Structural Calculations

For

Block 2 Upgrade
St. Canice's School
24A Brougham Street, Westport

These calculations are in accordance with:

AS/NZS 1170:2004 Structural Design Actions
NZS 3101:2006 Concrete Structures Standard
NZS 3404:1997 Steel Structures Standard
NZS 3603:1993 Timber Structures Standard
NZS 3604:2011 Timber Framed Buildings

Engineer:	**Initials:**
Hugh Falkner	HAF
Geert van de Vorstenbosch	GV

Preamble:

The project comprises proposed upgrades to an existing single-storey timber framed classroom block. These calculations pertain to the design of:

- Beams 1 and 2 and their associated supports and connections,
- Bracing schedule to NZS 3604,
- Specific bracing of cantilevered verandah roof posts

The ultimate limit state site wind speed has been determined as 37m/s (Medium) based on data provided by Buller District Council staff.

The bearing capacity is to be confirmed on site by the Engineer.

The upgrade includes seismic strengthening to 100%NBS for a Building Importance Level 2 structure, as per the Ministry of Education Guidelines for the Seismic Evaluation of Timber Framed School Buildings (June 2013).

Date:
9 July 2015

Job No.
40101

Schedule of Inspections
For
Block 2 Upgrade
St. Canice's School
24A Brougham Street, Westport

We confirm that CERTA Engineering Ltd have been engaged to undertake construction monitoring of the specific engineering design items to an IPENZ /ACENZ CM3 level and propose to undertake the following site inspections:

No.	Item of inspection	Timeframe
1	Concrete piles	Pre-pour
2	Internal beam and connections	Pre-line or prior to building in to such an extent that remediation work could not be carried out.
3	Internal posts and connections	Pre-line or prior to building in to such an extent that remediation work could not be carried out.
4	External verandah posts and connection	Pre-clad or prior to building in to such an extent that remediation work could not be carried out.

Notes:

a) The above items of inspections are the minimum required to enable CERTA Engineering Ltd to issue a PS4 – Producer Statement Construction Review for the specific engineering design items.

b) The above items of inspection do not cover work constructed in accordance with NZS 3604:2011, for which inspections are to be undertaken by the Building Consent Authority.

c) The Contractor/Builder is to provide CERTA Engineering Ltd at least 24 hours' notice of the requirement for an inspection. The above timeframes are indicative, the Engineer and Contractor are to agree the timing of inspection prior to work commencing on site.

d) The Contractor /Builder is to provide reasonable and safe access to enable works to be inspected.

e) The above schedule does not necessarily represent the actual number of inspections to be undertaken. The number of inspections will depend on the construction method, sequence of the works and whether or not unforeseen conditions or difficulties are encountered on site.

Date:
9 July 2015

Job No.
40101

Building Code Clause(s) **B1**

J40101

PRODUCER STATEMENT - PS1 - DESIGN

(Guidance notes on the use of this form are printed on page 2)

ISSUED: CERTA Engineering Ltd

TO: **Ian Rattray Building Consultant**

(Owner / Developer)

TO BE SUPPLIED TO: Buller District Council

(Building Consent Authority)

IN RESPECT OF: **Proposed Upgrade of Block 2, St. Canice's School**

(Description of Building Work)

AT: **24A Brougham Street, Westport**

(Address)

Secs 393-396 445-447 **town of Westport**

We have been engaged by the owner/developer referred to above to provide **structural design services and construction monitoring of specifically designed elements** in respect of the requirements of Clause B1 (B2 of specifically designed elements) of the building code for

☐ All

☑ ***Part only as specified of building work:***

- Specifically designed beams 1 and 2 outside the scope of NZS3604:2011
- Bracing of the classroom block in accordance with NZS 3604:2011;
- Specifically designed bracing of verandah roofs.

The design carried out by us has been prepared in accordance with Compliance Documents issued by the Ministry of Business, Innovation & Employment B1, VM1 & VM4 (foundations and retaining walls loads)

The proposed building work covered by this producer statement is decribed on the drawings titled **Block 2, St. Canice's School, Westport** and numbered **S1**.

On behalf of the Design Firm, and subject to:

(i) Site verification of the following design assumptions: Bearing capacity of excavated foundations to satisfy the requirements of NZS3604:2011 and to be confirmed on site by council inspector.

(ii) All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided will comply with the relevant provisions of the Building Code and b), the persons who have undertaken this design work have the necessary competency to do so. I also recommend the following level of construction monitoring:

☐CM1 ☐CM2 ☒ CM3☐ CM4 ☐ CM5 observation services.

(Engineering Categories)

I, Stuart Preston am CPEng # 138744

I am a member of: IPENZ and hold the following qualifications: BE(Civil), MIPENZ, CPEng

The design firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than $ 200,000*.

The Design Firm is a member of ACENZ

SIGNED BY Stuart Preston ON BEHALF OF CERTA Engineering Ltd

Date 9 July 2015 (Signature)..

Note: this statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provide to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of $200,000*.

This form is to accompany Form 2 of the Building (Forms) Regulations 2004 for the application of a Building Consent.

GUIDANCE ON USE OF PRODUCER STATEMENTS

Producer statements were first introduced with the Building Act 1992. The producer statements were developed by a combined task committee consisting of members of the New Zealand Institute of Architects, Institution of Professional Engineers New Zealand, Association of Consulting Engineers New Zealand in consultation with the Building Officials Institute of New Zealand. The original suite of producer statements has been revised as at the date of this form as a result of enactment of the Building Act (2004) by these organisations to ensure standard use within the industry.

The producer statement system is intended to provide Building Consent Authorities (BCAs) with reasonable grounds for the issue of a Building Consent or a Code Compliance Certificate, without having to duplicate design or construction checking undertaken by others.

PS1 Design Intended for the use by a suitably qualified independent design professional in circumstances where the BCA accepts a producer statement for establishing reasonable grounds to issue a Building Consent;

PS2 Design Review Intended for use by a suitably qualified independent design professional where the BCA accepts an independent design professional's review as the basis for establishing reasonable grounds to issue a Building Consent;

PS3 Construction Forms commonly used as a certificate of completion of building work are Schedule 6 of NZS 3910:20031 ; or Schedules E1/E2 of NZIA's SCC 2007 2

PS4 Construction Review Intended for use by a suitably qualified independent design professional who undertakes construction monitoring of the building works where the BCA requests a producer statement prior to issuing a Code Compliance Certificate. This must be accompanied by a statement of completion of building work (Schedule 6).

The following guidelines are provided by ACENZ, IPENZ and NZIA to interpret the Producer Statement.

Competence of Design Professional

This statement is made by a Design Firm that has undertaken a contract of services for the services named, and is signed by a person authorised by that firm to verify the processes within the firm and competence of its designers.

A competent design professional will have a professional qualification and proven current competence through registration on a national competence-based register, either as a Chartered Professional Engineer (CPEng) or a Registered Architect.

Membership of a professional body, such as the Institution of Professional Engineers New Zealand (IPENZ)or the New Zealand Institute of Architects (NZIA) provides additional assurance of the designer's standing within the profession. If the design firm is a member of the Association of Consulting Engineers New Zealand (ACENZ), this provides additional assurance about the standing of the firm.

Persons or firms meeting these criteria satisfy the term "suitably qualified independent design professional".

Professional Indemnity Insurance

As part of membership requirements, ACENZ requires all member firms to hold Professional Indemnity Insurance to a minimum level.

The PI insurance minimum stated on the front of this form reflects standard, small projects. If the parties deem this inappropriate for large projects the minimum may be up to $500,000.

Professional Services during Construction Phase

There are several levels of service which a Design Firm may provide during the construction phase of a project (CM1-5)3 (OL1-OL4)2. The Building Consent Authority is encouraged to require that the service to be provided by the Design Firm is appropriate for the project concerned.

Requirement to provide Producer Statement PS4

Building Consent Authorities should ensure that the applicant is aware of any requirement for producer statements for the construction phase of building work at the time the building consent is issued as no design professional should be expected to provide a producer statement unless such a requirement forms part of the Design Firm's engagement.

Attached Particulars

Attached particulars referred to in this producer statement refer to supplementary information appended to the producer statement.

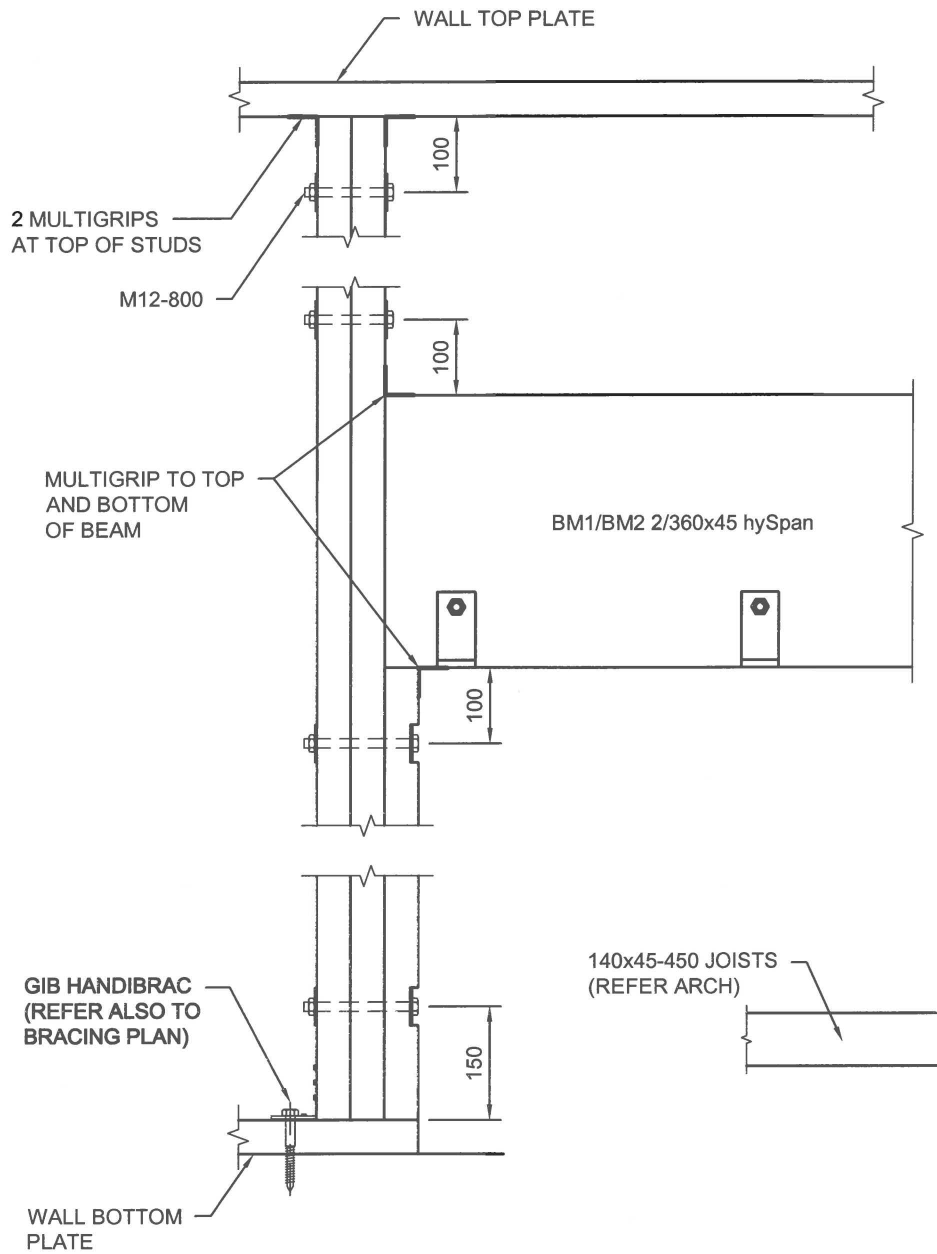
Refer Also:

1 Conditions of Contract for Building & Civil Engineering Construction NZS 3910: 2003

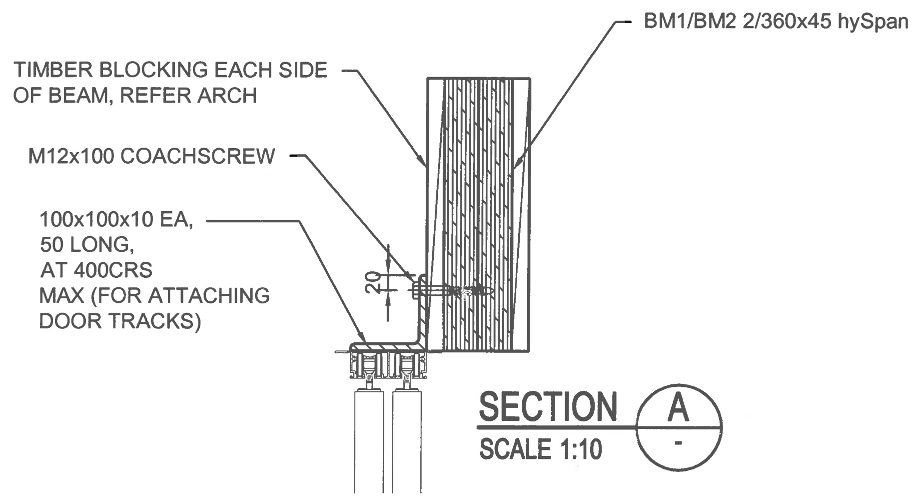
2 NZIA Standard Conditions of Contract SCC 2007 (1st edition)

3 Guideline on the Briefing & Engagement for Consulting Engineering Services (ACENZ/IPENZ 2004)

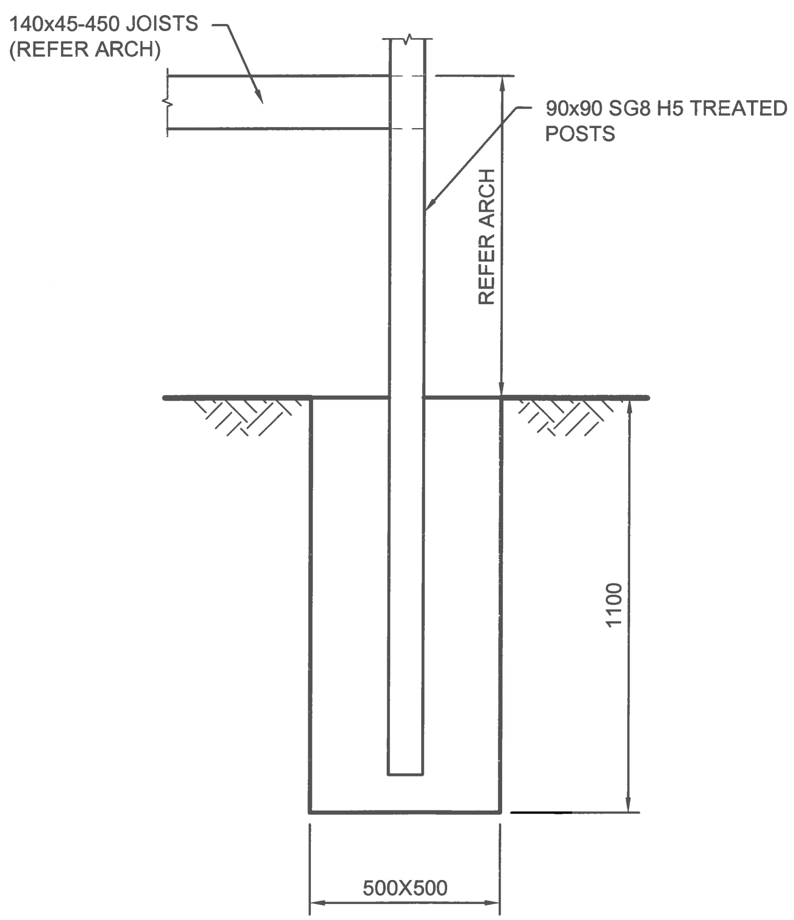
www.acenz.org.nz
www.ipenz.org.nz
www.nzia.co.nz



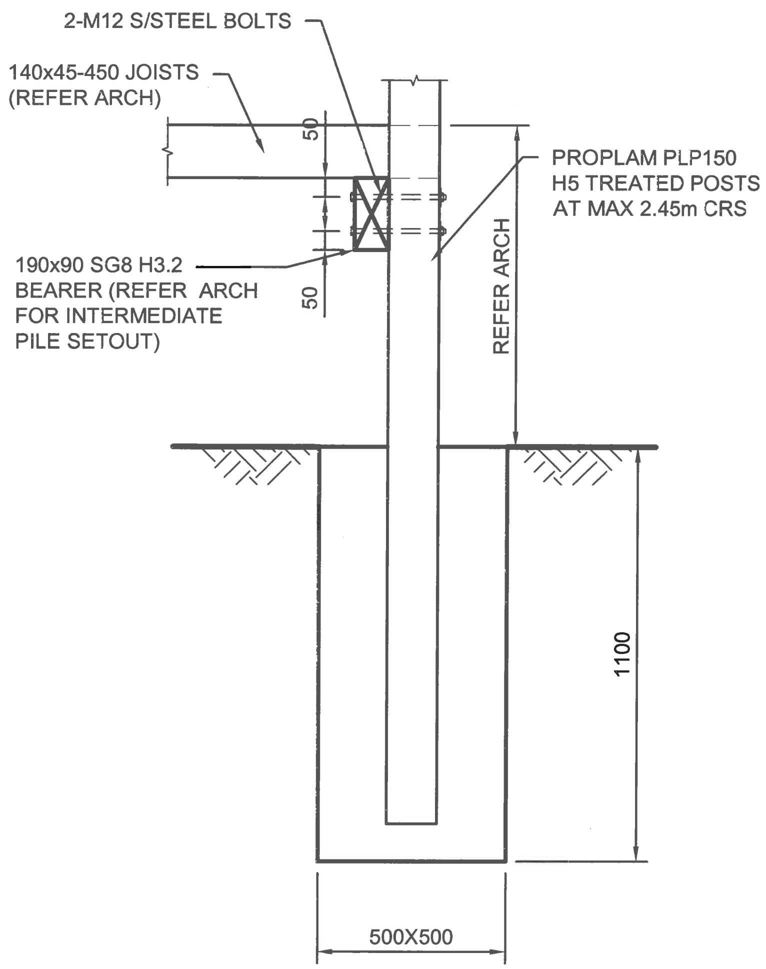
BM1/BM2 CONNECTION DETAIL
SCALE 1:10



SECTION A
SCALE 1:10



WEST VERANDAH POST DETAIL (NORTH END)
SCALE 1:20



EAST VERANDAH POST DETAIL (TYPICAL)
SCALE 1:20

NOTES:

1. REFER ARCHITECT'S DRAWINGS FOR DIMENSIONS, UNLESS NOTED OTHERWISE. DO NOT SCALE OFF THIS DRAWING. DIMENSIONS TO BE CONFIRMED ON SITE PRIOR TO STEEL FABRICATION.
2. ALL BOLTS TO BE GRADE 8.8 UNLESS NOTED OTHERWISE.
3. STEEL GRADES:
   - HOT ROLLED SECTIONS 300MPa
4. ALL BOLTED TIMBER CONNECTIONS TO HAVE 50x50x3 WASHERS.
5. ALL EXTERNAL BOLTS, NUTS, WASHERS AND OTHER STEEL CONNECTORS TO BE STAINLESS STEEL.
6. ALL INTERNAL STRUCTURAL STEEL TO BE PAINTED IN ACCORDANCE WITH SYSTEM DESIGNATION AS/NZS 2312/AKL1 BEFORE DELIVERY TO SITE. ANY AREAS DAMAGED TO BE MADE GOOD UPON INSTALLATION.
7. ENGINEER TO INSPECT ALL STEEL CONNECTIONS PRIOR TO CLOSING IN. ENGINEER REQUIRES 24 HOURS NOTICE BEFORE ANY VISIT.
8. TIMBER TREATMENT:
9. ALL EXTERNAL POSTS SHOWN TO BE TREATED TO TPC SPECIFICATION H5.
10. TIMBER IN CONTACT WITH GROUND TO BE TREATED TO TPC SPECIFICATION H4.
11. EXTERIOR TIMBER NOT IN CONTACT WITH GROUND TO BE TREATED TO TPC SPECIFICATION H3.2.
12. EXTERIOR WALL FRAMING TO BE TREATED TO TPC SPECIFICATION H1.2.
13. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE EXISTING STRUCTURE IS ADEQUATELY SUPPORTED DURING CONSTRUCTION.

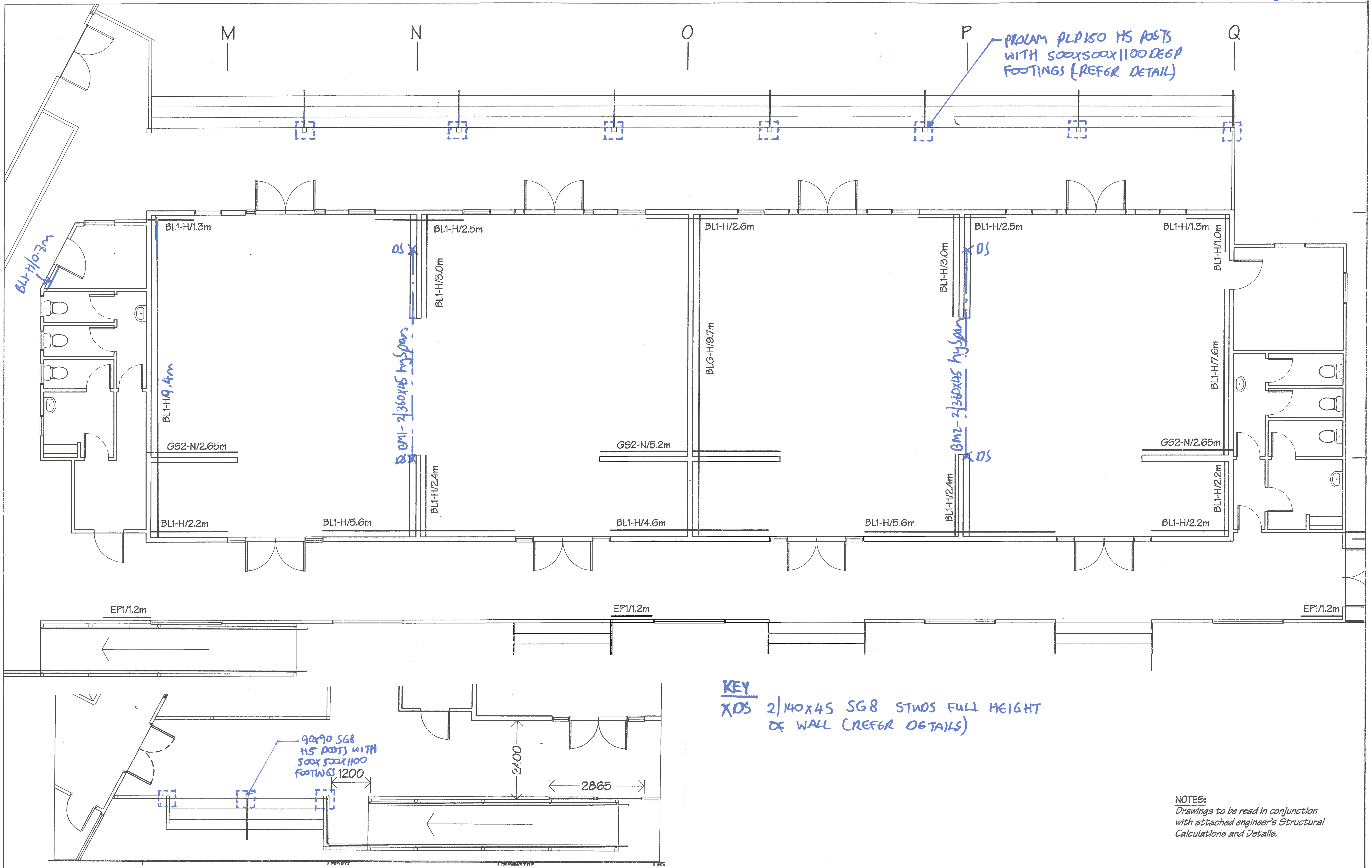
CLIENT
IAN RATTRAY BUILDING CONSULTANT

PROJECT
BLOCK 2, ST. CANICE'S SCHOOL
24A BROUGHAM ST, WESTPORT

CERTA ENGINEERING
Lower Hutt Office
Tel: 04 566 8004
Level 1, 14 Laings Rd
P.O. Box 30 535
Lower Hutt 5040
email@certa.nz

DATE: JULY 2015	DESIGNED: GV
DRAWN: GV	APPROVED: HAF
JOB No: 40101	SHEET No: S1 — REV: 0

J40101



St Canice's School 24a Brougham Street Westport	PROJECT Block 2 Upgrade	DRAWING TITLE STRUCTURAL LAYOUT PLAN	REVISIONS No Date Description

Scale	1:100
Date	30/7/2015
Original sheet size	A3
Drawn	GV
Sheet No	SK1

Do not scale from drawings. Check all dimensions on site.

(7)

Project:	St Canice's School	Date:	30-Jun-15
Location:	24A Brougham Street	Engineer:	GV
	Westport	Job No.	40101

DETERMINATION OF AS/NZS1170 SEISMIC COEFFICIENT

Applicable to Structure Of Period T < 0.7 Seconds
Base Shear Force $V = C_d.W_t$

Location = WESTPORT
First Mode Period (>0.4 sec) = 0.4
State = Ultimate

Site Subsoil Category: Deep/Soft Soil (Class D)
Structural Ductility Factor μ = 3

From AS/NZS1170 $C_h(T_1)$ =	3.00	S_p =	0.7
$C(T) = C_h(T_1)RZN(T,D)$ =	0.90	R =	1.00
$K_u = (\mu-1)T_1 / 0.7 + 1$ =	2.14	Z =	0.30
$Cd(T_1)$ = C(T)Sp/Ku =	**0.29**	N(T,D) =	1

EQUIVALENT STATIC METHOD — **Building Weight Determination**

Roof	Classblock Roof	0.35 kPa x 341m2	119.4
	Walkway Roof	0.30 kPa x 77m2	23.1
	1/2 Walls External	0.35 kN/m x 83m x 3.9/2.4	47.2
	1/2 Walls Internal	0.30 kN/m x 39m x 3.9/2.4	19.0
		W Roof =	**208.7**
Sub Floor		*Area Lower Floor*	*307 m2*
	1/2 Walls External	0.35 kN/m x 83m x 3.9/2.4	47.2
	1/2 Walls Internal	0.30 kN/m x 39m x 3.9/2.4	19.0
	Floor	0.4 kPa x L.F. Area m2	122.8
	Seismic Live	0.3 x 3.0kPa x S.F.area m2 x LLR	138.2
		W Lower Floor =	**327.2**
Floor LLR (ψ_a)	(Live Load Reduction Factor)	$\psi_a=0.3+(3\div\sqrt{A})$ *where* $1>\psi_a>0.5$	0.50
		Wt =	535.8
	V = Cd Wt	**V =**	**157.5 kN**

Bracing Distribution

Level	Wi	Hi	WiHi	Ratio WiHi/SumWiHi	Vi = 0.92(Ratio x V) (+8% V for roof level)	Vi Cum.	BU
Roof	209	4.8	1002	0.773	124.6	124.6	**2492**
Subfloor	327	0.9	294	0.227	32.9	157.5	**3151**
	536		1296				

2

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Demand Calculation Sheet

single storey V06/11

Job Details

Street and Number	Block 2, St Canice's School	
Suburb	24A Brougham Street, Westport	
Lot and DP Number		
City/Town/District		
Designer & Date	GV	30-Jun-15
Company Name	Certa Engineering Ltd	
Job Number	J40101	

BRANZ Appraised
Appraisal No.294 [2011]

Select Lining Option: 10 or 13 mm GIB® Plasterboard

Building Specification

Number of storeys	single	
Floor Loading	2kPa	
Foundation Type	subfloor	
Cladding Weight (subfloor)	heavy	
	Single Floor	**Complete Single Floor Column only**
Cladding Weight	light	
Roof Weight	light	
Room in Roof Space	no	
Roof Pitch (degrees)	30	
Roof height above eaves (m)	2.8	
Building height to apex (m)	7.6	
Ground to lower floor level (m)	0.9	
Stud Height (m)	3.9	
Building Length (m)	31.7	
Building Width (m)	9.7	
Building Plan Area (m2)	307	

Building Location

Wind Zone	***Medium*** (SUPPLIED BY BULLER D.C)
Select by Building Consent Authority Map	
or Preference	Medium
Wind Region	Preference selected
Lee Zone	Preference selected
Ground Roughness	Preference selected
Site Exposure	Preference selected
Topographic Class	Preference selected

Earthquake Zone: 3

Soil Type: D&E (deep to very soft)

Annual exceedance probability: 1/500 (NZS3604:2011 default)

Highlighted values below from Engineer's NZS1170:2004 specific calculations:

Bracing Units required for Wind

Demand W (BU)	subfloor	Walls single
along	993	578
across	3084	1833

Bracing Units required for Earthquake

Demand along / across E (BU)	
subfloor	Walls single
3151	2492

3

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SINGLE OR UPPER STOREY WALLS ALONG

V06/11

Lines		Bracing Elements							
1	2	3	4	5	6	7	8	9	10
Line Total Check	Line Label	Bracing Element No.	Available Wall Length L (m)	Angle to Bracing line (degrees)	Element Height H (m)	Bracing Type	Supplier	Bracing Units Achieved W	Bracing Units Achieved E
653	**A**	1	1.3		3.9	BL1-H	GIB®	96	83
		2	2.5		3.9	BL1-H	GIB®	185	160
		3	2.6		3.9	BL1-H	GIB®	192	166
		4	2.5		3.9	BL1-H	GIB®	185	160
		5	1.3		3.9	BL1-H	GIB®	96	83
556	**B**	1	2.65		3.9	GS2-N	GIB®	160	140
		2	5.2		3.9	GS2-N	GIB®	314	275
		3	2.65		3.9	GS2-N	GIB®	160	140
1293	**C**	1	2.2		3.9	BL1-H	GIB®	162	141
		2	5.6		3.9	BL1-H	GIB®	414	358
		3	4.6		3.9	BL1-H	GIB®	340	294
		4	5.6		3.9	BL1-H	GIB®	414	358
		5	2.2		3.9	BL1-H	GIB®	162	141

						Wind	Earthq.
Totals Achieved		W	498%	EQ	100%	2878	2501
Timber Floor, design limit of 120 BU/m				***accepted***		*OK*	*OK*
Totals Required (from Demand)						578	**2492**

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GIB

SINGLE OR UPPER STOREY WALLS ACROSS

V06/11

Lines		Bracing Elements							
1	2	3	4	5	6	7	8	9	10
Line Total Check	Line Label	Bracing Element No.	Available Wall Length L (m)	Angle to Bracing line (degrees)	Element Height H (m)	Bracing Type	Supplier	Bracing Units Achieved	
								W	E
595	**M**	1	9.3		3.9	BL1-H	GIB®	687	595
346	**N**	1	2.4		3.9	BL1-H	GIB®	177	154
		2	3		3.9	BL1-H	GIB®	222	192
716	**O**	1	9.7		3.9	BLG-H	GIB®	716	716
346	**P**	1	2.4		3.9	BL1-H	GIB®	177	154
		2	3		3.9	BL1-H	GIB®	222	192
550	**Q**	1	7.6		3.9	BL1-H	GIB®	561	486
		2	1		3.9	BL1-H	GIB®	73	63

					Wind	Earthq.
Totals Achieved	W	155%	EQ	102%	2835	2552
Timber Floor, design limit of 120 BU/m			***accepted***		*OK*	*OK*
Totals Required (from Demand)					1833	2492

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Subfloor Bracing Calculation Sheet

Subfloor Along V06/11

Along							
Bracing Line		*Bracing Elements provided*				*Wind*	*Earthq.*
1	2	3	4	5	6	8W	9EQ
Line Label	Minimum BUs Req/Ach	Bracing Element No.	Supplier	Bracing Type	Number or Length L (m)	BUs Achieved	BUs Achieved
a	*line totals*	1	NZS3604	masonry 4.5	31.7	9510	9510
W	9510	2					
EQ	9510	3					
b	*line totals*	1	NZS3604	masonry 4.5	31.7	9510	9510
W	9510	2					
EQ	9510	3					
c	*line totals*	1					
W		2					
EQ		3					
d	*line totals*	1					
W		2					
EQ		3					
e	*line totals*	1					
W		2					
EQ		3					
f	*line totals*	1					
W		2					
EQ		3					
g	*line totals*	1					
W		2					
EQ		3					
h	*line totals*	1					
W		2					
EQ		3					
i	*line totals*	1					
W		2					
EQ		3					
j	*line totals*	1					
W		2					
EQ		3					
						Wind	Earthq.
Totals Achieved						19020	19020
						OK	*OK*
Totals Required (from Sheet A)						993	3151

(EXISTING)

(EXISTING)

GIB EzyBrace® 2011 Software

Subfloor Bracing Calculation Sheet					Subfloor Across		V06/11
Along							
Bracing Line		*Bracing Elements provided*				*Wind*	*Earthq.*
1	2	3	4	5	6	8W	9EQ
Line Label	Minimum BUs Req/Ach	Bracing Element No.	Supplier	Bracing Type	Number or Length L (m)	BUs Achieved	BUs Achieved
m	*line totals*	1	NZS3604	masonry 4.5	9.7	2910	2910
W	2910	2					
EQ	2910	3					
n	*line totals*	1	NZS3604	masonry 4.5	9.7	2910	2910
W	2910	2					
EQ	2910	3					
o	*line totals*	1	NZS3604	masonry 4.5	9.7	2910	2910
W	2910	2					
EQ	2910	3					
p	*line totals*	1	NZS3604	masonry 4.5	9.7	2910	2910
W	2910	2					
EQ	2910	3					
q	*line totals*	1	NZS3604	masonry 4.5	9.7	2910	2910
W	2910	2					
EQ	2910	3					
r	*line totals*	1					
W		2					
EQ		3					
s	*line totals*	1					
W		2					
EQ		3					
t	*line totals*	1					
W		2					
EQ		3					
u	*line totals*	1					
W		2					
EQ		3					
v	*line totals*	1					
W		2					
EQ		3					
						Wind	Earthq.
Totals Achieved						14550	14550
						OK	*OK*
Totals Required (from Sheet A)						3084	3151

ALL EXISTING

F14-06/02

Date 30 JUL 2015	Eng. GV	Job No. 40101	Sheet No. 6A

Project

BLOCK 2 - ST. CANICE'S SCHOOL, WESTPORT

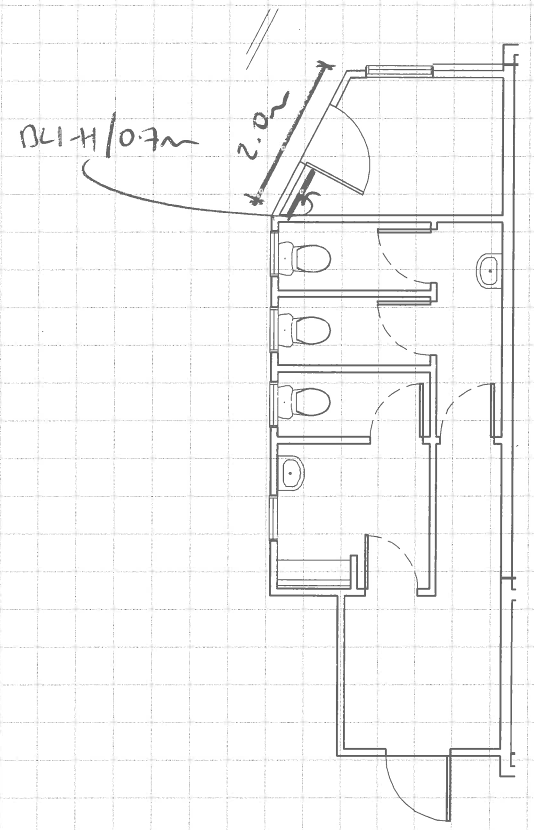
CALCULATIONS

NEW DOORWAY TO BE BUILT INTO WEST WALL OF STORE ROOM 1:

BRACING LOST = 2.0m x 30BU/m x $\frac{2.4}{2.7}$ x cos 27° = 48BUs ACROSS

(BRACING LOST ALONG IS NEGLIGIBLE)

REPLACE WITH BL1-H/0.7m = 56BUs > 48BUs ∴ OK



F14-06/02

Date	Eng.	Job No.	Sheet No.
8 JUL 2015	GN	40101	7

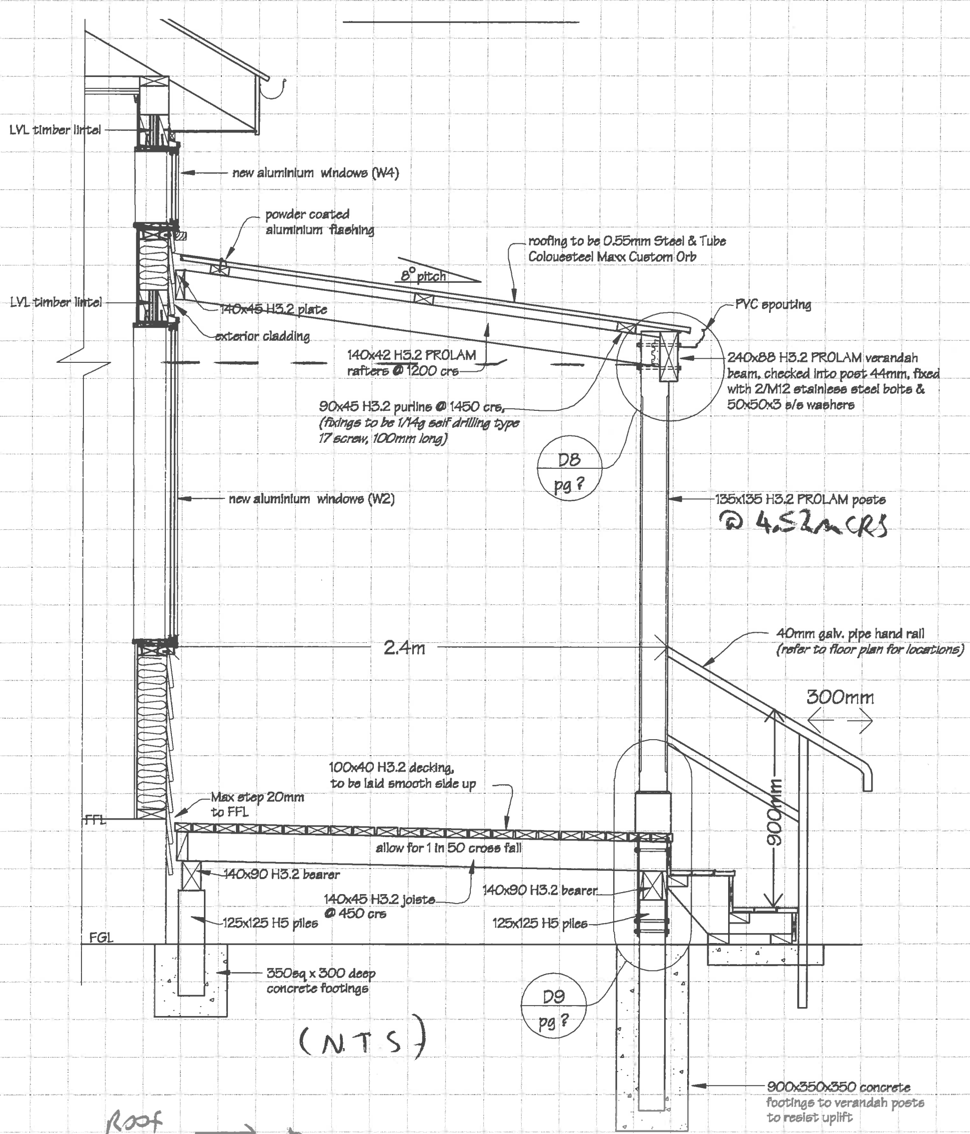
Project

BLOCK 2 – ST. CANICE'S SCHOOL, WESTPORT

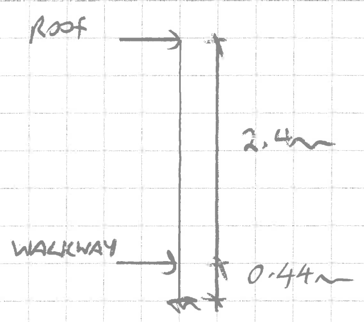
CALCULATIONS

BRACING OF EASTERN VERANDAH

* OPEN ON ENDS & ALONG EDGE → SEISMIC GOVERNS BY INSPECTION



(NTS)



ROOF : ½ RESISTED BY CLASSROOM, ½ TO POSTS
WALKWAY: ½ RESISTED BY WALKWAY POSTS

DIL = 2, $\mu = 1.25 \rightarrow C_d(T_1) = 0.73$

F14-06/02

Date	Eng.	Job No.	Sheet No.
8 JUL 2015	GW	4010	8

Project

BLOCK 2 - ST. CANICE'S SCHOOL, WESTPORT

CALCULATIONS

→ $V_{EU, ROOF} = 0.73(0.15kPa)(1.2)(4.5) = 0.60 kN$

$V_{EU, WALKWAY} = 0.73(0.3kPa)(1.2)(4.5) = 1.20 kN$

→ $M^*_{IN\ POST} = 0.6(2.88) + 1.2(0.44) = 2.26 kNm$

ϕM_n (135x135 PROLAM POST, $f_b = 19MPa$) $= 0.8(19)\frac{(135)^2(135)}{6} = 6.23 kNm$ - OK

CHECK DEFLECTIONS:

$C_d(T_1)$ SLS = 0.16

→ $V_{ES, ROOF} = 0.6 \times 0.16/0.73 = 0.13 kN$

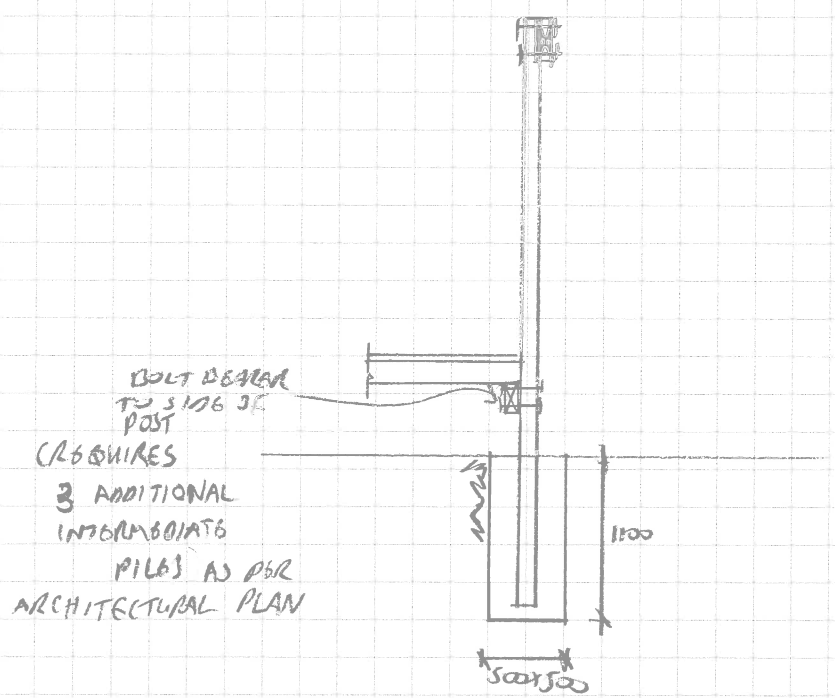
$V_{ES, WALKWAY} = 1.2 \times 0.16/0.73 = 0.26 kN$

→ $\delta_{ES} = \frac{132(2880)^3}{3(8000)(135^3 \times 135/12)} + \frac{263(440)^2}{6(8000)(135^3 \times 135/12)}(3 \times 2880 - 440)$

$= 5.1mm = \frac{H}{569}$ - OK

$\delta_{EU} = 5.1 \times \frac{0.73}{0.16} = 23.1 mm = 0.8\%$ INTERSTOREY DRIFT - OK

CHECK FOOTING - FROM SHEET 9, $\boxed{1.1m \times 500 \times 500 \text{ FOOTING}}$ OK

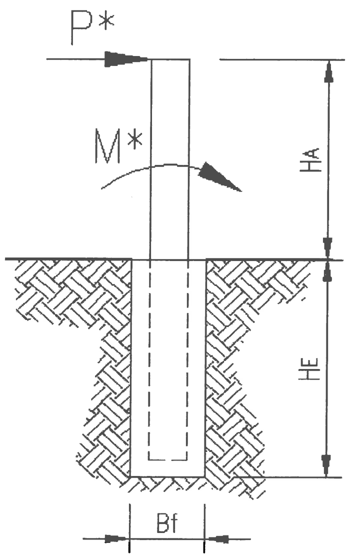


Job Name: Block 2, St. Canice's School | **Job Num:** **40101**

Date: 8-Jul-15

Location: Eastern Walkway Posts | **Engineer:** GV

Cantilevered Timber Post Embedment Calculation Sheet



Post Embedment Calculations

H_A = 2.88 m

P* = 0.78472 kN

Determine moment ground level P* x H_A = M*

M* = 2.26 kN.m

Embedment soil properties

γ =	18	kN/m3	*Logarithmic spiral Kp*
ϕ =	*30*	degrees	Kp = 4.7
H_E =	1.1	m	$2(H_A+H_E)$= 7.96
B_f =	500	mm	$K_p.B_f.H_E^3.\gamma$ = 56.301
Φ =	0.5		

Horizontal Capacity of Pile

$\Phi P = \Phi K_p.B_f.H_E^3.\gamma/2(H_A+H_E)$ = **3.54 kN per pole** **OKAY**

Depth of max pile moment = 0.16 m Max pile moment= 2.34 kN.m

Check post flexural capacity

Round SED post			Rectangular Post		
ΦMb =Φk1.k20.k21.fb.Z			**ΦMb =Φk1.fb.Z**		
Φ=0.8, k1=1, k20=k21=0.85, fb=38MPa			Φ=0.8, k1=1, fb=11.7MP		
Pole Size Ø =	mm Diameter		Post size d =	135 mm	
			Post size b =	135 mm	
Gives Z =	0 mm^3	Z = 0.0982Ø³	Gives Z =	410063 mm^3	Z = d³/6
Gives ϕM_b =	**0.00 kNm**	NO GOOD	**Gives ϕM_b =**	**3.84 kNm**	OKAY

Check post deflection

E =	8700 MPa	E =	4800 MPa
I_{xx} =	0.00E+00 mm^4	I_{xx} =	2.77E+07 mm^4
Δ =	$\boxed{\text{\#DIV/0!}}$ mm	Δ =	$\boxed{47.0}$ mm

F14-06/02

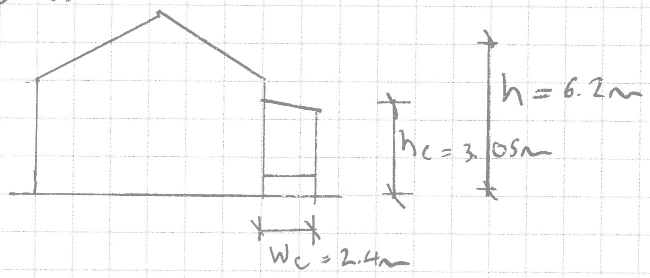
Date 9 JUL 2015	Eng. GN	Job No. 4001	Sheet No. 10

Project
BLOCK 2 - ST. CANICE'S SCHOOL, WESTPORT

CALCULATIONS

CHECK ASSEMBLY FOR UPLIFT.

TREAT AS CANOPY.



$\frac{h_c}{h} = \frac{3.05}{6.20} = 0.49$

$\rightarrow C_{p,n} = -0.2$ FOR UPLIFT

WIND SPEED = 37m/s ≡ 0.82 kPa (ULS)

$C_{fig} = C_{p,n} K_a K_\ell$; $K_a = 1.0$ FOR $A = 1.2 \times 4.52 = 5.4m^2$

$K_\ell = 1.0$ FOR RAFTERS, BEAMS & POSTS

$C_{fig} = -0.2(1.0)(1.0)$
$= -0.2$

$\rightarrow P_{(z)} = 0.82(-0.2) = -0.164$ kPa

→ UPWARD FORCE ON ONE BEAM/POST CONNECTION =

-0.164 kPa $(1.2m)(4.52m) = -0.89$ kN

↳ ∴ 2-M12 BOLTS (BEAM TO POST) OK BY INSPECTION

↳ ∴ 1.1m × 0.5 × 0.5 PILE OK FOR UPLIFT (= 6.46 kN)

Project:	**St Canice's School - Block 2 Upgrade**	**Date:**	9-Jul-15
Location:	**24A Brougham Street, Westport**	**Engineer:**	GV
	WEST WALKWAY	**Job No.**	40101

DETERMINATION OF AS/NZS1170 SEISMIC COEFFICIENT

Applicable to Structure Of Period T < 0.7 Seconds
Base Shear Force $V = C_d.W_t$

Location = WESTPORT | First Mode Period (>0.4 sec) = 0.4 | State = Ultimate

Site Subsoil Category: Deep/Soft Soil (Class D) | Structural Ductility Factor μ = 3

From AS/NZS1170 $C_h(T_1)$ =	3.00	S_p =	0.7
$C(T) = C_h(T_1)RZN(T,D)$ =	0.90	R =	1.00
$K_u = (\mu-1)T_1 / 0.7 + 1$ =	2.14	Z =	0.30
$Cd(T_1)$ = C(T)Sp/Ku =	**0.29**	N(T,D) =	1

EQUIVALENT STATIC METHOD | **Building Weight Determination**

Roof

Roofing	0.3 kPa x 1.2m x 38.1m	13.7
1/2 Upper Walls External	0.35 kPa x 2.4m/2 x 31m	13.0
	W Roof =	**26.7**

Subfloor Floor

	Area Walkway Floor	46 *m2*
		m2
1/2 Upper Walls External	0.35 kPa x 2.4m/2 x 31m	13.02
Walkway Floor	0.3 kPa x Walkway Floor Area m2	18.3
Seismic Live	0.3 x 2.0kPa x U. F.area m2 x LLR	20.4
Subfloor Cladding	0.14kPa x 0.2m x 38.1m	1.1
	W Sub Floor =	**52.8**

Walkway Floor LLR (ψ_a) | (Live Load Reduction Factor) $\psi_a=0.3+(3\div\sqrt{A})$ *where* $1>\psi_a>0.5$ | 0.74

Wt = 79.5

V = Cd Wt	**V =**	**23.4 kN**

Bracing Distribution

Level	Wi	Hi	WiHi	Ratio WiHi/SumWiHi	Vi = 0.92(Ratio x V) (+8% V for roof level)	Vi Cum.	BU
Roof	27	2.9	78	0.766	18.3	18.3	**367**
First Floor	53	0.45	24	0.234	5.0	23.4	**468**
	80		101				

COMPARE TO WINDLOAD: $F_{WIND} = 0.82\,kPa \times \frac{2.4m}{2} \times \frac{2.4m}{2} \times C_{fig}$

$C_{fig} = C_{p,e} - C_{p,i} = 0.7 - {-0.3} = 1.0$

→ F_{WIND} = 1.1 kN ∴ SEISMIC GOVERNS

ROOF: $\frac{367\,BUs}{130\,BU/m}$ (EP1) = 2.82m → SAY $\boxed{3 \times EP1 / 1.2m}$

SUBFLOOR: $\frac{468\,BUs}{120\,BU/ANCHOR\ PILE}$ = 3.9 → $\boxed{4\ ANCHOR\ PILES}$

F14-06/02

Date 01 JUL 2015	Eng. GW	Job No. 40101	Sheet No. 12

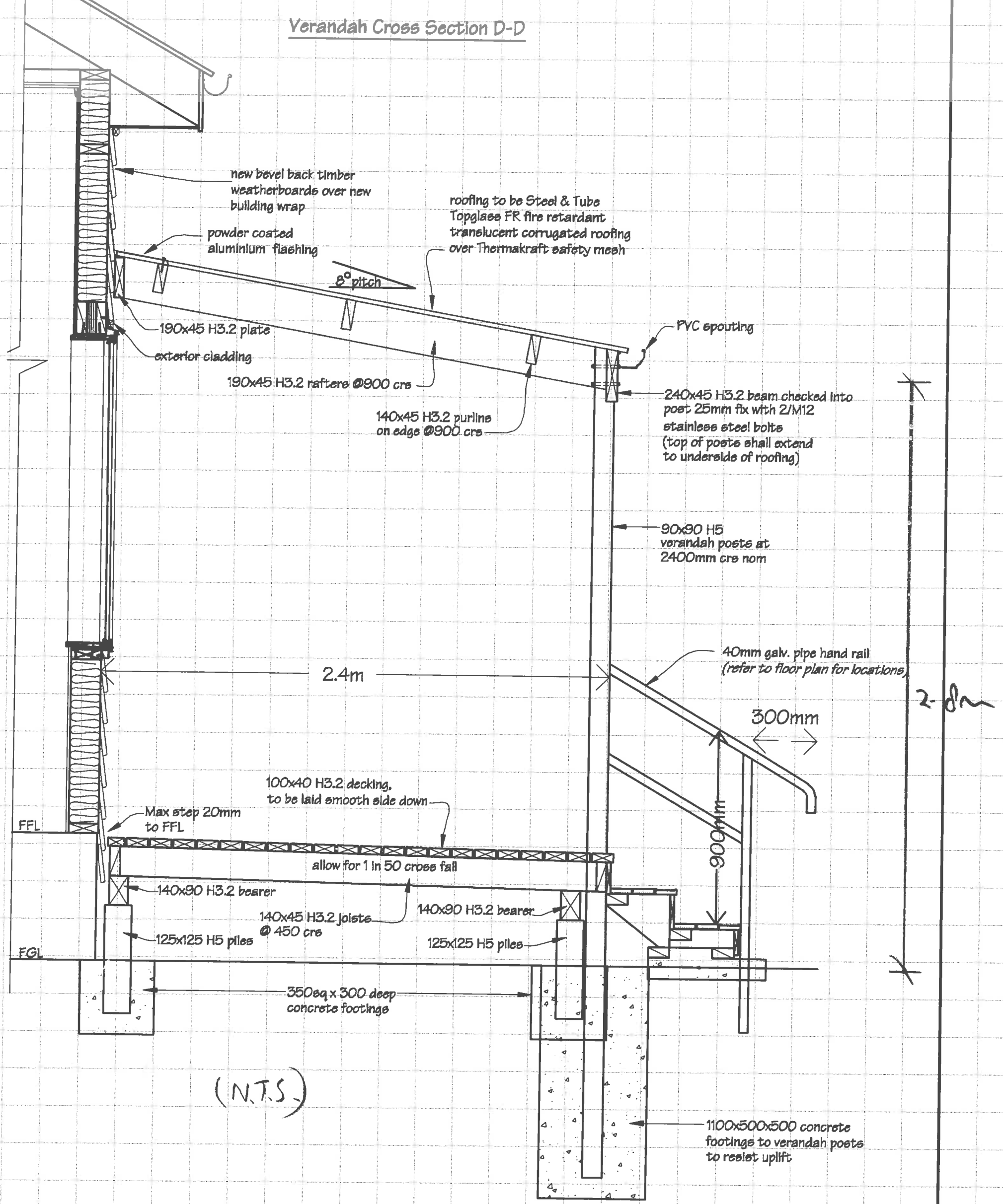
Project

BLOCK 2 - ST. CANICE'S SCHOOL, WESTPORT

CALCULATIONS

BRACING OF WALKWAY ROOF - NORTH END OF WEST WALKWAY

* SEISMIC GOVERNS BY PREVIOUS CALC'S.
* FLOOR SUPPORTED INDEPENDENTLY BY OTHER PILES SO ONLY NEED TO CONSIDER ROOF LOADING.



½ RESISTED BY CLASS BLOCK.
½ RESISTED BY CANTILEVERED TIMBER POSTS @ 2.4m CRS

$BIL = 2, \mu = 1.25 \rightarrow C_d(T_1) = 0.73$

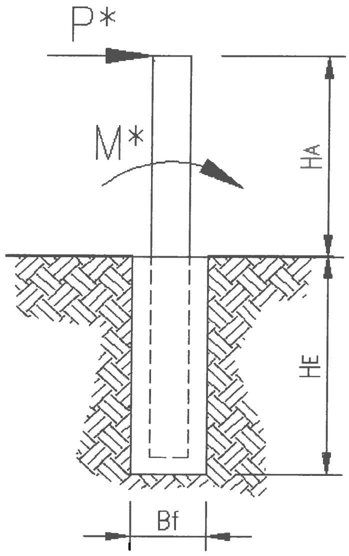
$\rightarrow V_{EQ} = 0.73\,(0.15\,kPa)(1.2)(1.2) = 0.16\,kN/POST$ (2-M12'S OK TO DELIVER LOAD INTO POSTS)

FROM SHEET 8, 90x90 H5 POST & FOOTING OK

(13)

Job Name: Block 2, St. Canice's School | **Job Num:** **40101**
Date: 1-Jul-15
Location: 24A Brougham St, Westport | **Engineer:** GV

Cantilevered Timber Post Embedment Calculation Sheet



Post Embedment Calculations

H_A = 2.8 m
P* = 0.2 kN

Determine moment ground level $P^* \times H_A = M^*$

M* = 0.56 kN.m

Embedment soil properties

γ =	18	kN/m3	*Logarithmic spiral Kp*
ϕ =	*30*	degrees	Kp = 4.7
H_E =	1.1	m	$2(H_A+H_E)$= 7.8
B_f =	500	mm	$K_p.B_f.H_E^3.\gamma$ = 56.301
Φ =	0.5		

Horizontal Capacity of Pile

$\Phi P = \Phi K_p.B_f.H_E^3.\gamma/2(H_A+H_E)$ = **3.61 kN per pole** **OKAY**

Depth of max pile moment = 0.08 m   Max pile moment= 0.57 kN.m

Check post flexural capacity

Round SED post			Rectangular Post		
$\Phi Mb = \Phi k1.k20.k21.fb.Z$			**$\Phi Mb = \Phi k1.fb.Z$**		
Φ=0.8, k1=1, k20=k21=0.85, fb=38MPa			Φ=0.8, k1=1, fb=11.7MP		
Pole Size Ø =	150 mm Diameter		Post size d =	90 mm	
			Post size b =	90 mm	
Gives Z =	331341 mm^3	Z = 0.0982Ø³	Gives Z =	121500 mm^3	Z = d³/6
Gives ϕM_b =	**7.28 kNm**	OKAY	**Gives ϕM_b =**	**1.14 kNm**	OKAY

Check post deflection

E =	8700 MPa	E =	4800 MPa
I_{xx} =	2.49E+07 mm^4	I_{xx} =	5.47E+06 mm^4
Δ =	$\boxed{6.8}$ mm	Δ =	$\boxed{55.8}$ mm

F14-06/02

Date 30 JUN 2015	Eng. GV	Job No. 4010I	Sheet No. 14	CALCULATIONS

Project

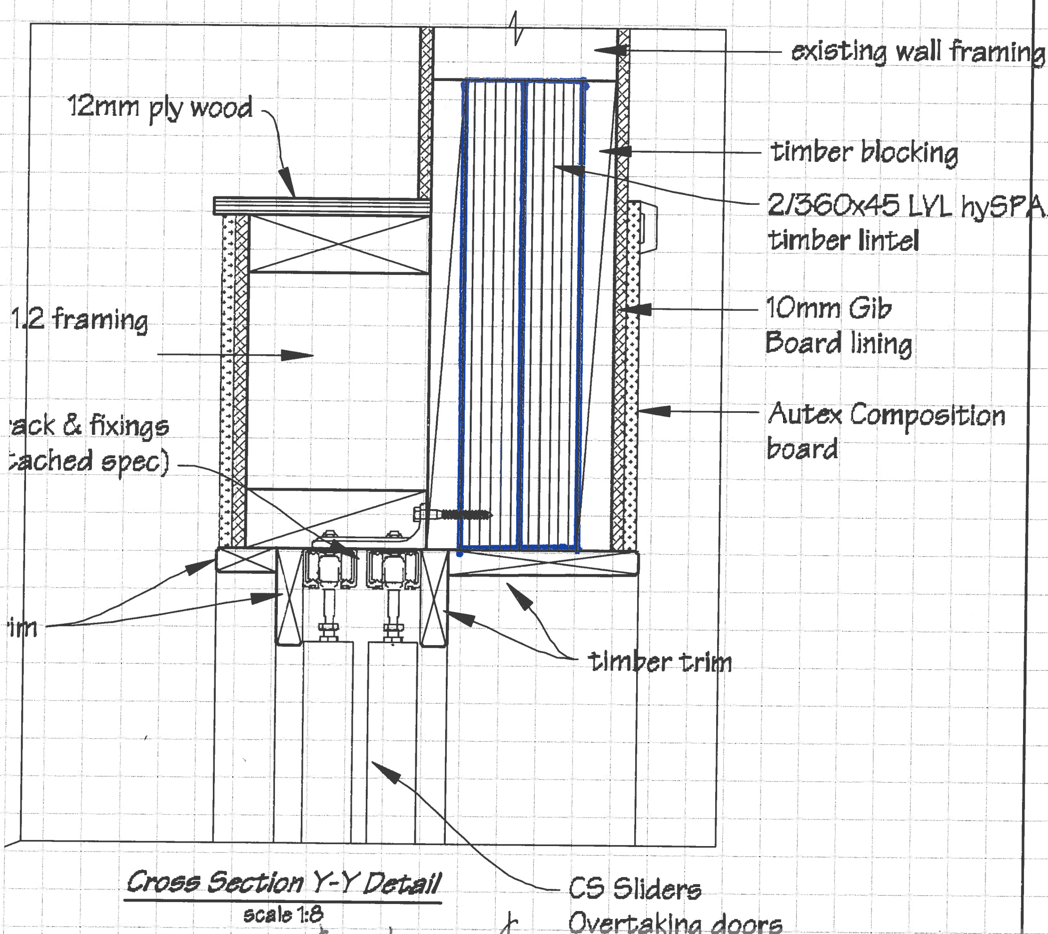
BLOCK 2, ST. CANICE'S SCHOOL, WESTPORT

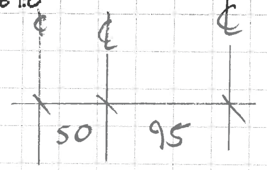
INTERNAL DOORWAY LINTEL (BM1 & BM2)

* SUPPORTS EXISTING FRAMING OVER DOORWAY AND CS OVERTAKING DOORS.

* DOORS ARE MOUNTED ECCENTRICALLY FROM ℄ OF LINTEL:

↳ INDUCES TORSION IN BEAM, → NEEDS TO BE RESISTED AT ENDS.

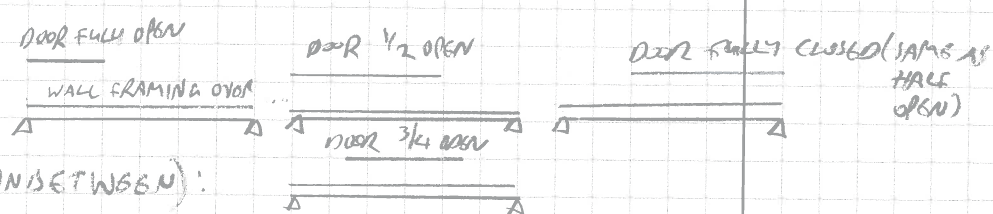




SPAN = 6.0m

LOADING POSSIBILITIES:

(AND SOMEWHERE INBETWEEN):



F14-06/02

Date 30 JUN 2015	Eng. GV	Job No. 40101	Sheet No. 15

Project

BLOCK 2, ST. CANICE'S SCHOOL, WESTPORT

CALCULATIONS

$W_{WALL} = 0.3 kPa \times 1.34m = 0.40 kN/m$

$W_{DOOR} = \frac{130kg \times 0.0098}{2m \text{ OR } 4m \text{ (OR SOMEWHERE IN BETWEEN)}}$ $= 0.64 kN/m$ (2m)
$= 0.32 kN/m$ (4m)
$= 0.32 kN/m \times 2$ (3m) OVERLAPPING

FROM SPACEGASS ANALYSIS (SHEETS 16–20),

$\delta_{G,MAX} = 3.19mm = \frac{SPAN}{1881}$ WHICH INCLUDES 2.18mm DEFLECTION

↳ DOOR TRACK IS INSTALLED LEVEL AFTER GRAVITY LOAD IS APPLIED

∴ DEFLECTION IS OK.

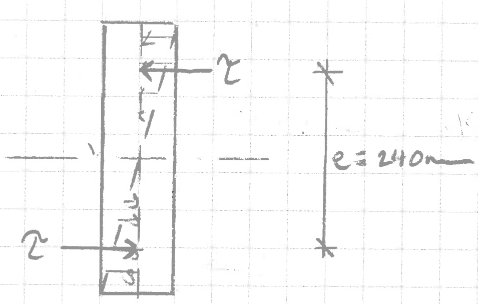
$M^*_{1.35G} = 5.35 kNm < \phi M_n (L_e = 6m, f'_b = 50MPa, k_1 = 0.6) = 30kNm$ – OK

NOW, CHECK TORSION EFFECTS:

$T_0 = 0.32 kN \times 0.095m + 0.32 kN \times 0.145m = 0.0768 kNm(/m)$ (DOOR FULLY OPEN)

$= 0.32 kN \times 0.095 = 0.0304 kNm(/m) + 0.32 kN \times 0.145m = 0.0464 kNm(/m)$
DOOR 1/2, 3/4 & FULLY CLOSED (TORSIONS SEPARATE FOR 1/2 & FULLY CLOSED, TORSIONS OVERLAP FOR 3/4 OPEN.)

T_0^* (AT BEAM ENDS) $= 0.17 kNm$



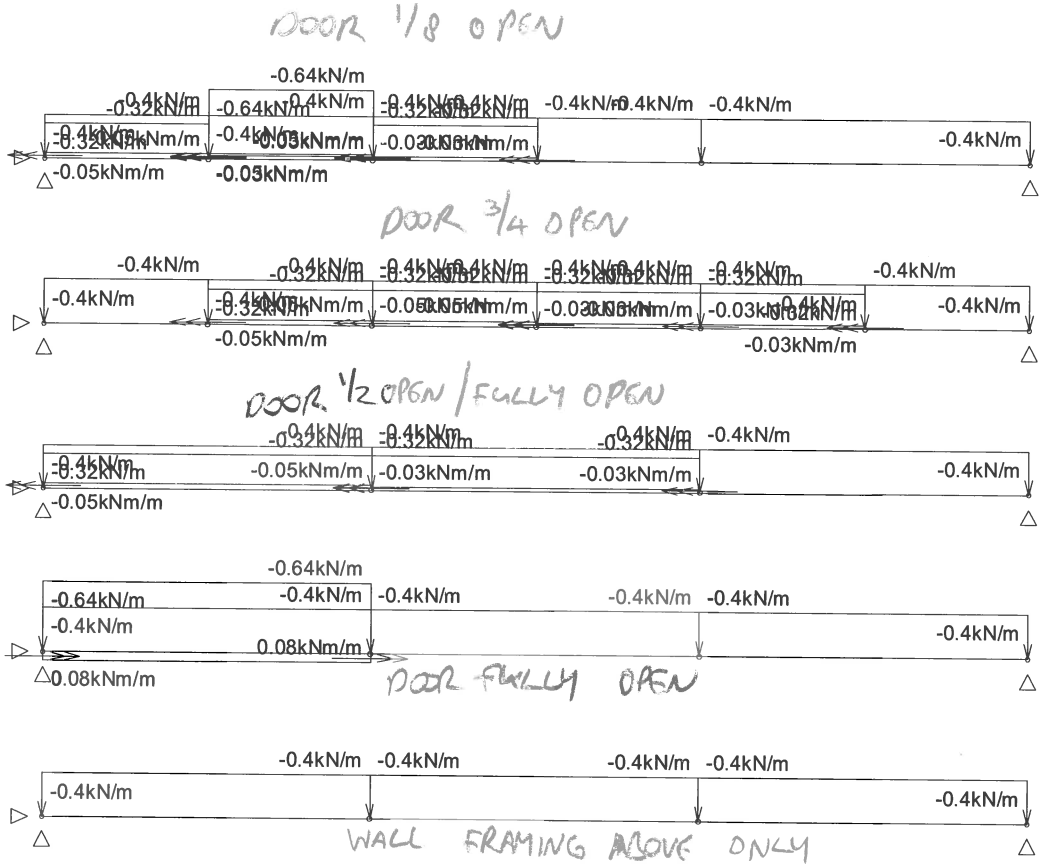
$\tau^* = \frac{0.17kNm}{0.24m} = \frac{0.708 kN \times 1.5}{180 \times 90/2} = 0.09MPa < f_{s,p} = 3.5MPa$ ∴ BEAM OK FOR TORSION

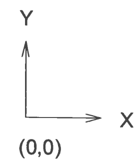
SPACE GASS 12.23 - ISP CONSULTING ENGINEERS LTD

1 Jul 2015, 1:07 pm

Load cases:
1 ——— (SW) G

LOADS





No general restraint

Materials:
1 HySpan LVL

Sections:
1 2-360x45 hySpan

Job: I:\CERTA\JOBFILES\40100\40101\Design\40101 BM1
Units - Len: m, Sec: mm, Mat: MPa, Dens: T/m^3, Temp: Celsius, Force: kN, Mom: kNm, Mass: T, Acc: g's, Trans: mm, Stress: MPa
Scales - Frame: 1:46, Load: 0.068719, Disp: None, Moment: None, Shear: None, Axial: None, Torsion: None

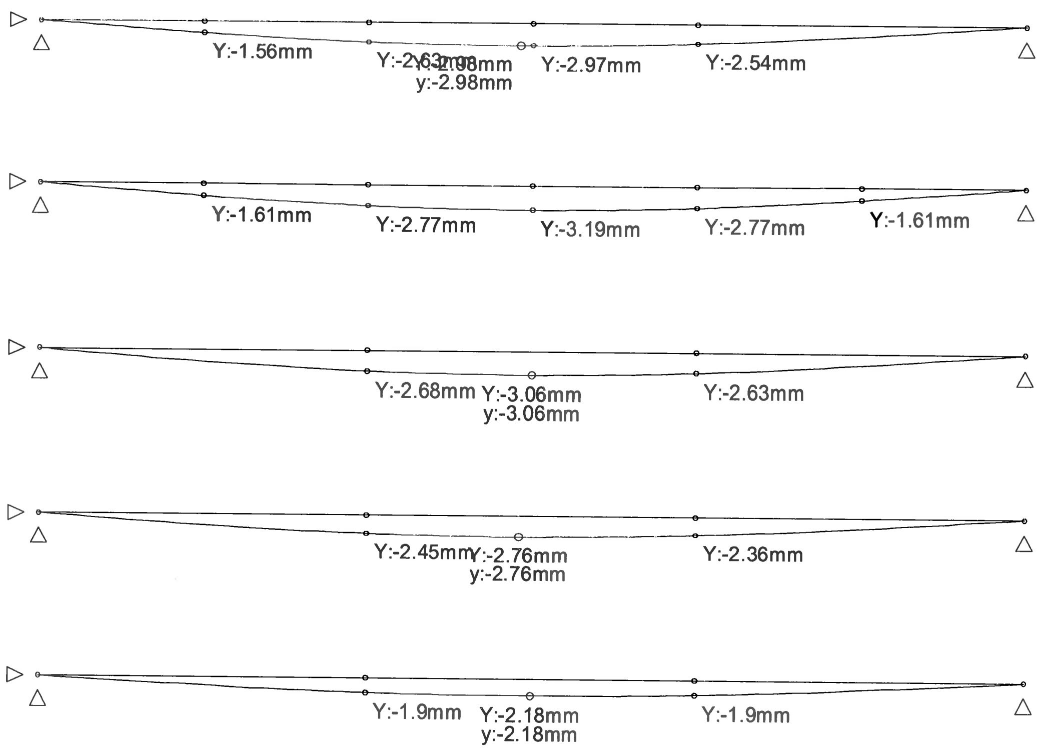
16

SPACE GASS 12.23 - ISP CONSULTING ENGINEERS LTD

1 Jul 2015, 1:52 pm

Load cases:
1 ——— (SW) G

DEFLECTIONS (SLS)



Y
X
(0,0)

No general restraint

Materials:
1 HySpan LVL

Sections:
1 2-360x45 hySpan

Job: I:\CERTA\JOBFILES\40100\40101\Design\40101 BM1

Units - Len: m, Sec: mm, Mat: MPa, Dens: T/m^3, Temp: Celsius, Force: kN, Mom: kNm, Mass: T, Acc: g's, Trans: mm, Stress: MPa

Scales - Frame: 1:46, Load: None, Disp: 45.8752, Moment: None, Shear: None, Axial: None, Torsion: None

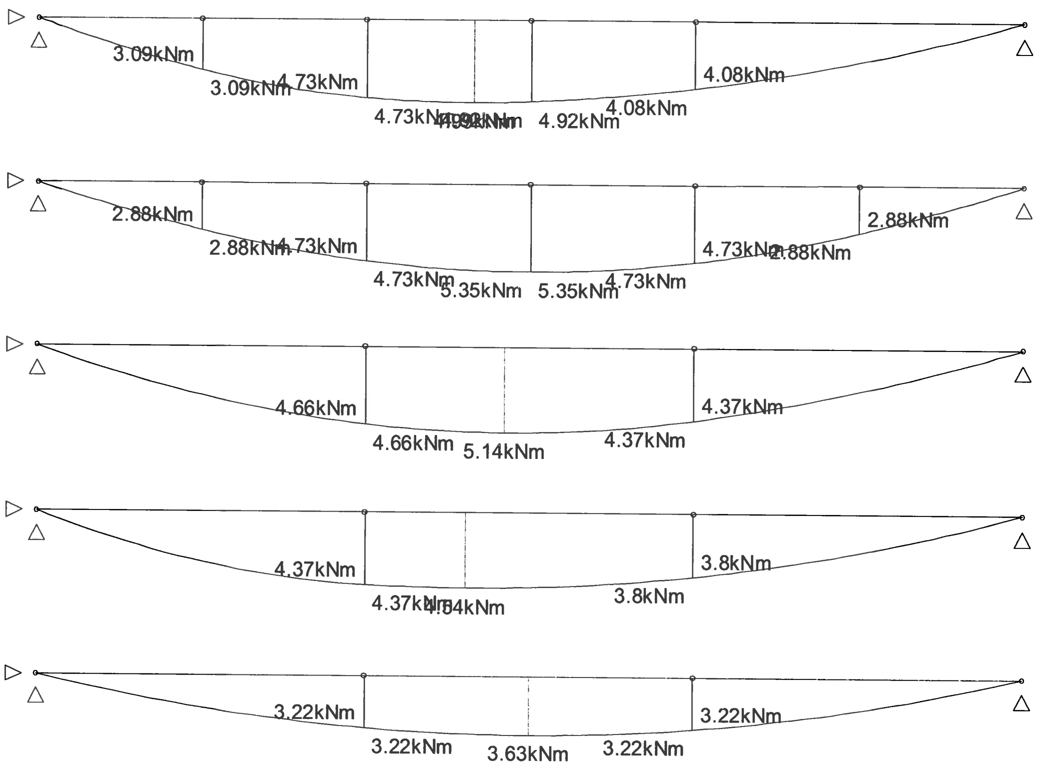
SPACE GASS 12.23 - ISP CONSULTING ENGINEERS LTD

1 Jul 2015, 1:52 pm

Load cases:
2 ——— (SW) 1.35G

FLEXURE (ULS)

Y
X
(0,0)



No general restraint

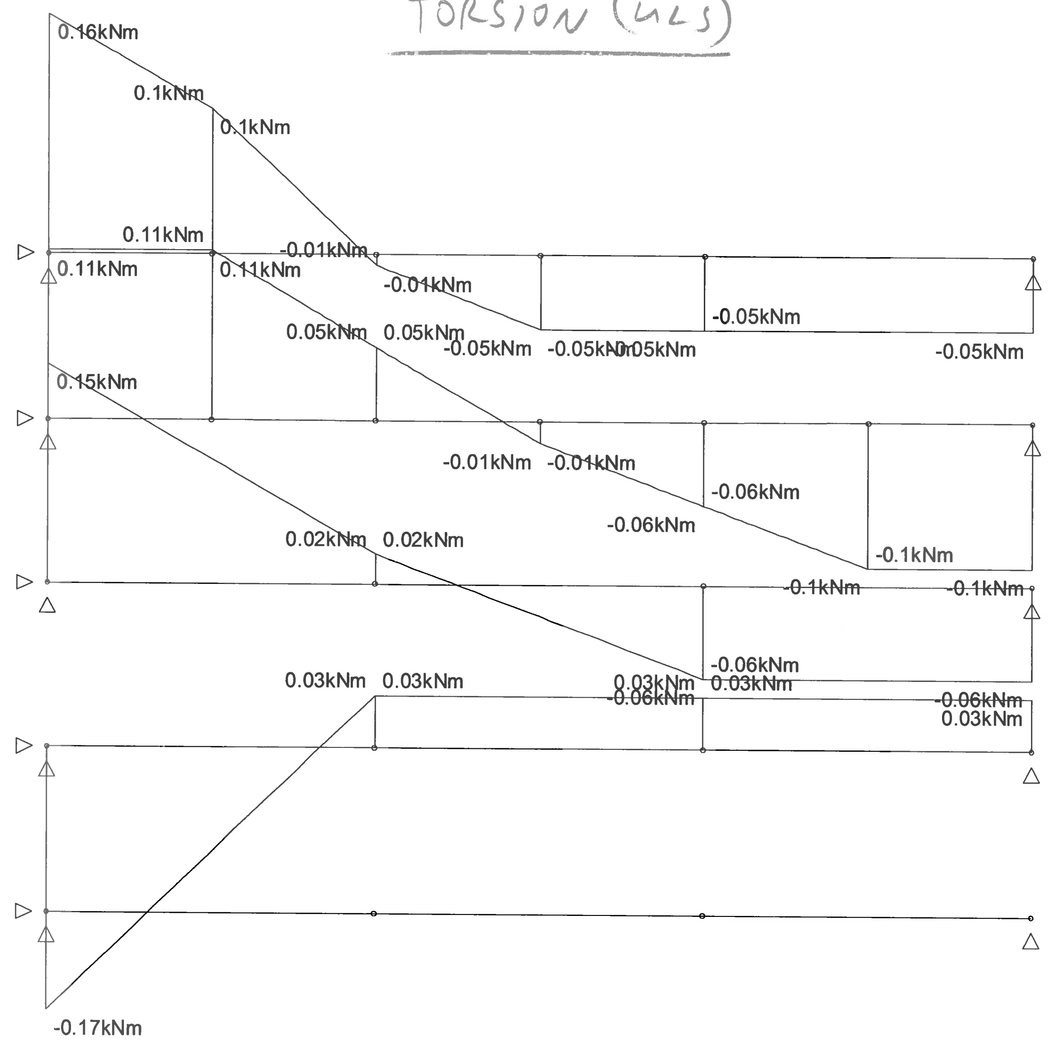
Materials:
1 HySpan LVL

Sections:
1 2-360x45 hySpan

Job: I:\CERTA\JOBFILES\40100\40101\Design\40101 BM1
Units - Len: m, Sec: mm, Mat: MPa, Dens: T/m^3, Temp: Celsius, Force: kN, Mom: kNm, Mass: T, Acc: g's, Trans: mm, Stress: MPa
Scales - Frame: 1:46, Load: None, Disp: None, Moment: 0.457764, Shear: None, Axial: None, Torsion: None

Load cases:
2 ——— (SW) 1.35G

TORSION (ULS)



No general restraint

Materials:
1 HySpan LVL

Sections:
1 2-360x45 hySpan

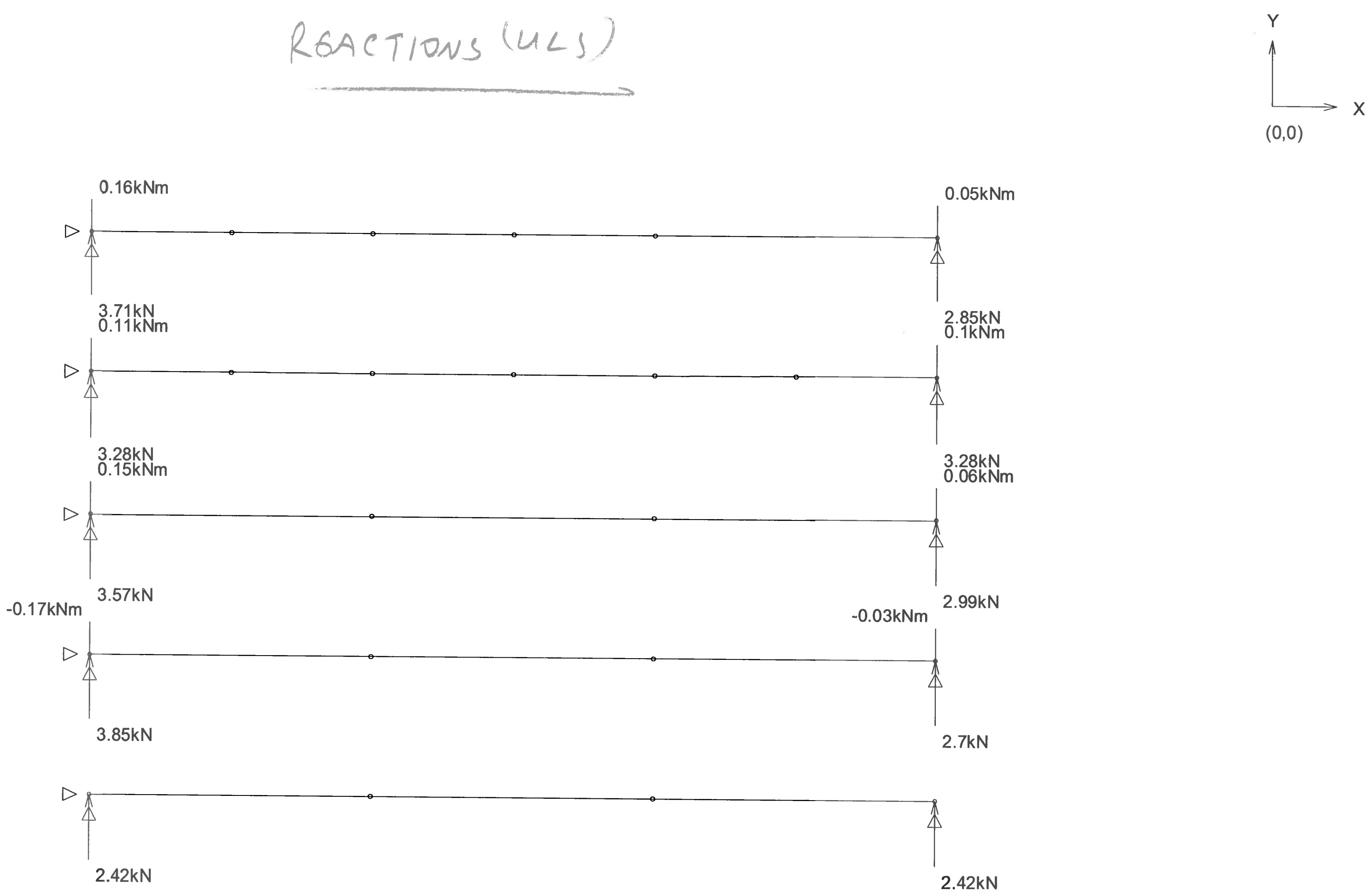
Job: I:\CERTA\JOBFILES\40100\40101\Design\40101 BM1
Units - Len: m, Sec: mm, Mat: MPa, Dens: T/m^3, Temp: Celsius, Force: kN, Mom: kNm, Mass: T, Acc: g's, Trans: mm, Stress: MPa
Scales - Frame: 1:46, Load: None, Disp: None, Moment: None, Shear: None, Axial: None, Torsion: 0.005

SPACE GASS 12.23 - ISP CONSULTING ENGINEERS LTD

1 Jul 2015, 1:53 pm

Load cases:
2 ——— (SW) 1.35G

REACTIONS (ULS)



No general restraint

Materials:
1 HySpan LVL

Sections:
1 2-360x45 hySpan

Job: I:\CERTA\JOBFILES\40100\40101\Design\40101 BM1
Units - Len: m, Sec: mm, Mat: MPa, Dens: T/m^3, Temp: Celsius, Force: kN, Mom: kNm, Mass: T, Acc: g's, Trans: mm, Stress: MPa
Scales - Frame: 1:46, Load: None, Disp: None, Moment: None, Shear: None, Axial: None, Torsion: None

20

TIMBER COLUMN DESIGN

J 40101

MEMBER PROPERTIES

Member width	b =	90	
Member depth	d =	90	mm
Effective length about x-axis	Lax =	3900	mm
Effective length about y-axis	Lay =	800	mm
Area	A =	8100	mm^2
Section modulus about x-axis	Zx =	121500	mm^3
Section modulus about y-axis	Zy =	121500	mm^3
Moisture condition for k8		Dry	
Timber grade		MSG 8	
Bending strength	fb =	14	MPa
Compression strength	fc =	18	MPa
Tension strength	ft =	6	MPa

MEMBER DEMANDS

Axial compression	N*c =	3.9 kN			
Axial tension	N*t =	0 kN			
Strong axis bending	M*x =	0.35 kN.m	*or*	0 kN.m
Weak axis beding	M*y =	0 kN.m	*or*	0.1755 kN.m

These moments take account of eccentric loading if no moment is applied to the pole. If a moment is entered then they go to zero.

MEMBER CAPACITY

Post in Compression

Strength reduction factor	Φ =	0.8
Load duration factor	k1 =	0.6
One edge continuously restrained		No
Slenderness coefficient	S2 =	43.3
Stability factor	k8 =	0.16

Axial compression capacity	**ΦNnc =**	**11.13 kN**	OK

Post in Tension

Strength reduction factor	Φ =	0.8
Load duration factor	k1 =	0.6

Axial tension capacity	**ΦNnt =**	**23.328 kN**	OK

Post in bending

Strength reduction factor	Φ =	0.8
Load duration factor	k1 =	0.6
Parallel support factor	k4 =	1
Slenderness coefficient	S1 =	0
Stability factor	k8 =	1

Strong axis bending capacity	**ΦMnx =**	**0.82 kN.m**	OK
Weak axis bending capacity	**ΦMny =**	**0.82 kN.m**	OK

Combined actions

Combined bending and compression

Weak axis bending	**1 ≥**	**0.57**	OK
Strong axis bending	**1 ≥**	**0.78**	OK
Strong axis bending	**1 ≥**	**0.53**	OK

Combined bending and tension

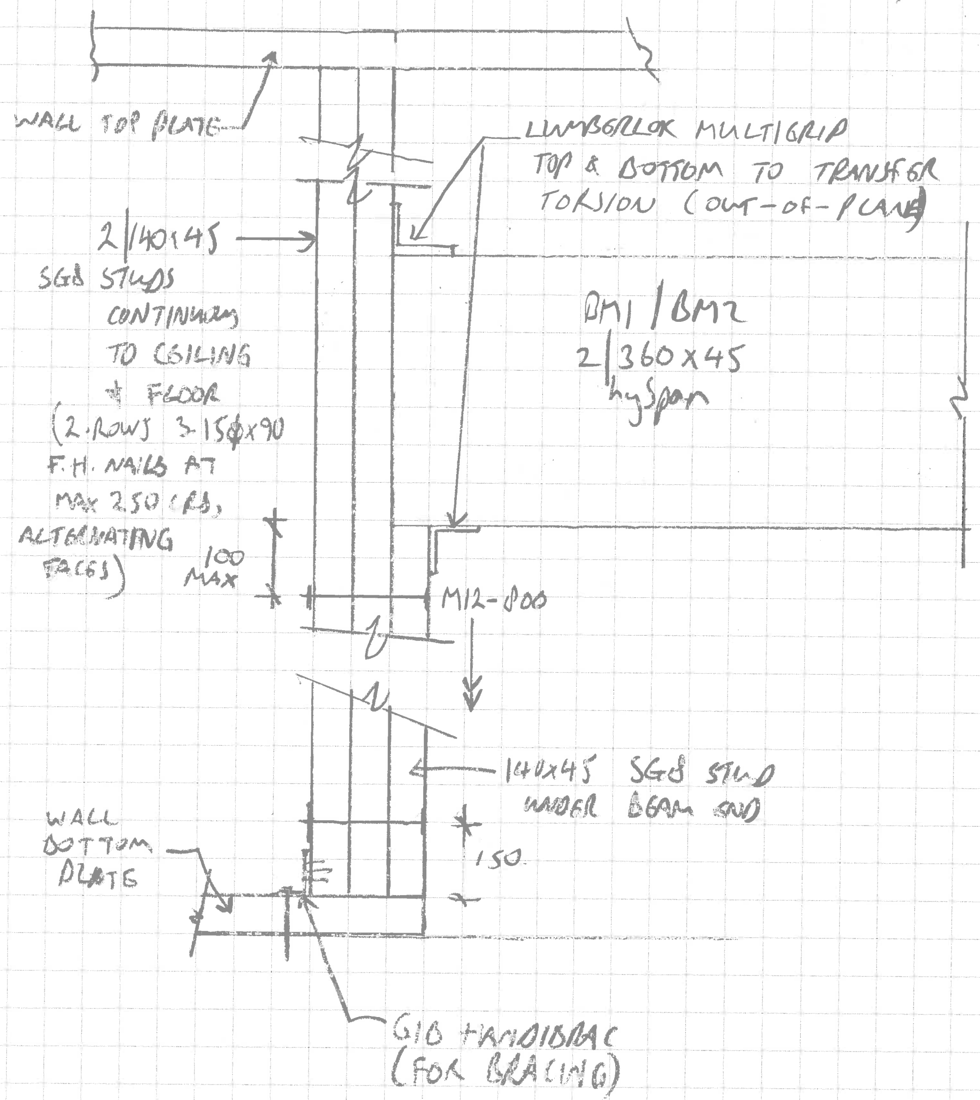
Tension and bending	**1 ≥**	**0.43**	OK

NOW, CHECK TORSION ON SUPPORTS:

→ RECOMMEND INSTALLING AT LEAST ON FULL-HEIGHT MEMBER.

FROM GRAVITY ANALYSIS,

$R^* = 3.9kN$ → DOUBLE STUD OK (REFER SHEET 17)



F14-06/02

Date 01 JUL 2015	Eng. GV	Job No. 40101	Sheet No. 23

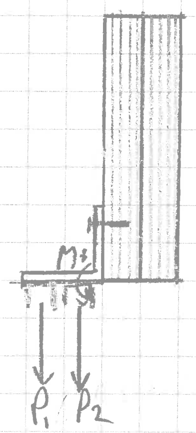
Project

BLOCK 2, ST. CANICE'S SCHOOL, WESTPORT

CALCULATIONS

DOOR TRACK SUPPORT BRACKETS:

CHILD HANGING ON DOOR (BRIEF)



P_1 = DOOR SELF WEIGHT + LIVE LOAD

$P^* = 1.2(0.32\,kN/m \times 0.4m) + 1.5(1.0kN)$

$= 1.65kN$

P_2 = DOOR SELF WEIGHT ONLY

$= 1.2(0.32)(0.5)$

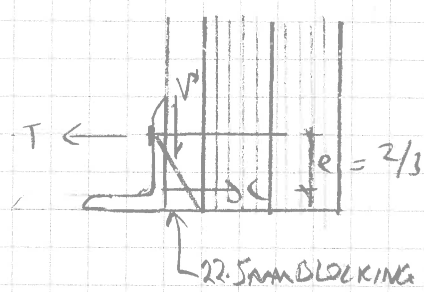
$= 0.15kN$

$M^* = 0.15 \times 0.025 + 1.65 \times 0.075 = 0.128\ kNm$

DEPTH OF LEG REQ'D (/m) $= \sqrt{\dfrac{0.128 \times 1E6 \times 6}{0.9(300MPa)(50)}} = 7.5\ mm$

TRY 100x100x10EA

$V^* = P_1^* + P_2^* = 1.80kN$



$e = 2/3 \times 0.08 = 0.053m$

$T = C = \dfrac{M}{e}$

$= \dfrac{0.128\ kNm}{0.053m}$

$= 2.41kN$

$\rightarrow \phi Q_n$ (M12 COACHSCREW) $= \phi \overset{10}{n}\, \rho\, Q_{nk}\, \underset{JS}{\ }\, \underset{k_1}{\ }$

$= 0.7(\rho \times 118N/mm)(0.7 \times 1.0) = 57.9\ N/mm$

∴ REQUIRE $\dfrac{2406}{57.9} = 42mm$ EMBEDMENT

$\rightarrow$ SAY M12x100 (68mm EMBEDMENT INTO BEAM) $\rightarrow \phi Q_n = 3.94kN$

F14-06/02

Date 9 JUL 2015	Eng. GV	Job No. 40101	Sheet No. 24

Project

BLOCK 2 - ST. CANICE'S SCHOOL

CALCULATIONS

CHECK SHEAR, $\phi Q_n = \phi \overset{1.0}{k} k_1 \overset{1.0}{k_2} \overset{1.0}{k_3} Q_{sk}$

$= 0.7(1.0)(6.97)$

$= 4.88\,kN > V^* = \quad kN \therefore OK$

CHECK COMBINED ACTIONS:

$\frac{1.80}{4.88} + \frac{2.41}{3.74} = 0.98 \leq 1.0 \therefore OK$

M12x100 COACHSCREWS