Hadley & Robinson Ltd.
Consulting Civil & Structural Engineers

16 March 2015

Job Number: 14028

Catholic Property Services
Bill Haydon
Private Bag 1941
Dunedin 9054

6 Cromwell Street, Wakari, Dunedin 9010 – St Mary's Church
Initial Seismic Assessment Report

Dear Bill

We have now completed an Initial Seismic Assessment (ISA) of the Immaculate Conception Church located at 6 Cromwell Street, Wakari, Dunedin 9010 using the Initial Evaluation Procedure (IEP).

Background to the IEP and Its Limitations

The IEP procedure was developed in 2006 by the New Zealand Society for Earthquake Engineering (NZSEE) and updated in 2013 to reflect experience with its application and as a result of experience in the Canterbury earthquakes. It is a tool to assign a percentage of New Building Standard (%NBS) score and associated grade to a building as part of an initial seismic assessment of existing buildings.

The IEP enables territorial authorities, building owners and managers to review their building stock as part of an overall risk management process.

Characteristics and limitations of the IEP include:

- It tends to be somewhat conservative, identifying some buildings as earthquake prone, or having a lower %NBS score, which subsequent detailed investigation may indicate is less than actual performance. However, there will be exceptions, particularly when critical structural weaknesses (CSWs) are present that have not been recognised from the level of investigation employed.
- It can be undertaken with variable levels of available information, e.g. exterior only inspection, structural drawings available or not, interior inspection, etc. The more information available the more representative the IEP result is likely to be. The IEP records the information that has formed the basis of the assessment and consideration of this is important when determining the likely reliability of the result.

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- It is an initial, first-stage review. Buildings or specific issues which the IEP process flags as being problematic or as potentially critical structural weaknesses, need further detailed investigation and evaluation. A Detailed Seismic Assessment is recommended if the seismic status of a building is critical to any decision making.
- The IEP assumes that the buildings have been designed and built in accordance with the building standard and good practice current at the time. In some instances, a building may include design features ahead of its time - leading to better than predicted performance. Conversely, some unidentified design or construction issues not picked up by the IEP process may result in the building performing not as well as predicted.
- It is a largely qualitative process, and should be undertaken or overseen by an experienced engineer. It involves considerable knowledge of the earthquake behaviour of buildings, and judgement as to key attributes and their effect on building performance. Consequently, it is possible that the %NBS derived for a building by independent experienced engineers may differ.
- An IEP may over-penalise some apparently critical features which could have been satisfactorily taken into account in the design.
- An IEP does not take into account the seismic performance of non-structural items such as ceiling, plant, services or glazing.

Experience to date is that the IEP is a useful tool to identify potential issues and expected overall performance of a building in an earthquake. However, the process and the associated %NBS and grade should be considered as only indicative of the building's compliance with current code requirements. A detailed investigation and analysis of the building will typically be required to provide a definitive assessment.

An IEP score above 34%NBS should be considered sufficient to classify the building as not earthquake prone. However, if further information comes available reassessment may be required.

IEP Assessment Results

Our IEP assessment of this building indicates the building can achieve 55%NBS in the longitudinal direction and 55%NBS in the transverse direction. The IEP assessment of this building therefore indicates an overall score of 55%NBS, corresponding to a 'Grade C' building as defined by the New Zealand Society for Earthquake Engineering (NZSEE) building grading scheme. This is above the threshold for earthquake prone buildings (34%NBS) and below the threshold for earthquake risk buildings (67%NBS) as recommended by the NZSEE.

IEP Grades and Relative Risk

Table 2 taken from the NZSEE Guidelines provides the basis of a proposed grading system for existing buildings, as one way of interpreting the %NBS building score. It can be seen that occupants in Earthquake Prone buildings (less than 34%NBS) are exposed to more than 10 times the risk that they would be in a similar new building. For buildings that are potentially Earthquake Risk (less than 67%NBS), but not Earthquake Prone, the risk is at least 5 times greater than that of an equivalent new building. Broad descriptions of the life-safety risk can be assigned to the building grades as shown in Table 2.

Table 2: Relative Earthquake Risk

Building Grade	Percentage of New Building Strength (%NBS)	Approx. Risk Relative to a New Building	Life-safety Risk Description
A+	>100	<1	low risk
A	80 to 100	1 to 2 times	low risk
B	67 to 79	2 to 5 times	low or medium risk
C	34 to 66	5 to 10 times	medium risk
D	20 to 33	10 to 25 times	high risk
E	<20	more than 25 times	very high risk

This building has been classified by the IEP as a grade B building and is therefore considered to be a medium risk.

The New Zealand Society for Earthquake Engineering (which provides authoritative advice to the legislation makers, and should be considered to represent the consensus view of New Zealand structural engineers) classifies a buildings achieving greater than 67%NBS as "Low Risk", and having "Acceptable (improvement may be desirable)" building structural performance.

Seismic Restraint of Non-Structural Items

During an earthquake, the safety of people can be put at risk due to non-structural items falling on them. These items should be adequately seismically restrained, where possible, to the NZS 4219:2009 "The Seismic Performance of Engineering Systems in Buildings".

An assessment has not been made of the bracing of the ceilings, in-ceiling ducting, services and plant. We have also not checked whether tall or heavy furniture has been seismically restrained or not. These issues are outside the scope of this initial assessment but could be the subject of another investigation.

Conclusion

Our ISA assessment for this building, carried out using the IEP indicates an overall score of 55%NBS which corresponds to a Grade C building, as defined by the NZSEE building grading scheme. This is above the threshold for Earthquake Prone Buildings (34%NBS) and below the threshold for Earthquake Risk Buildings (67%NBS) as defined by the NZSEE and the New Zealand Building Code.

The ISA is considered to provide a relatively quick, high-level and qualitative measure of the building's performance. In order to confirm the seismic performance of this building with more reliability you may wish to request a DSA. A DSA would likely focus on the following issues:

Wall construction and connection to roof.

A DSA would also investigate other potential weaknesses that may not have been considered in the initial seismic assessment.

N/A

We trust this letter and initial seismic assessment meets your current requirements. We would be pleased to discuss further with you any issues raised in this report.

Regards

Ralf Schruba
Civil & Structural Engineer
Hadley & Robinson Ltd

Enclosed: IEP Assessment
Copy to: N/A

Initial Evaluation Procedure (IEP) Assessment - Catholic Property Services

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Street Number & Name:	6 Cromwell Street, Kaikorai	Job No.:	14028
AKA:		By:	Ralf Schruba
Name of building:	St Mary's Church	Date:	16/03/2015
City:	Dunedin 9010	Revision No.:	

Table IEP-1 Initial Evaluation Procedure Step 1

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)

front (Taieri Road)

right

NOTE: THERE ARE MORE PHOTOS ON PAGE 1a ATTACHED

s of interest)

back

left

NOTE: THERE ARE MORE SKETCHES ON PAGE 1a ATTACHED

1.3 List relevant features (Note: only 10 lines of text will print in this box. If further text required use Page 1a)

This church was originally built in 1912 according to a commemorative plaque. There is no report of any significant alteration since.
The building consists of elevated timber ground floor; external walls are thick masonry (most probable multiple brick without cavity) without buttresses or engaged columns; roof is timber (trusses, rafters and sarking) with roof shingles.

1.4 Note information sources Tick as appropriate

Visual Inspection of Exterior	☑	Specifications	☐
Visual Inspection of Interior	☑	Geotechnical Reports	☐
Drawings (note type)	☐	Other (list)	☐

Subfloor space of nave could not be inspected. No drawings available at all.

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Table IEP-2 Initial Evaluation Procedure Step 2

Step 2 - Determination of *(%NBS)*$_b$

(Baseline *(%NBS)* for particular building - refer Section B5)

2.1 Determine nominal *(%NBS)* = *(%NBS)*$_{nom}$

	Longitudinal	Transverse
a) Building Strengthening Data		
Tick if building is known to have been strengthened in this direction	☐	☐
If strengthened, enter percentage of code the building has been strengthened to	N/A	N/A
b) Year of Design/Strengthening, Building Type and Seismic Zone		
Pre 1935	◉	◉
1935-1965	○	○
1965-1976	○	○
1976-1984	○	○
1984-1992	○	○
1992-2004	○	○
2004-2011	○	○
Post Aug 2011	○	○
Building Type:	Others	Others
Seismic Zone:		
c) Soil Type		
From NZS1170.5:2004, Cl 3.1.3 :	C Shallow Soil	C Shallow Soil
From NZS4203:1992, Cl 4.6.2.2 : (for 1992 to 2004 and only if known)		Flexible
d) Estimate Period, *T*		
Comment: N/A	h_n = 8	8 m
	A_c = 1.00	1.00 m^2
Moment Resisting Concrete Frames: $T = \max\{0.09h_n^{0.75}, 0.4\}$	○	○
Moment Resisting Steel Frames: $T = \max\{0.14h_n^{0.75}, 0.4\}$	○	○
Eccentrically Braced Steel Frames: $T = \max\{0.08h_n^{0.75}, 0.4\}$	○	○
All Other Frame Structures: $T = \max\{0.06h_n^{0.75}, 0.4\}$	○	○
Concrete Shear Walls $T = \max\{0.09h_n^{0.75}/A_c^{0.5}, 0.4\}$	○	○
Masonry Shear Walls: $T \leq 0.4$sec	○	○
User Defined (input Period):	◉	◉
Where h_n = height in metres from the base of the structure to the uppermost seismic weight or mass.	T: 0.40	0.40
e) Factor A: Strengthening factor determined using result from (a) above (set to 1.0 if not strengthened)	Factor A: 1.00	1.00
f) Factor B: Determined from NZSEE Guidelines Figure 3A.1 using results (a) to (e) above	Factor B: 0.04	0.04
g) Factor C: For reinforced concrete buildings designed between 1976-84 Factor C = 1.2, otherwise take as 1.0	Factor C: 1.00	1.00
h) Factor D: For buildings designed prior to 1935 Factor D = 0.8 except for Wellington where Factor D may be taken as 1, otherwise take as 1.0	Factor D: 0.80	0.80
***(%NBS)*$_{nom}$ = AxBxCxD**	***(%NBS)*$_{nom}$** 3%	3%

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Table IEP-2 Initial Evaluation Procedure Step 2 continued

2.2 Near Fault Scaling Factor, Factor E

If $T \leq 1.5$sec, Factor E = 1

		Longitudinal	Transverse
a) Near Fault Factor, *N(T,D)* (from NZS1170.5:2004, Cl 3.1.6)	N(T,D):	1	1
b) Factor E = 1/N(T,D)	Factor E:	1.00	1.00

2.3 Hazard Scaling Factor, Factor F

a) Hazard Factor, *Z*, for site

Location: Dunedin

Z =	0.13	(from NZS1170.5:2004, Table 3.3)
Z_{1992} =	0.6	(NZS4203:1992 Zone Factor from accompanying Figure 3.5(b))
Z_{2004} =	0.13	(from NZS1170.5:2004, Table 3.3)

b) Factor F

For pre 1992	=	$1/Z$
For 1992-2011	=	Z_{1992}/Z
For post 2011	=	Z_{2004}/Z

	Longitudinal	Transverse
Factor F:	7.69	7.69

2.4 Return Period Scaling Factor, Factor G

a) Design Importance Level, I (Set to 1 if not known. For buildings designed prior to 1965 and known to be designed as a public building set to 1.25. For buildings designed 1965-1976 and known to be designed as a public building set to 1.33 for Zone A or 1.2 for Zone B. For 1976-1984 set I value.)

	Longitudinal	Transverse
I =	1	1

b) Design Risk Factor, R_o (set to 1.0 if other than 1976-2004, or not known)

	Longitudinal	Transverse
R_o =	1	1

c) Return Period Factor, R (from NZS1170.0:2004 Building Importance Level)

	Longitudinal	Transverse
Choose Importance Level	○ 1 ◉ 2 ○ 3 ○ 4	○ 1 ◉ 2 ○ 3 ○ 4
R =	1.0	1.0

d) Factor G = IR_o/R

	Longitudinal	Transverse
Factor G:	1.00	1.00

2.5 Ductility Scaling Factor, Factor H

a) Available Displacement Ductility Within Existing Structure

Comment:
External walls are thick masonry (most probable multiple brick without cavity) without buttresses or engaged columns.

	Longitudinal	Transverse
μ =	1.00	1.00

b) Factor H

		k_μ Longitudinal	k_μ Transverse
For pre 1976 (maximum of 2)	=	1.00	1.00
For 1976 onwards	=	1	1
Factor H:		1.00	1.00

(where k_μ is NZS1170.5:2004 Inelastic Spectrum Scaling Factor, from accompanying Table 3.3)

2.6 Structural Performance Scaling Factor, Factor I

a) Structural Performance Factor, S_p (from accompanying Figure 3.4)

Tick if light timber-framed construction in this direction

	Longitudinal	Transverse
	☐	☐
S_p =	1.00	1.00

b) Structural Performance Scaling Factor = $1/S_p$

	Longitudinal	Transverse
Factor I:	1.00	1.00

Note Factor B values for 1992 to 2004 have been multiplied by 0.67 to account for Sp in this period

2.7 Baseline *%NBS* for Building, $(\%NBS)_b$

(equals $(\%NBS)_{nom}$ x E x F x G x H x I)

Longitudinal	Transverse
22%	22%

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Table IEP-3 Initial Evaluation Procedure Step 3

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

a) Longitudinal Direction

potential CSWs	Effect on Structural Performance (Choose a value - Do not interpolate)			Factors
3.1 Plan Irregularity				
Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor A 1.0
N/A				
3.2 Vertical Irregularity				
Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor B 1.0
N/A				
3.3 Short Columns				
Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor C 1.0
N/A				

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or 1.0 if no potential for pounding, or consequences are considered to be minimal)

a) Factor D1: - Pounding Effect

Note:
Values given assume the building has a frame structure. For stiff buildings (eg shear walls), the effect of pounding may be reduced by taking the coefficient to the right of the value applicable to frame buildings.

Factor D1 For Longitudinal Direction: 1.0

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep< 005H	005<Sep< 01H	Sep> 01H
Alignment of Floors within 20% of Storey Height	○ 1	○ 1	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

N/A

b) Factor D2: - Height Difference Effect

Factor D2 For Longitudinal Direction: 1.0

Table for Selection of Factor D2	Severe	Significant	Insignificant
	0<Sep< 005H	005<Sep< 01H	Sep> 01H
Height Difference > 4 Storeys	○ 0.4	○ 0.7	◉ 1
Height Difference 2 to 4 Storeys	○ 0.7	○ 0.9	○ 1
Height Difference < 2 Storeys	○ 1	○ 1	○ 1

N/A

Factor D 1.0

3.5 Site Characteristics - *Stability, landslide threat, liquefaction etc as it affects the structural performance from a life-safety perspective*

Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor E 1.0
N/A				

3.6 Other Factors - *for allowance of all other relevant characterstics of the building*

For ≤ 3 storeys - Maximum value 2.5
otherwise - Maximum value 1.5.
No minimum.

Factor F 2.5

Record rationale for choice of Factor F:

1.56 for unreinforced masonry damping and 1.6 for thick walls rocking and sliding.

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F)

PAR

Longitudinal 2.50

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Table IEP-3 Initial Evaluation Procedure Step 3

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

b) Transverse Direction

potential CSWs	Effect on Structural Performance (Choose a value - Do not Interpolate)			Factors
3.1 Plan Irregularity				
Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor A 1.0
N/A				
3.2 Vertical Irregularity				
Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor B 1.0
N/A				
3.3 Short Columns				
Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor C 1.0
N/A				

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or 1.0 if no potential for pounding, or consequences are considered to be minimal)

a) Factor D1: - Pounding Effect

Note:
Values given assume the building has a frame structure. For stiff buildings (eg shear walls), the effect of pounding may be reduced by taking the coefficient to the right of the value applicable to frame buildings.

Factor D1 For Transverse Direction: 1.0

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 1	○ 1	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

N/A

b) Factor D2: - Height Difference Effect

Factor D2 For Transverse Direction: 1.0

Table for Selection of Factor D2	Severe	Significant	Insignificant
	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Height Difference > 4 Storeys	○ 0.4	○ 0.7	◉ 1
Height Difference 2 to 4 Storeys	○ 0.7	○ 0.9	○ 1
Height Difference < 2 Storeys	○ 1	○ 1	○ 1

N/A

Factor D 1.0

3.5 Site Characteristics - *Stability, landslide threat, liquefaction etc as it affects the structural performance from a life-safety perspective*

Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor E 1.0
N/A				

3.6 Other Factors - *for allowance of all other relevant characterstics of the building*

For ≤ 3 storeys - Maximum value 2.5
otherwise - Maximum value 1.5.
No minimum.

Factor F 2.50

Record rationale for choice of Factor F:

1.56 for unreinforced masonry damping and 1.6 for thick walls rocking and sliding.

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F)

PAR

Transverse 2.50

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Table IEP-4 Initial Evaluation Procedure Steps 4, 5, 6 and 7

Step 4 - Percentage of New Building Standard *(%NBS)*

		Longitudinal	Transverse
4.1	Assessed Baseline *%NBS* $(\%NBS)_b$ (from Table IEP - 1)	22%	22%
4.2	Performance Achievement Ratio (PAR) (from Table IEP - 2)	2.50	2.50
4.3	PAR x Baseline $(\%NBS)_b$	55%	55%
4.4	Percentage New Building Standard *(%NBS)* (Use lower of two values from Step 4.3)		55%

Step 5 - Potentially Earthquake Prone? (Mark as appropriate) *%NBS* ≤ 34 — NO

Step 6 - Potentially Earthquake Risk? (Mark as appropriate) *%NBS* < 67 — YES

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade: C

Additional Comments (items of note affecting IEP score)

N/A

Relationship between Grade and *%NBS*:

Grade:	A+	A	B	C	D	E
%NBS:	> 100	100 to 80	79 to 67	66 to 34	33 to 20	< 20

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Table IEP-5 Initial Evaluation Procedure Step 8

Step 8 - Identification of potential Severe Critical Structural Weaknesses that could result in significant risk to a significant number of occupants

8.1	Number of storeys above ground level	1
8.2	Presence of heavy concrete floors and/or concrete roof? (Y/N)	N

Occupancy not considered to be significant - no further consideration required

Risk not considered to be significant - no further consideration required

IEP Assessment Confirmed by **Signature**

L M Robinson **Name**

38322 **CPEng. No**

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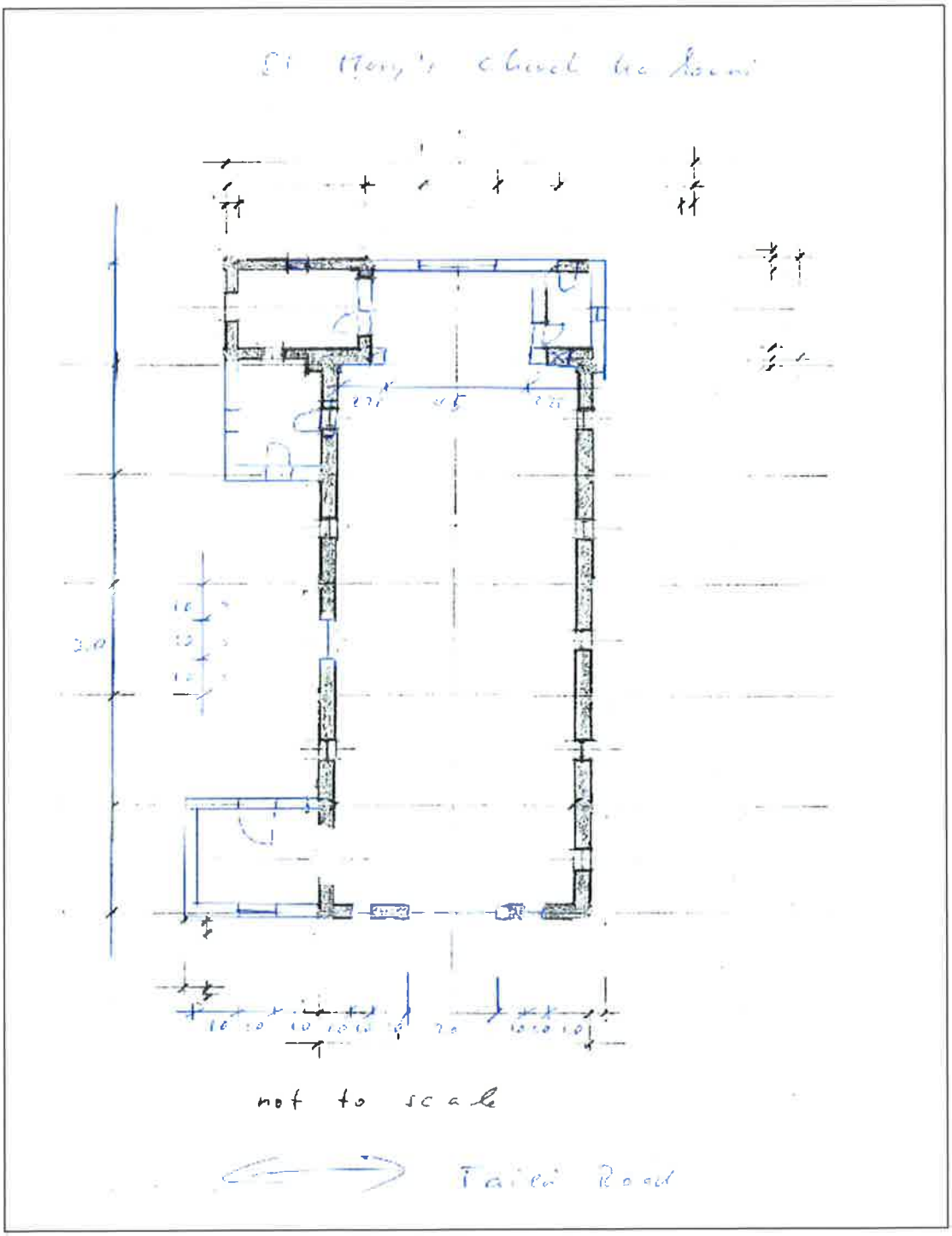
Table IEP-1a Additional Photos and Sketches



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