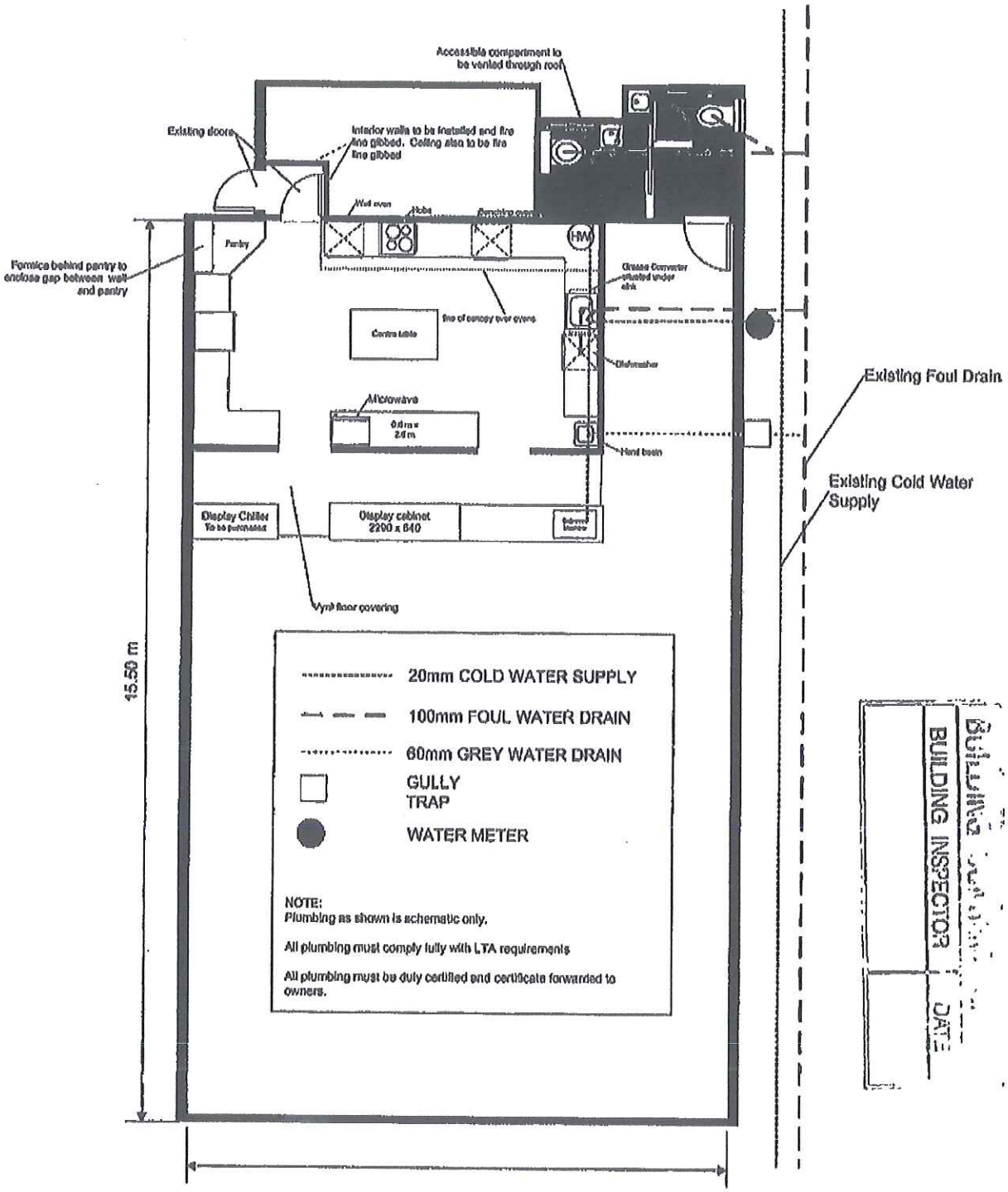
PROPOSED PLAN FOR THE REPLACEMENT OF EXISTING CHURCH HALL

MAIN ROAD

HERETAUNGA

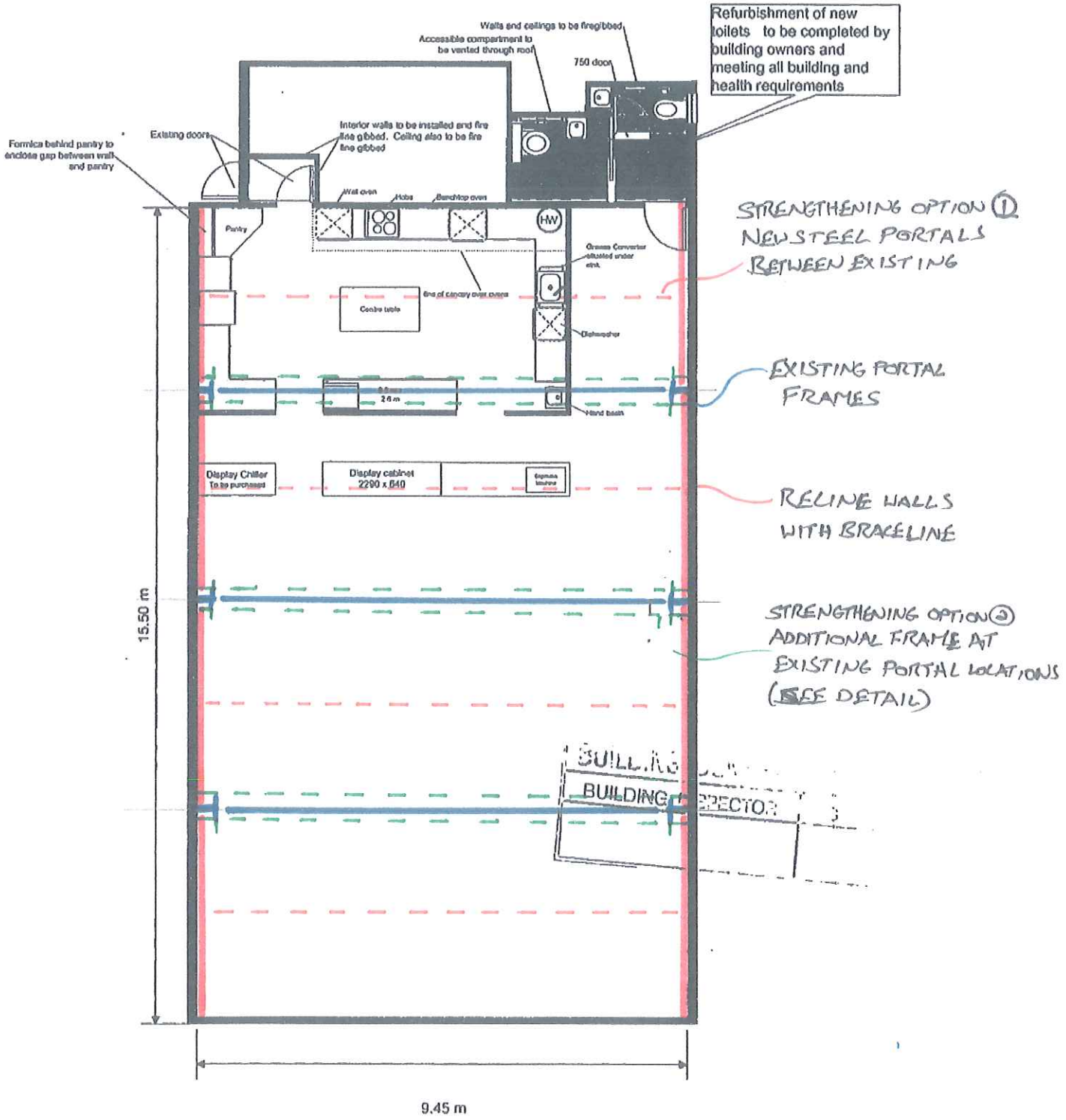
PLAN PRINTING SERVICES.


PROPOSED PLAN FOR THE REPLACEMENT OF EXISTING CHURCH HALL.
MAIN ROAD
HEREFAUNGA
LOT 2 DP 8388 PART SEC. 96 HUTT DISTRICT
PART SECTION 'AA'
SHOWING STAGE & BASEMENT STOREROOM
STAGE LEVEL.
SECTION
SECTION BB.
SITE PLAN
SCALE 1:20'0"
PROPOSED BUILDING.
EXISTING CHAPEL.
SOUTH.
EAST.
WEST
NORTH.
30'0" FRONTAGE.
DETAIL AT APEX
1"=1 FOOT
DETAIL AT PORTAL FRAME
SCALE 1"=1 FOOT
SECTION THRO' COLUMN AT BOND BEAM.
BASE PLATE DETAILS
1"=1 FOOT
CLEAT DETAIL
1"=1 FOOT
RAM PRINTING SERVICES.



REVISED PLUMBING PLAN	Drawn by: Amanda Lockyer			
	PROPOSED FIG TREE CAFE AND LARDER 388 FERGUSSON DRIVE HERETAUNGA			
	SIZE	FSCM NO	DWG NO	REV
			TWO (2)	
	SCALE 1:100	Dated 22/01/02	SHEET 6 OF 6	

113400 - FRONT HALL.



STRENGTHENING SCHEME

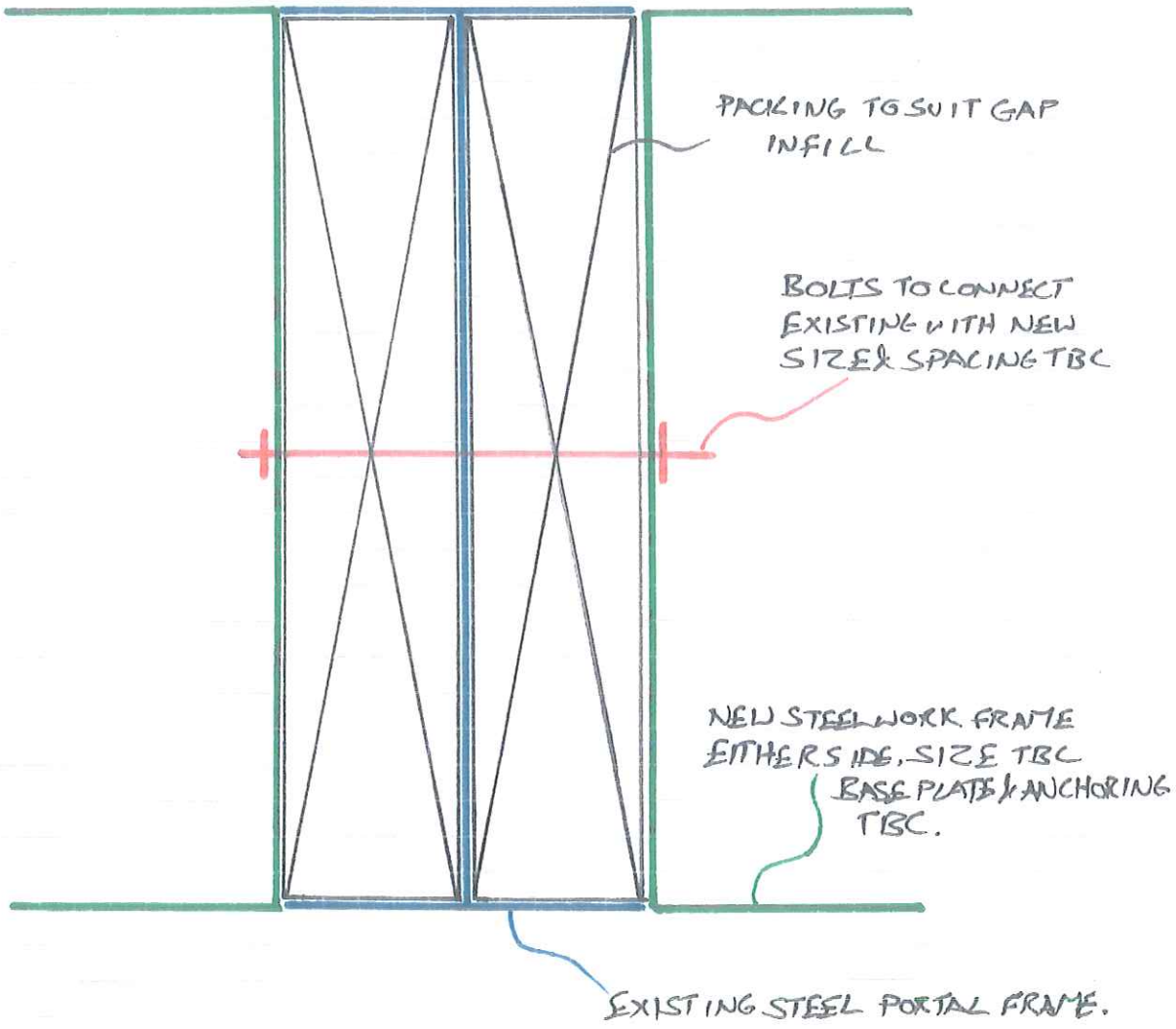
LEGEND

- NEW GIB BRACELINE WALL LINING
- OPTION (1) - NEW PORTALS BETWEEN EXISTING
- OPTION (2) - NEW PFC PORTAL EITER SIDE OF EXISTING -SEE DETAIL.

CLIENT

SUBJECT

FILE No. 113400	DATE	PAGE OF	BY	CKD



STRENGTHENING OPTION 2 - DETAIL 1-1