Structural Calculations

For

Proposed Seismic Strengthening
at
Block A, Sacred Heart College
65 Laings Road, Lower Hutt

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:**
Stuart Preston	SRNP
Geert van de Vorstenbosch	GV

Preamble:
The project comprises proposed seismic strengthening to an existing 2-storey school block. The school block consists of three seismically separated structures, herein labelled the Main Block (which includes the 1975 extension), The Prefects Wing and the Staff Wing. Lastly, there is a brick wall along the south boundary that is supported by an in-situ reinforced concrete frame that is also proposed to be seismically strengthened.

Building Descriptions:
Main Block: The original 1955 structure is a 2-storey building with a concrete first floor and suspended timber ground floor. The transverse ground floor walls are predominantly in-situ reinforced concrete, with two 2-storey longitudinal in-situ reinforced concrete walls at the west end of the block. The walls at first floor level ate predominantly timber framed (with the exception of the longitudinal walls mentioned above) supporting a timber-sarked corrugated steel roof. All concrete walls are supported on shallow foundations. There is brick veneer to the ground floor south wall and below window sill height on the north ground floor wall.
The 1975 addition consists of a reinforced concrete first floor supported by concrete-encased steel beams and columns. The lightweight roof is supported by steel portal frames with timber framed partition walls in both directions. The ground floor columns are supported by shallow concrete foundation pads connected with tie beams.

Prefects Wing: This is a 2-storey timber framed structure with lightweight claddings except to the ground floor south wall, which has a brick veneer.

Staff Wing: This 2-storey structure consists of an in-situ reinforced concrete first floor slab supported by four in-situ reinforced concrete columns. The first floor is timber framed walls and a lightweight roof.

Detailed Seismic Assessment:
Certa Engineering Limited has carried out a Detailed Seismic Assessment (DSA) that has determined there are a number of areas in the block that require seismic strengthening. The

Date:
23 February 2016

Job No.
40249

outcome of the DSA is that this block currently has an equivalent seismic load carrying capacity of 20% New Building Standard (%NBS).

The areas where seismic strengthening is required is as follows:
Main Block:

- Improve the lateral force transfer capacity of the roof and first floor to longitudinal concrete wall connections;
- Improve the lateral force transfer capacity of the first floor to two ground floor transverse concrete wall connections;
- Improve the flexural and shear capacity of the two longitudinal and selected transverse ground floor concrete walls;
- Improve the lateral load transfer through the first floor slab adjacent to the south longitudinal concrete wall;
- Improve the connection between the rafters and first floor walls; and
- Reduce the lateral load on the two longitudinal concrete walls.

Prefects Wing:

- Reduce the seismic demand on the structure; and
- Improve the lateral load carrying capacity and distribution of the timber framed bracing walls.

Staff Wing:

- Reduce the flexural demand on the four columns.

South Boundary Wall:

- Reduce the seismic demand on the concrete beams (that form part of the concrete frame).

Seismic Strengthening Design:

The following description of proposed seismic strengthening increases the equivalent seismic load carrying capacity of the block to **67%NBS.**

Main Block:

- Fasten a continuous steel angle to the intersection of the roof and walls;
- Form new in-situ reinforced concrete flanges to selected ground floor walls;
- Shotcrete the two longitudinal and two selected transverse concrete walls;
- Construct an in-situ concrete slab extension between the original slab and the 1975 extension slab (through the Prefects Wing upper stairway – this requires an additional new roof beam due to the existing timber stairs being relocated);
- Construct a new in-situ reinforced concrete wall between two concrete-encased steel columns. This includes a new foundation with Ischebeck Titan Rock Anchors at each end of the wall; and
- Bolt the rafters to the supporting studs.

Prefects Wing:

- Remove the brick veneer to the south ground floor wall; and
- Reline some of the walls (including removal of two first floor windows along the south façade) with Gib Braceline and Structural Plywood (EP1).

Staff Wing:

- Bolt steel frames to the concrete columns and first floor slab in both directions; and
- Weld together the laps of the longitudinal reinforcement of the ground floor columns.

South Boundary Wall:

- Bolt steel beams to the concrete frame columns and the brick wall.

Scala penetrometer soil tests indicate that an ultimate bearing capacity of 150kPa is achieved at an approximate depth of 500mm below existing ground level.

Date:
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Schedule of Inspections
For
Proposed Seismic Strengthening
at
Block A, Sacred Heart College
65 Laings Road, Lower Hutt

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	Foundation subgrade	Prior to placing hardfill, sand or concrete blinding layer.
2	Foundation pads	Pre-pour
3	Wall to Floor/Roof Connections	Pre-pour of in-situ concrete walls
4	In-situ concrete flanges, walls and slabs	Pre-pour
5	Staff Wing steel frames and connections; Boundary Wall beams and connections	Pre-clad or prior to building in to such an extent that remediation work could not be carried out.
6	Prefects Wing bracing elements and roof beam	Pre-clad or prior to building in to such an extent that remediation work could not be carried out.
7	Rafter to stud connections	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:
23 February 2016

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40249

IPENZ ENGINEERS NEW ZEALAND

ACENZ

Building Code Clause(s) **B1**

J40249

PRODUCER STATEMENT - PS1 - DESIGN

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

ISSUED: CERTA Engineering Ltd

TO: **Mission Colleges Lower Hutt Trust Board**

(Owner / Developer)

TO BE SUPPLIED TO: Hutt City Council

(Building Consent Authority)

IN RESPECT OF: **Proposed Seismic Strengthening**

(Description of Building Work)

AT: **Block A, Sacred Heart College, 65 Laings Road, Lower Hutt**

(Address)

LOT 3 **DP** 26955 **SEC** 955 HUTT DIST BLK XIV;
LOT 1 **DP** 51495 **& LOT** 2 **DP** 473782 ETC. (SACRED HEART) F3/666

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:***

- Main Block: in-situ concrete walls, slabs and flanges; timber rafter to wall connections; roof to wall and floor to wall connections; new wall foundations
- Prefects Wing: bracing elements in accordance with NZS 3604:2011; roof beam BM1
- Staff Wing: steel frames between columns and first floor slab; welding of column longitudinal reinforcement
- South Boundary Wall: steel beams

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), however strength has been designed to satisfy 67% of design seismic loadings criteria specified in AS/NZS 1170.

The proposed building work covered by this producer statement is decribed on the drawings titled:**Seismic Strengthening Block A, Sacred Heart College, Lower Hutt** and numbered **S1** to **S5**.

On behalf of the Design Firm, and subject to:

(i) Site verification of the following design assumptions: Ultimate bearing capacity of excavated foundations to be a minimum of 150kPa.

(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 $ 500,000*.

The Design Firm is a member of ACENZ

SIGNED BY Stuart Preston ON BEHALF OF CERTA Engineering Ltd

Date 23 March 2016 (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 $500,000*.
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

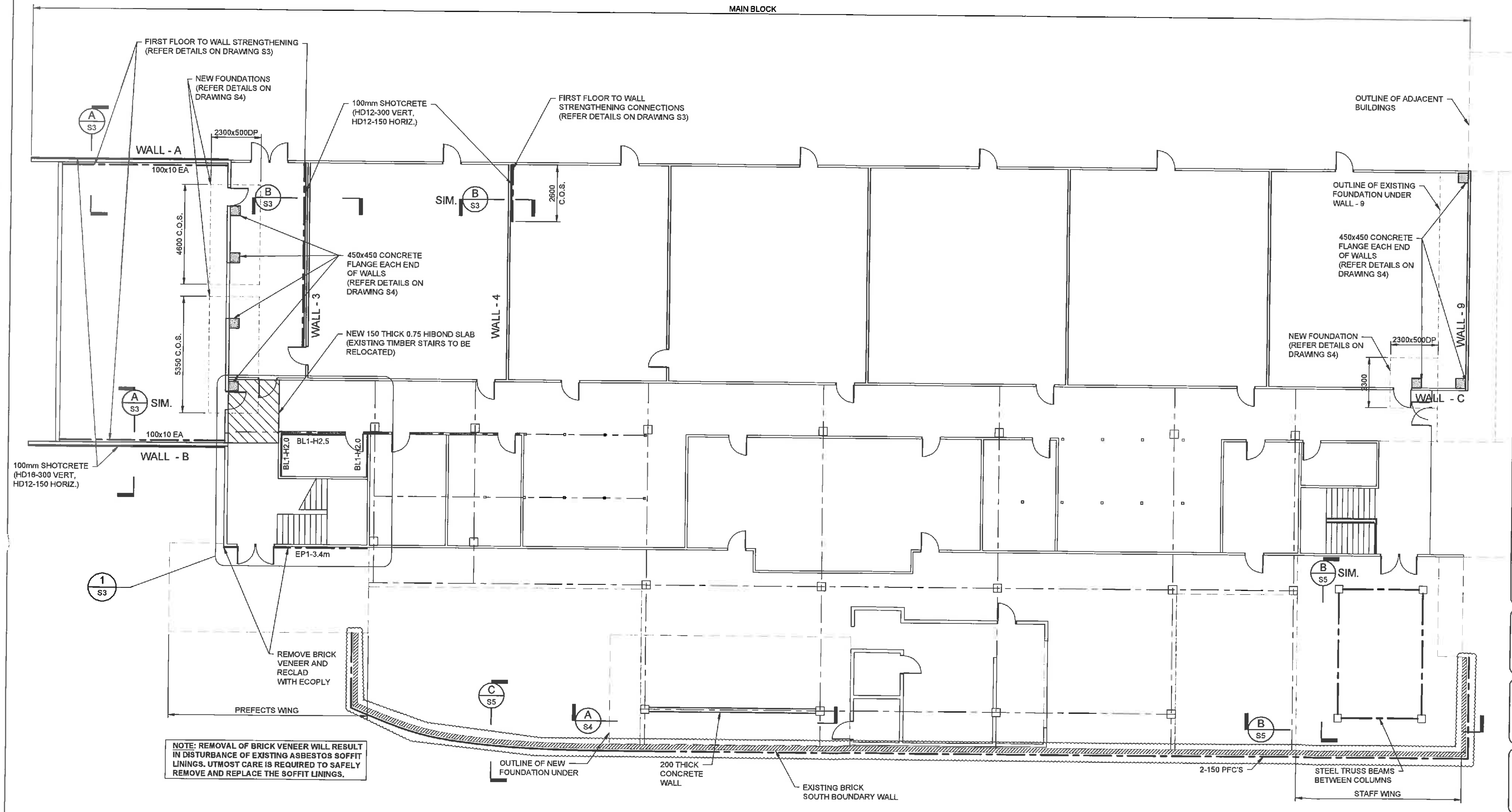
2 NZIA Standard Conditions of Contract SCC 2007 (1st edition)

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

REV	DESCRIPTION	BY	APP	DATE
0	ORIGINAL ISSUE	EH	SRNP	FEB 2016
1	CHANGES CLOUDED	GV	SRNP	MAY 2016

NOTES:



NOTE: REMOVAL OF BRICK VENEER WILL RESULT IN DISTURBANCE OF EXISTING ASBESTOS SOFFIT LININGS. UTMOST CARE IS REQUIRED TO SAFELY REMOVE AND REPLACE THE SOFFIT LININGS.

SEISMIC STRENGTHENING - GROUND FLOOR PLAN

SCALE 1:100

CERTA ENGINEERING
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P.O. Box 30 535
Lower Hutt 5040
email@certa.nz

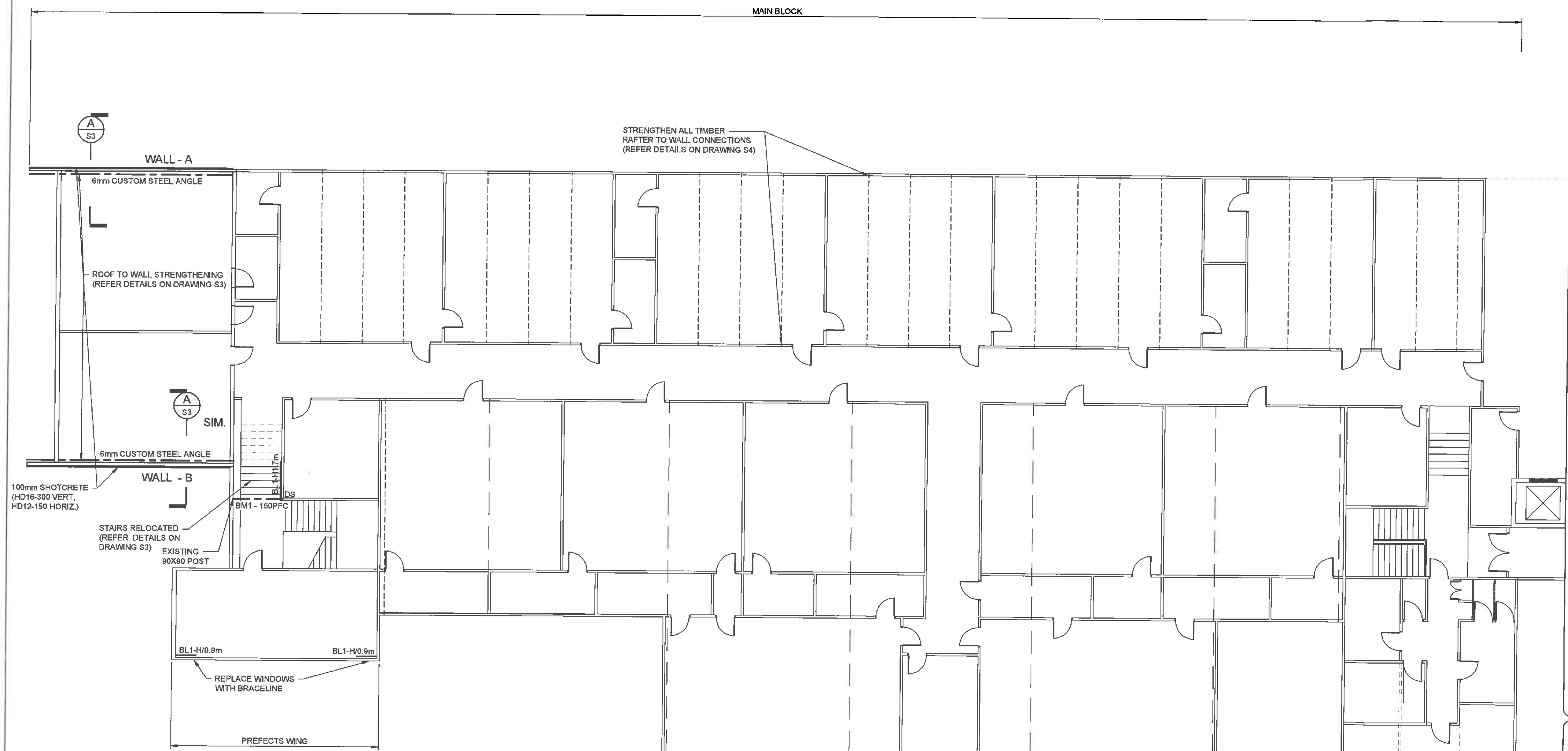
CLIENT
MISSION COLLEGES LOWER HUTT TRUST BOARD

PROJECT
SEISMIC STRENGTHENING BLOCK A, SACRED HEART COLLEGE, LOWER HUTT

DRAWING
GROUND FLOOR PLAN

DESIGNED:	GV	DATE:	FEB 2016
DRAWN:	EH	SCALE:	1:100
APPROVED:	SRNP		1:200
JOB No: 40249		SHEET No: S1	REV 1

REV	DESCRIPTION	BY	APP	DATE
0	ORIGINAL ISSUE	EH	SRNP	FEB 2016



SEISMIC STRENGTHENING - FIRST FLOOR PLAN

SCALE 1:100

NOTES:

CERTA ENGINEERING

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

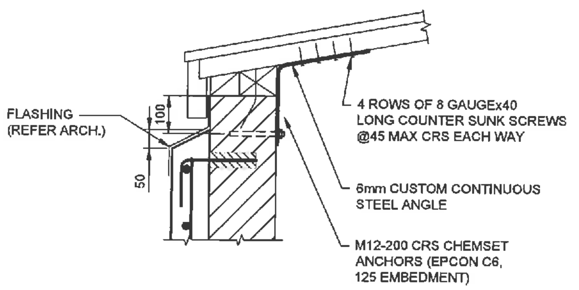
CLIENT
MISSION COLLEGES LOWER HUTT TRUST BOARD

PROJECT
SEISMIC STRENGTHENING BLOCK A, SACRED HEART COLLEGE, LOWER HUTT

DRAWING
FIRST FLOOR PLAN

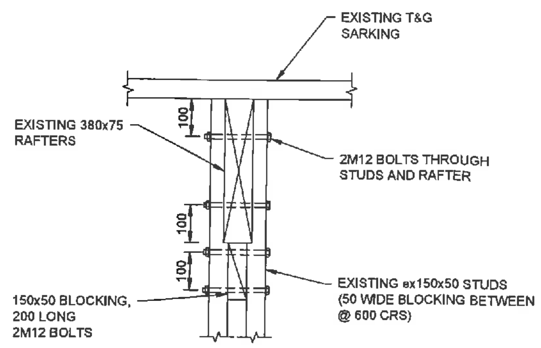
DESIGNED:	GV	DATE:	FEB 2016
DRAWN:	EH	SCALE:	1:100
APPROVED:	SRNP		1:200
JOB No: 40249		SHEET No: S2	REV 0

REV	DESCRIPTION	BY	APP	DATE
0	ORIGINAL ISSUE	EH	SRNP	FEB 2016



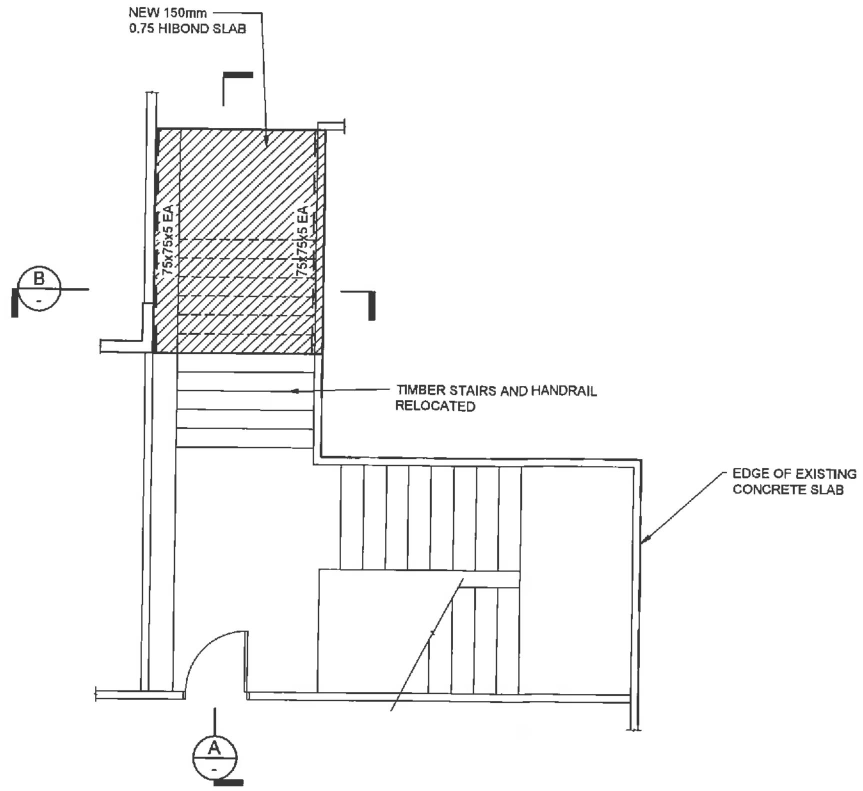
MAIN BLOCK: WALL A & B TO ROOF STRENGTHENING DETAIL

SCALE 1:10



MAIN BLOCK: FIRST FLOOR RAFTER TO STUD STRENGTHENING DETAIL

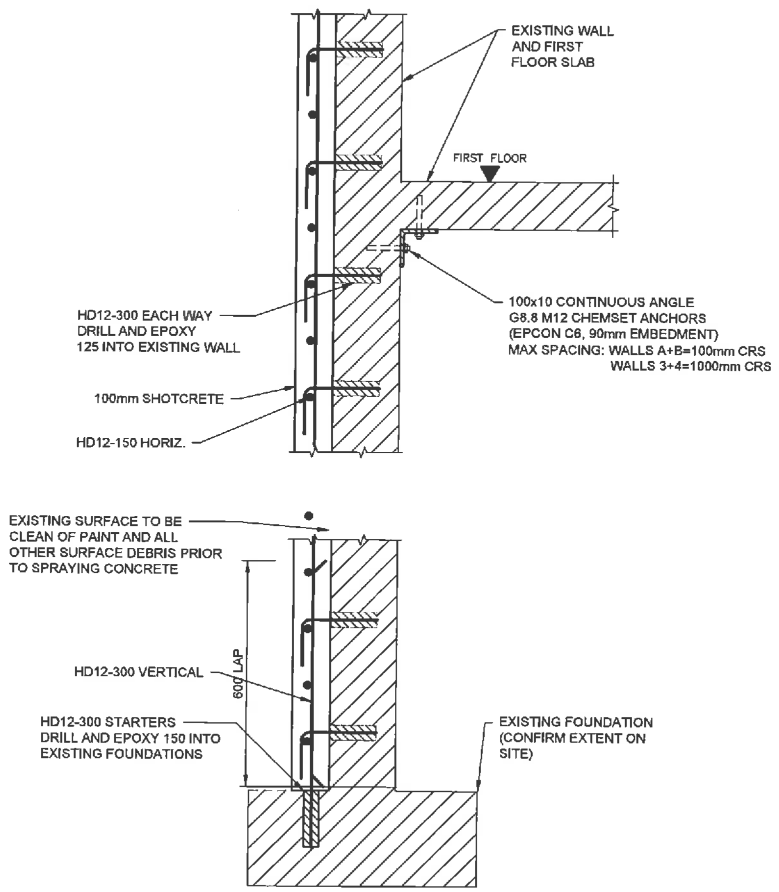
SCALE 1:10



PREFECTS WING: SLAB EXTENSION

DETAIL 1/S1

SCALE 1:50

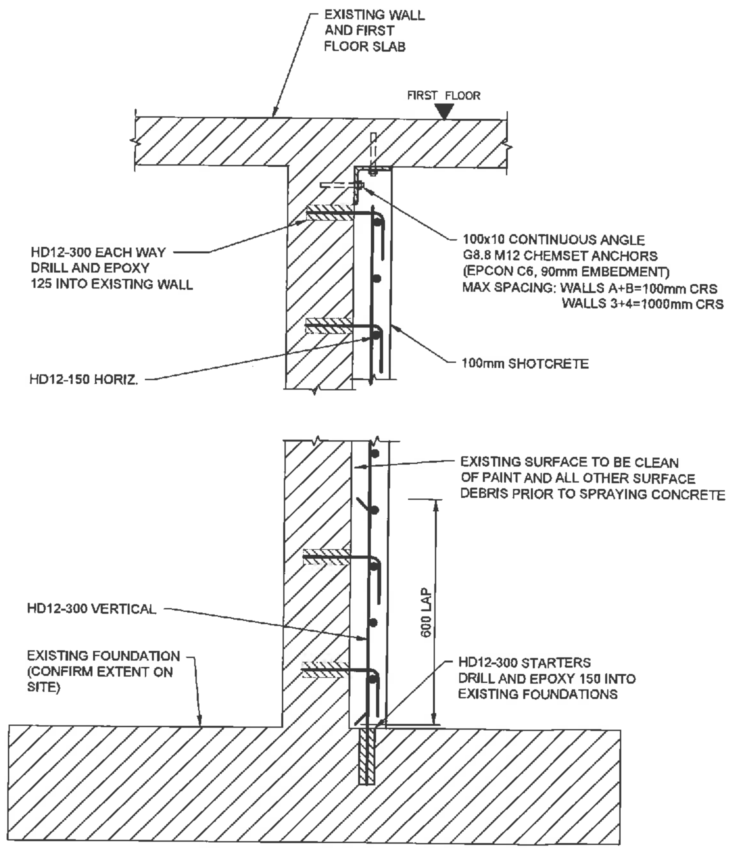


MAIN BLOCK: WALL A & B TO FIRST FLOOR STRENGTHENING DETAIL

SCALE 1:10

SECTION A/S1

SCALE 1:10

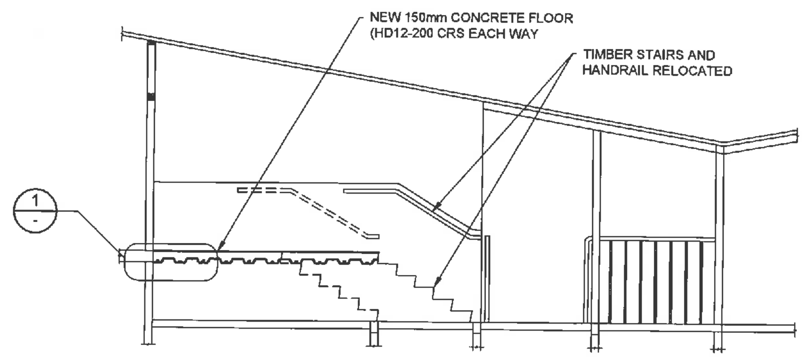


MAIN BLOCK: WALL 3 & 4 TO FIRST FLOOR STRENGTHENING DETAIL

SCALE 1:10

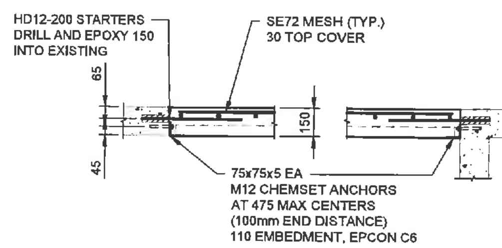
SECTION B/S1

SCALE 1:10



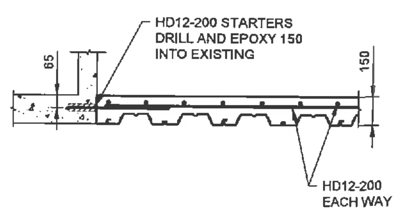
SECTION A

SCALE 1:50



SECTION B

SCALE 1:20



DETAIL 1

SCALE 1:20

NOTES:

1. DO NOT SCALE OFF DRAWINGS. CONFIRM ALL DIMENSIONS ON SITE
2. ALL CONCRETE WORK SHALL COMPLY WITH THE REQUIREMENTS OF NZS3109:1997
3. IF DIMENSIONS VARY FROM THAT SHOWN CONTACT ENGINEER IMMEDIATELY. IT IS THE CONTRACTOR'S RESPONSIBILITY FOR THE SET OUT ON SITE AND DETERMINING ACTUAL WALL HEIGHTS AS THESE MAY VARY FROM THAT SHOWN
4. CONCRETE SHALL BE:
   - SLABS & FOOTINGS N25 (25MPa)
   - IN SITU WALLS & FLANGES N30 (30MPa)
   - TIDY SLABS N10 (10MPa)
5. MAXIMUM SLUMP TO BE 100mm UNLESS NOTED OTHERWISE
6. HD12 BARS LAP LENGTH IS 600mm IN CONCRETE. HD16 BARS LAP LENGTH IS 800mm IN CONCRETE.
7. CONCRETE FINISHES SHALL BE:
   - SLABS U3
   - EXPOSED FOOTINGS F4
8. CONCRETE COVER
   -25mm MIN. INTERIOR
   -45mm MIN. EXTERIOR
   -75mm MIN. IN CONTACT WITH GROUND
9. ALL REINFORCEMENT SHALL COMPLY WITH AS/NZS4671:2001 (HD BARS SHALL NOT BE REBENT)
10. ENGINEER TO INSPECT PRIOR TO POURING CONCRETE. ENGINEER REQUIRES 24 HOURS NOTICE BEFORE ANY VISIT

CERTA ENGINEERING
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P.O. Box 30 515
Lower Hutt 5040
email@certa.nz

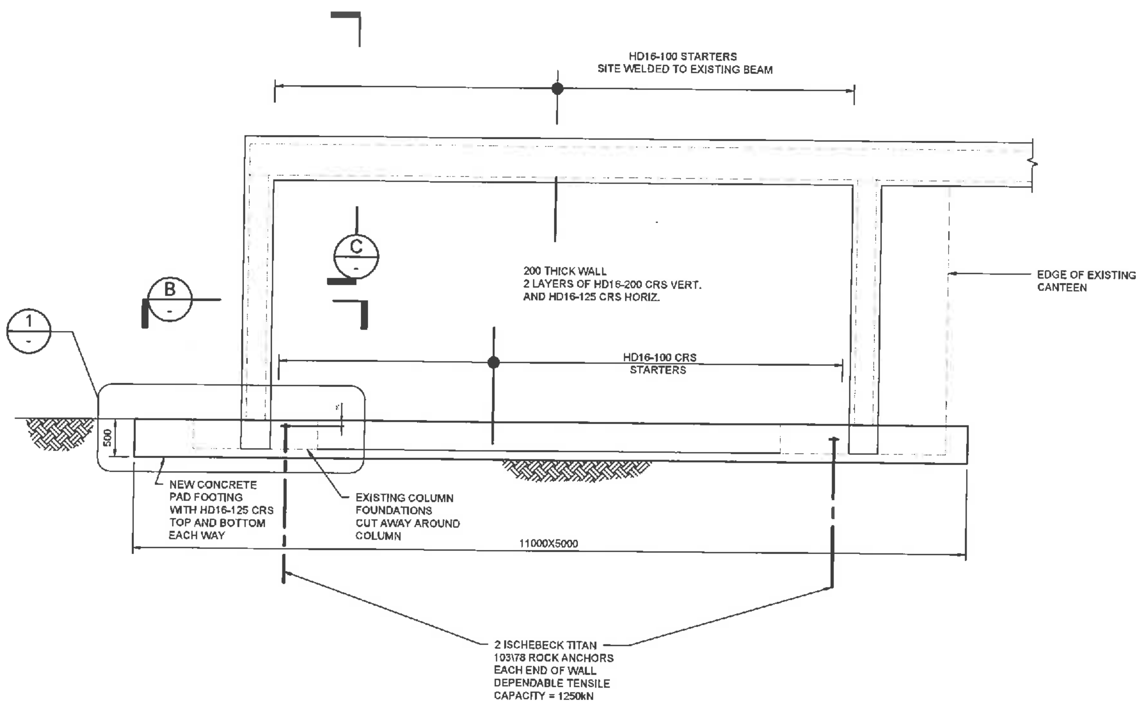
CLIENT
MISSION COLLEGES LOWER HUTT TRUST BOARD

PROJECT
SEISMIC ASSESSMENT BLOCK A, SACRED HEART COLLEGE, LOWER HUTT

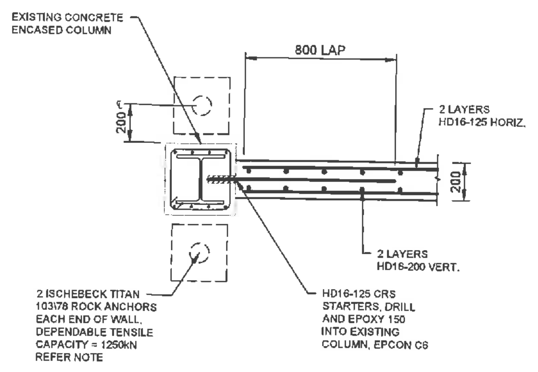
DRAWING
MAIN BLOCK WALL TO ROOF/FLOOR CONNECTIONS

SLAB EXTENSION DETAILS

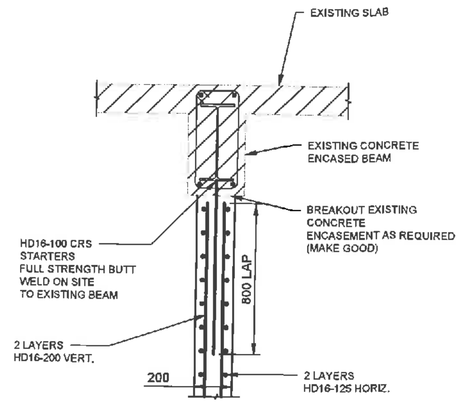
DESIGNED:	GV	DATE:	FEB 2016
DRAWN:	EH	SCALE:	1:50, 1:20, 1:10
APPROVED:	SRNP		1:100, 1:40, 1:20
JOB No: 40249		SHEET No: S3	REV 0



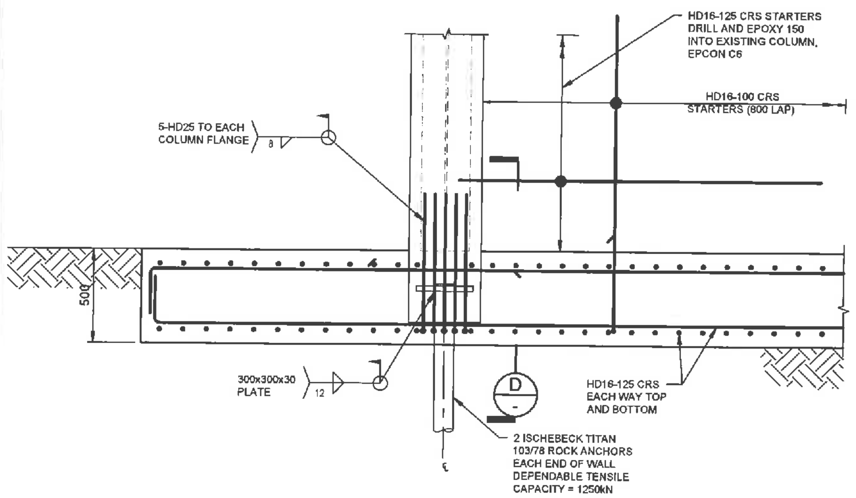
SECTION A
SCALE 1:50 S1



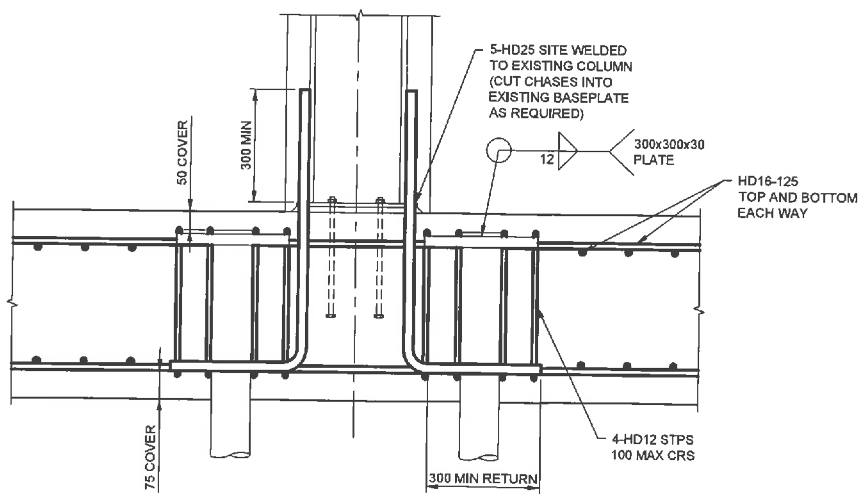
SECTION B
SCALE 1:20



SECTION C
SCALE 1:20



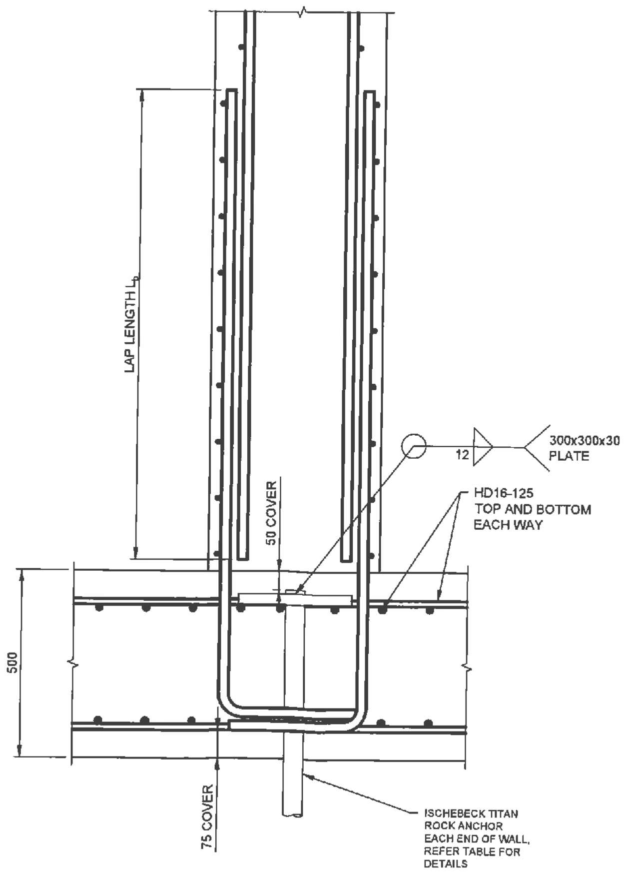
DETAIL 1
SCALE 1:20



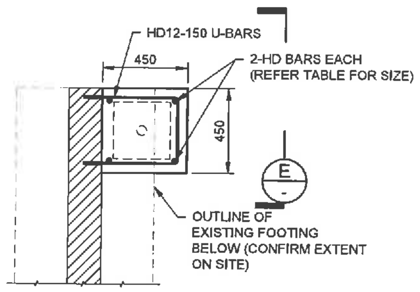
SECTION D
SCALE 1:10

CONCRETE FLANGE/FOUNDATION DETAILS

WALL ID	VERTICAL FLANGE REINFORCEMENT	LAP LENGTH L_b (mm)	ISCHEBECK TITAN ANCHOR TYPE
C	4-HD20	1000	40 / 16
2	4-HD20	1000	40 / 16
2A	4-HD20	1000	40 / 16
9	4-HD25	1250	73 / 53



SECTION E
SCALE 1:10



MAIN BLOCK: TYPICAL CONCRETE WALL FLANGE DETAIL*
SCALE 1:20

*REFER TO GROUND FLOOR PLAN FOR LOCATIONS

REV	DESCRIPTION	BY	APP	DATE
0	ORIGINAL ISSUE	EH	SRNP	FEB 2016

NOTES:

CERTA ENGINEERING
Lower Hutt Office

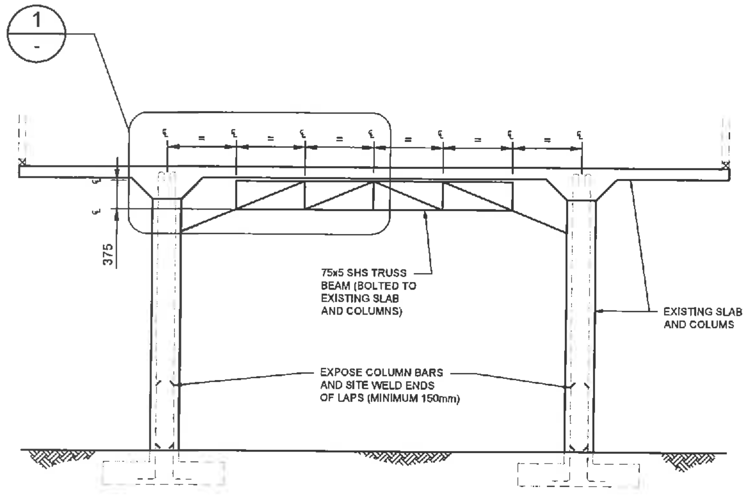
CLIENT
MISSION COLLEGES LOWER HUTT TRUST BOARD

PROJECT
SEISMIC STRENGTHENING BLOCK A, SACRED HEART COLLEGE, LOWER HUTT

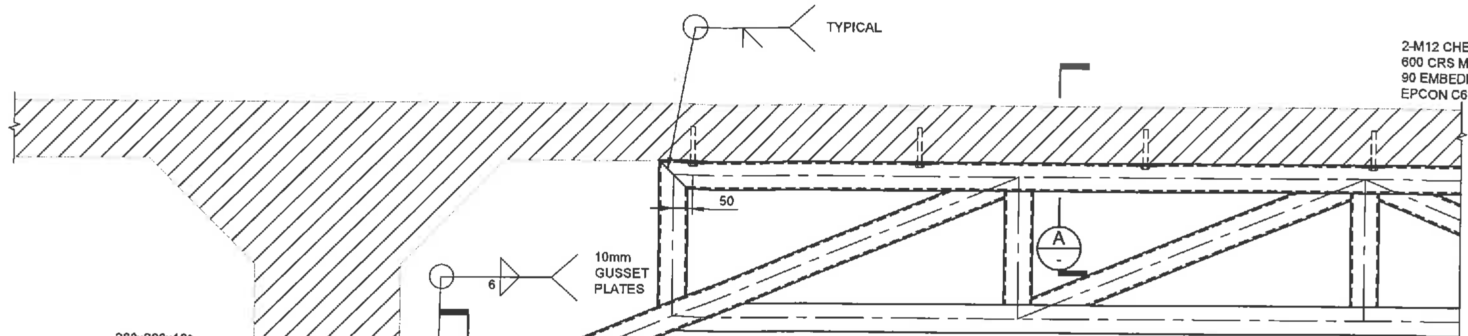
DRAWING
MAIN BLOCK VARIOUS STRENGTHENING DETAILS NEW WALL ELEVATION AND DETAILS

DESIGNED: GV
DRAWN: EH
APPROVED: SRNP
DATE: FEB 2016
SCALE: 1:50, 1:20, 1:10
1:100, 1:40, 1:20
JOB No: 40249
SHEET No: S4
REV: 0

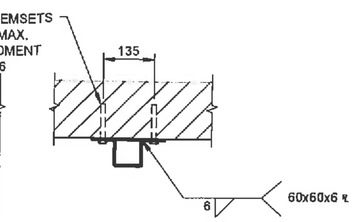
REV	DESCRIPTION	BY	APP	DATE
0	ORIGINAL ISSUE	EH	SRNP	FEB 2016
1	CHANGES CLOUDED	GV	SRNP	MAY 2016



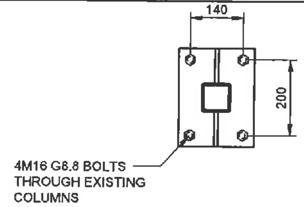
SECTION B
SCALE 1:50 S1



DETAIL 1
SCALE 1:10



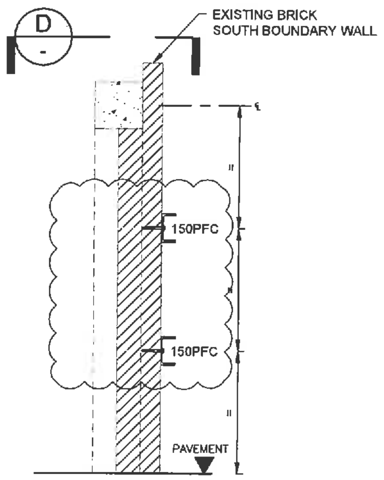
SECTION A
SCALE 1:10



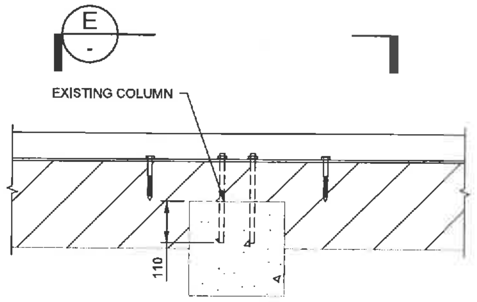
SECTION B
SCALE 1:10

NOTES:

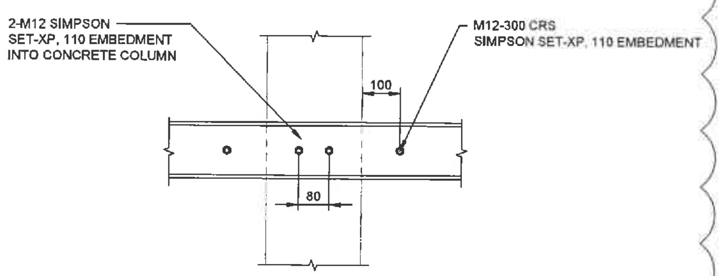
1. DO NOT SCALE OFF DRAWINGS. CONFIRM ALL DIMENSIONS ON SITE.
2. ALL WELDS TO BE 6 FILLET WELDS ALL ROUND UNLESS NOTED OTHERWISE.
3. ALL M12 BOLTS TO BE GRADE 4.6. ALL M16 BOLTS TO BE GRADE 8.8 UNLESS NOTED OTHERWISE.
4. ALL PLATES TO BE 10 THICK UNLESS NOTED OTHERWISE.
5. STEEL GRADES:
   - PLATES 250MPa
   - HOLLOW SECTIONS 350MPa
6. ALL WELD ELECTRODES ARE f_{uw} = 480MPa.
7. ALL INTERNAL STRUCTURAL STEEL TO BE PAINTED IN ACCORDANCE WITH SYSTEM DESIGNATION AS/NZS2312/AKL1 BEFORE DELIVERY TO SITE. ANY AREAS DAMAGED TO BE MADE GOOD UPON INSTALLATION.
8. ALL EXTERNAL STRUCTURAL STEEL TO BE HOT DIP GALVANIZED IN ACCORDANCE WITH SYSTEM DESIGNATION AS/NZS2312/HDG600. ANY AREAS DAMAGED TO BE MADE GOOD UPON INSTALLATION.
9. ALL BOLTED TIMBER CONNECTIONS TO HAVE 50x50x3 WASHERS.
10. ALL TIMBER TO BE MSG8 UNLESS SPECIFIED OTHERWISE.
11. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THE STRUCTURE IS ADEQUATELY SUPPORTED DURING CONSTRUCTION.
12. ENGINEER TO INSPECT ALL STEEL & TIMBER CONNECTIONS PRIOR TO CLOSING IN. ENGINEER REQUIRES 24 HOURS NOTICE BEFORE ANY VISIT.



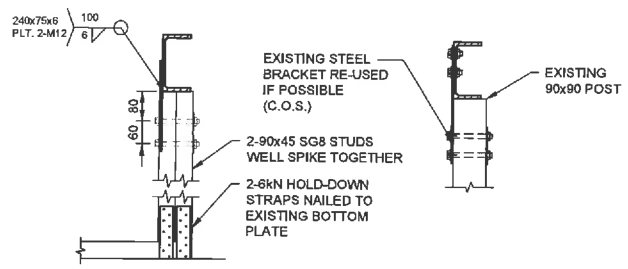
SECTION C
SCALE 1:20 S1



SECTION D
SCALE 1:10



SECTION E
SCALE 1:10



PREFECTS WING: BM1 END CONNECTION DETAILS
SCALE 1:10

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

CLIENT
MISSION COLLEGES LOWER HUTT TRUST BOARD

PROJECT
SEISMIC STRENGTHENING BLOCK A, SACRED HEART COLLEGE, LOWER HUTT

DRAWING
STAFF WING FRAME DETAILS SOUTH BOUNDARY WALL DETAILS PREFECTS WING DETAILS

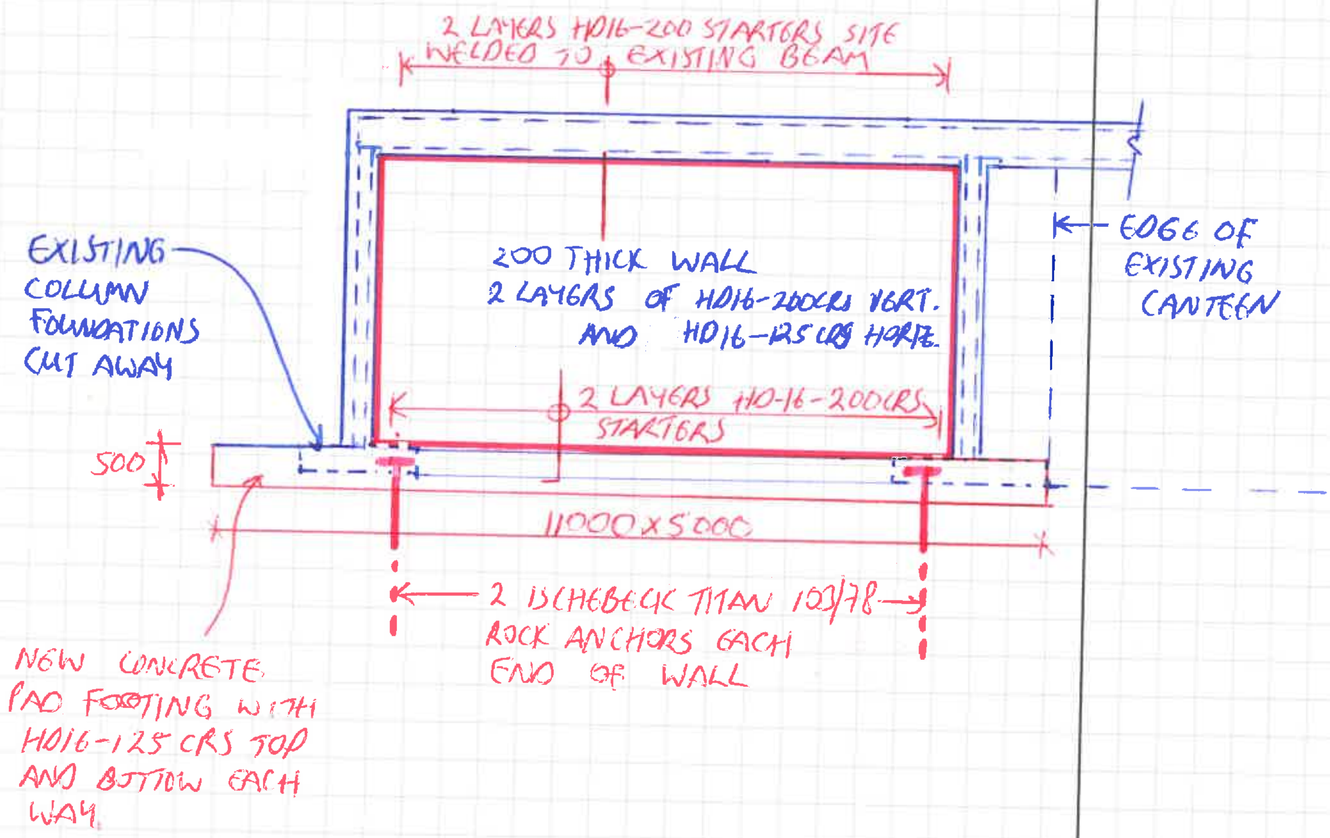
DESIGNED: GV		DATE: FEB 2016	
DRAWN: EH		SCALE: 1:50, 1:20, 1:10	
APPROVED: SRNP		1:100, 1:40, 1:20	
JOB No: 40249		SHEET No: S5	REV 1

F14-06/02

Date - 2 FEB 2016	Eng. GV	Job No. 40249	Sheet No. SK3

Project SEISMIC STRENGTHENING
BLOCK A - SACRED HEART COLLEGE, LOWER HUTT

CALCULATIONS



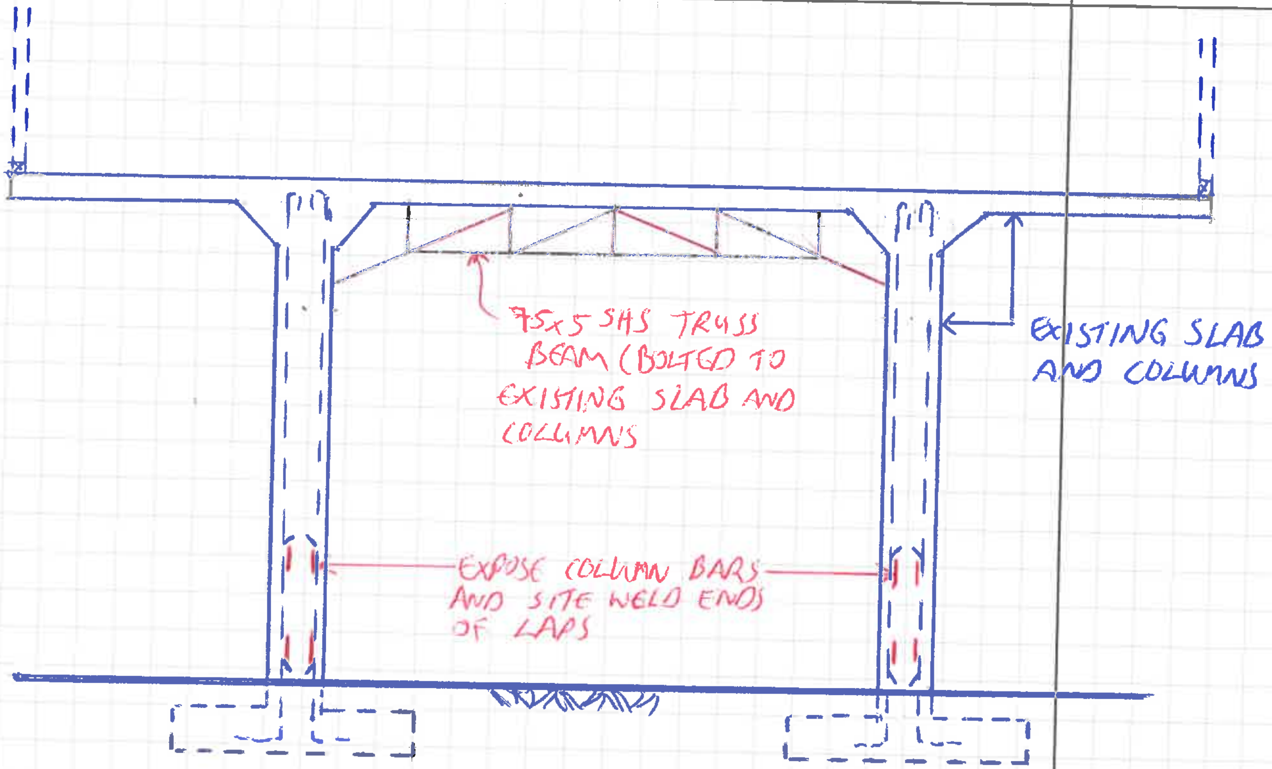
MAIN BLOCK : NEW STRUCTURAL WALL ELEVATION

F14-06/02

Date	Eng.	Job No.	Sheet No.
-2 FEB 2016	GV	40249	SK 4

CALCULATIONS

Project
SEISMIC STRENGTHENING
BLOCK A - SACRED HEART COLLEGE, LOWER HUTT



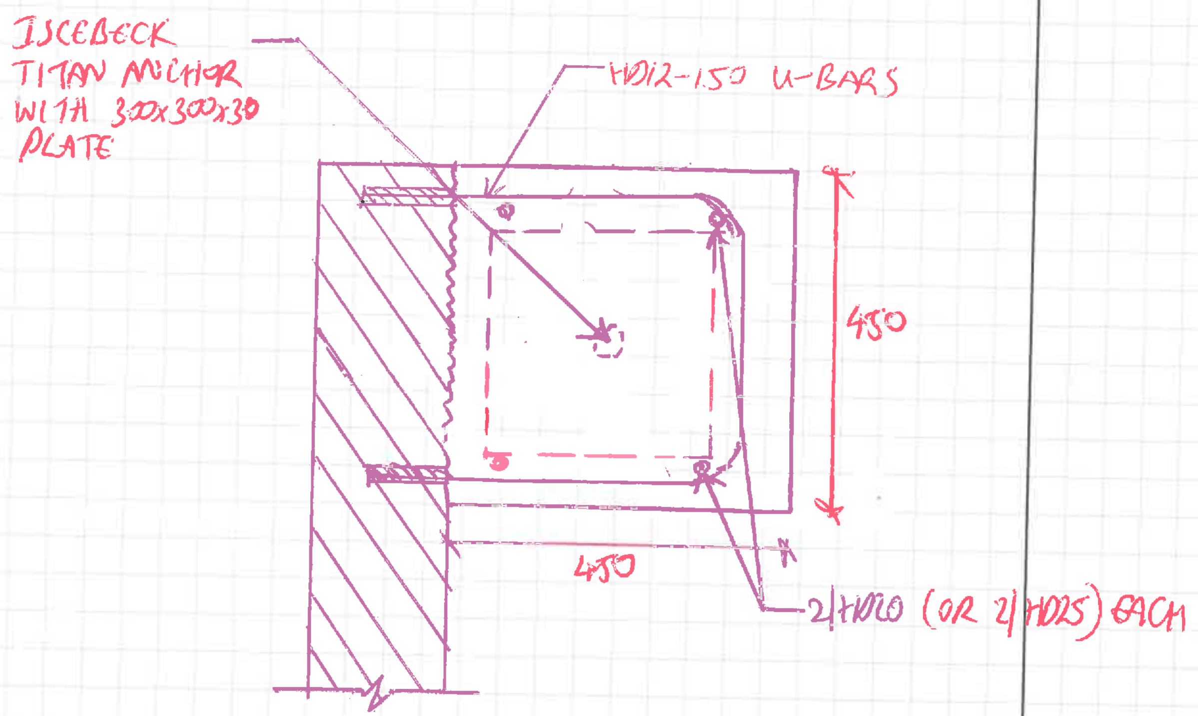
STAFF WING: SEISMIC STRENGTHENING - TYPICAL ELEVATION

F14-06/02

Date	Eng.	Job No.	Sheet No.
-2 FEB 2016	GV	40249	SK5

Project
SEISMIC STRENGTHENING
BLOCK A - SACRED HEART COLLEGE, LOWER HUTT

CALCULATIONS



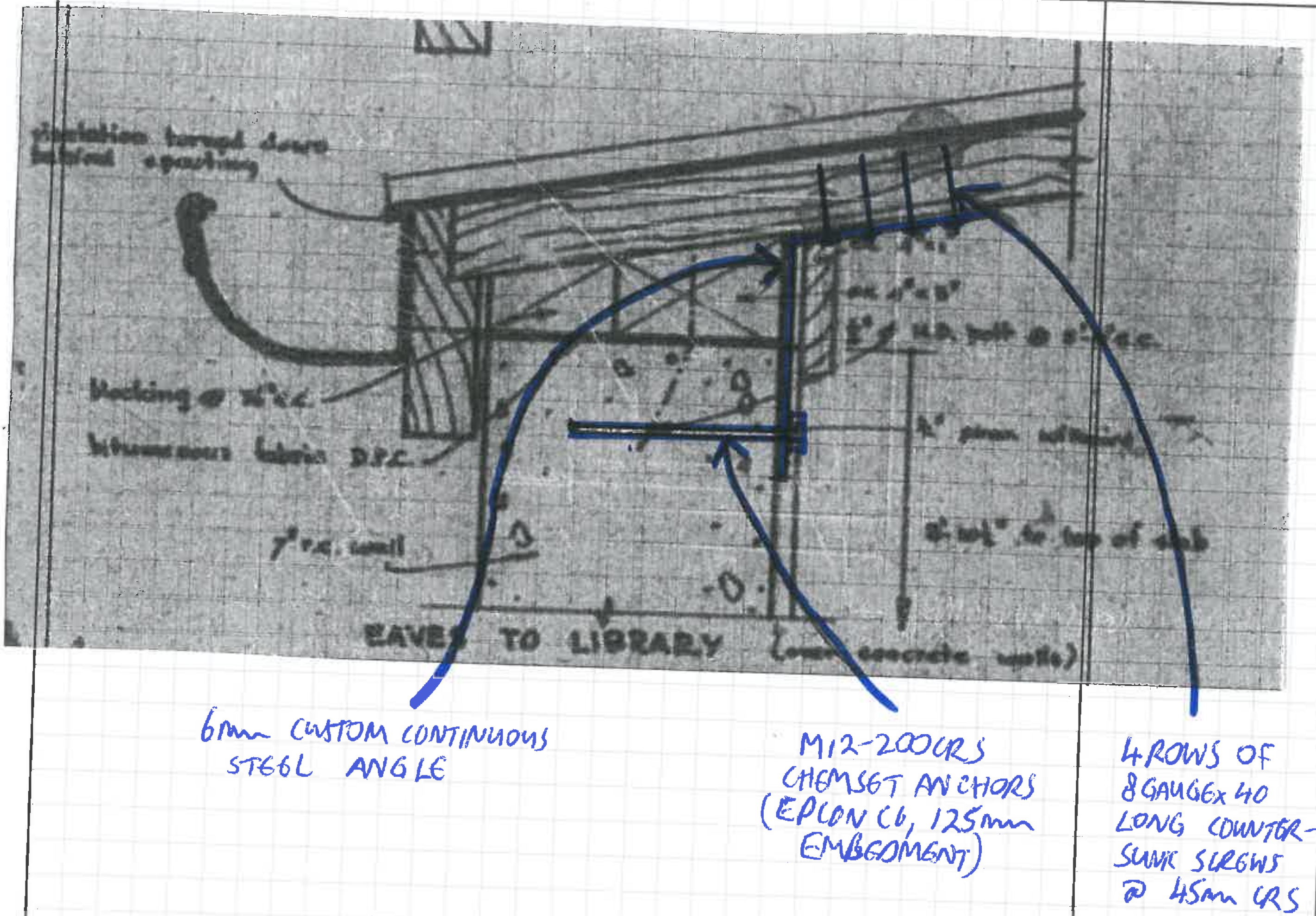
MAIN BLOCK: TYPICAL CONCRETE FLANGE DETAIL

F14-06/02

Date	Eng.	Job No.	Sheet No.
2 FEB 2016	GV	40249	SK 6

CALCULATIONS

Project: SEISMIC STRENGTHENING
BLOCK A - SACRED HEART COLLEGE, LOWER HUTT



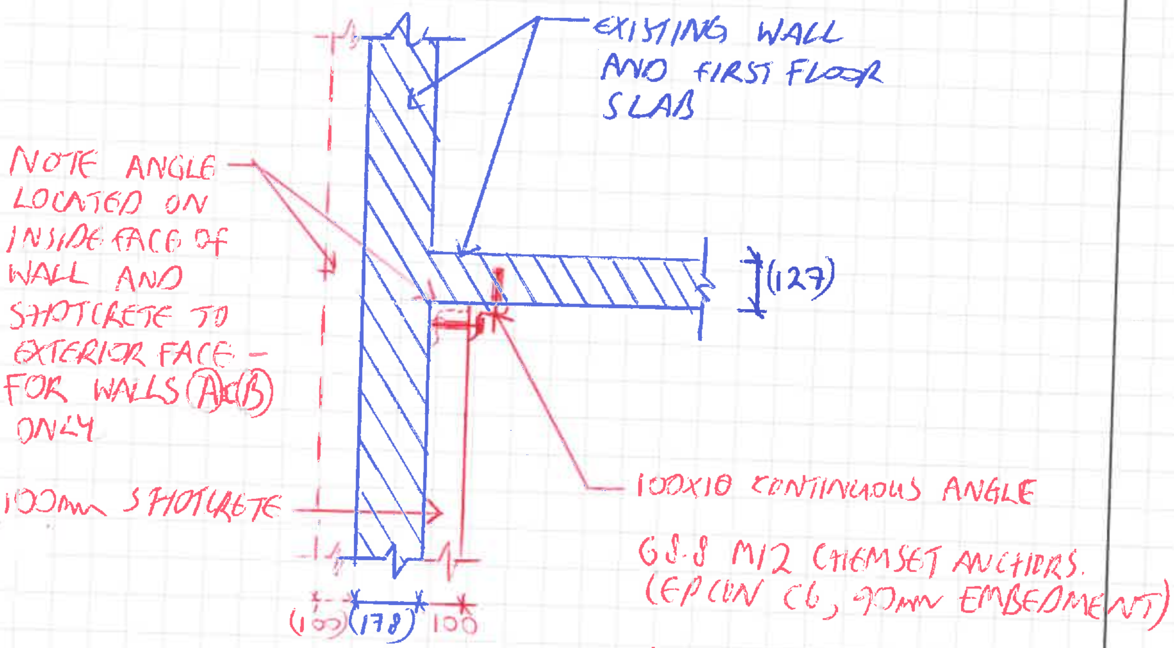
MAIN BLOCK: ROOF TO WALL CONNECTION DETAIL

F14-06/02

Date	Eng.	Job No.	Sheet No.
- 2 FEB 2016	GV	40249	SK 7

Project
SEISMIC STRENGTHENING
BLOCK A - SACRED HEART COLLEGE, LOWER HUTT

CALCULATIONS



SPACING: WALLS (A)&(B) = 1000mm CRS
WALLS (3)&(4) = 1000mm CRS

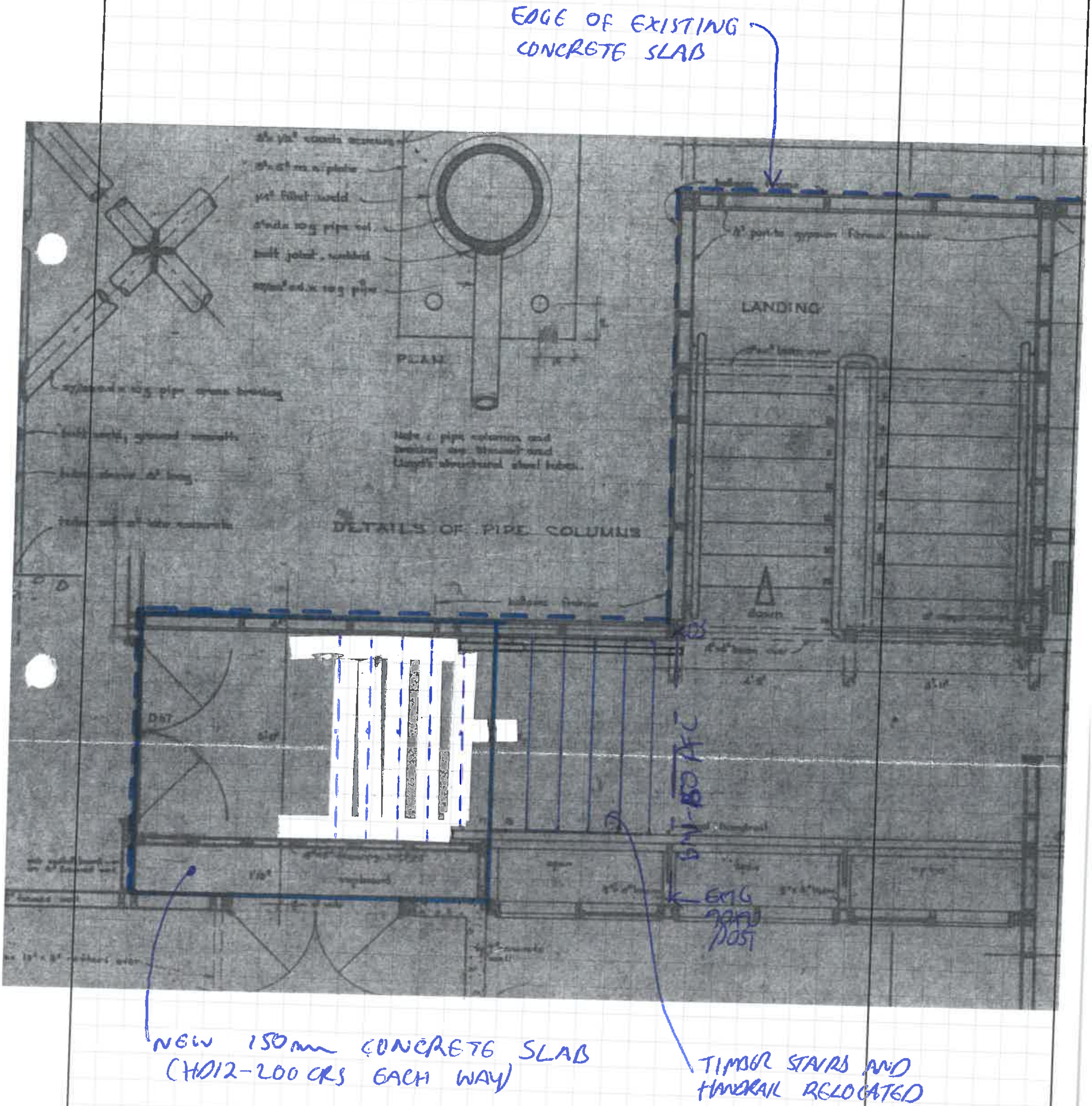
MAIN BLOCK: WALL TO FIRST FLOOR CONNECTION DETAIL

F14-06/02

Date 2 FEB 2016	Eng. GU	Job No. 40249	Sheet No. SK 8

CALCULATIONS

Project
SEISMIC STRENGTHENING
BLOCK A - SACRED HEART COLLEGE, LOWER HUTT



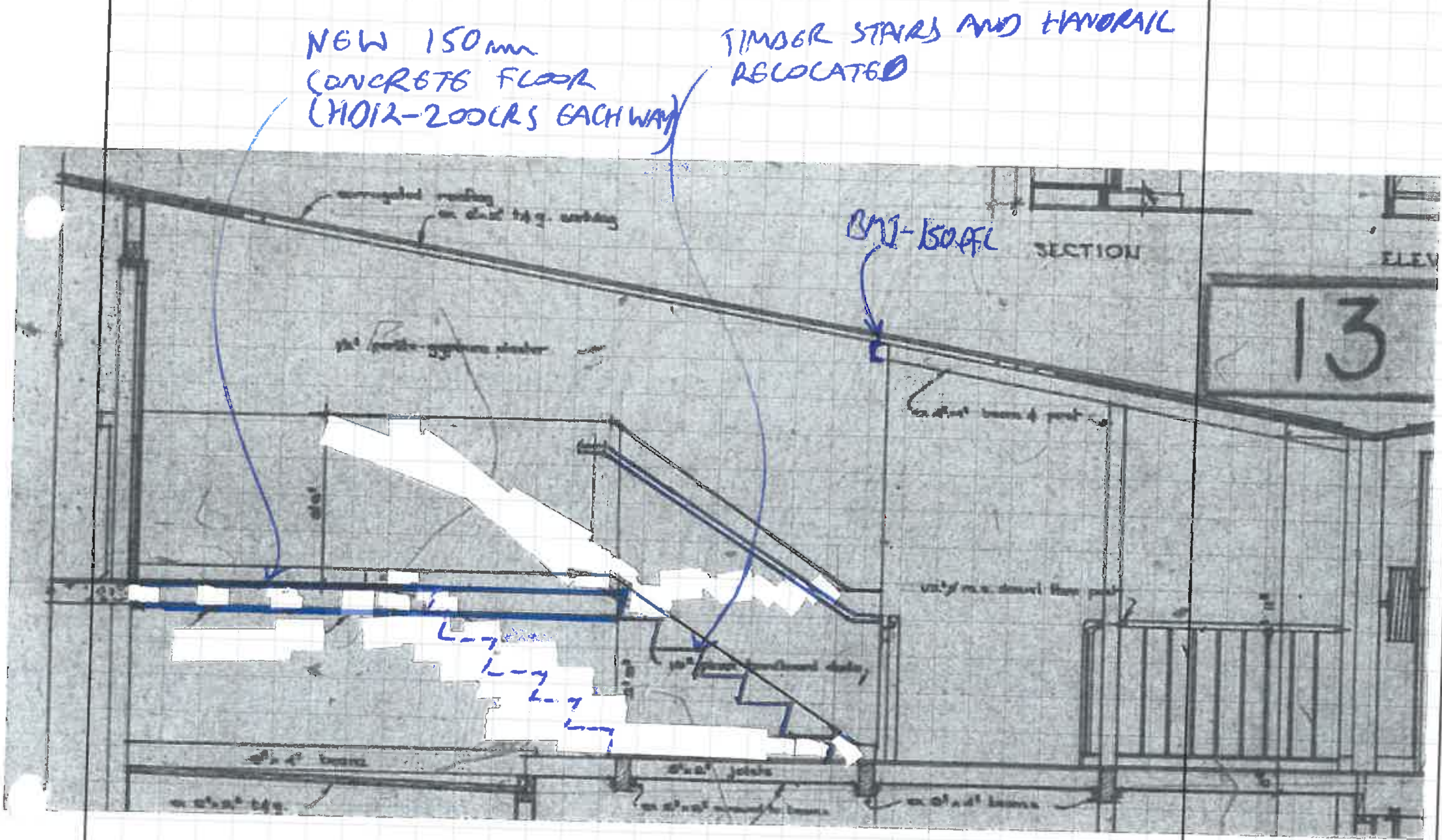
MAIN BLOCK: SLAB EXTENSION THROUGH PREFECT'S WING (PLAN VIEW)

F14-06/02

Date	Eng.	Job No.	Sheet No.
- 2 FEB 2016	GV	40249	SK9

Project
SEISMIC STRENGTHENING
BLOCK A - SACRED HEART COLLEGE, LOWER HUTT

CALCULATIONS



MAIN BLOCK: SLAB EXTENSION THROUGH PREFECT'S WING
(SECTIONAL ELEVATION)

F14-06/02

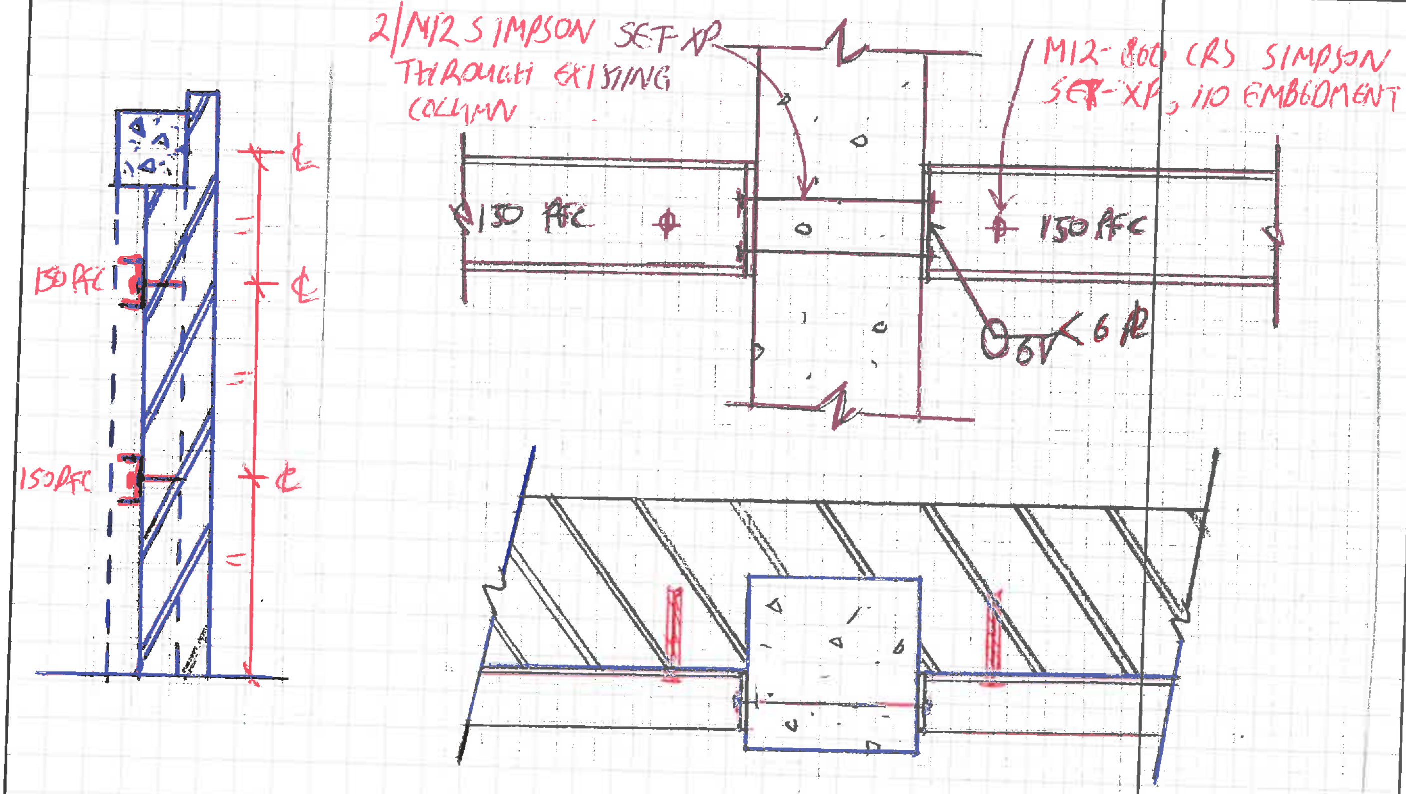
Date	Eng.	Job No.	Sheet No.
- 3 FEB 2016	GN	40249	SK10

Project

SEISMIC STRENGTHENING

BLOCK A - SACRED HEART COLLEGE, LOWER HUTT

CALCULATIONS



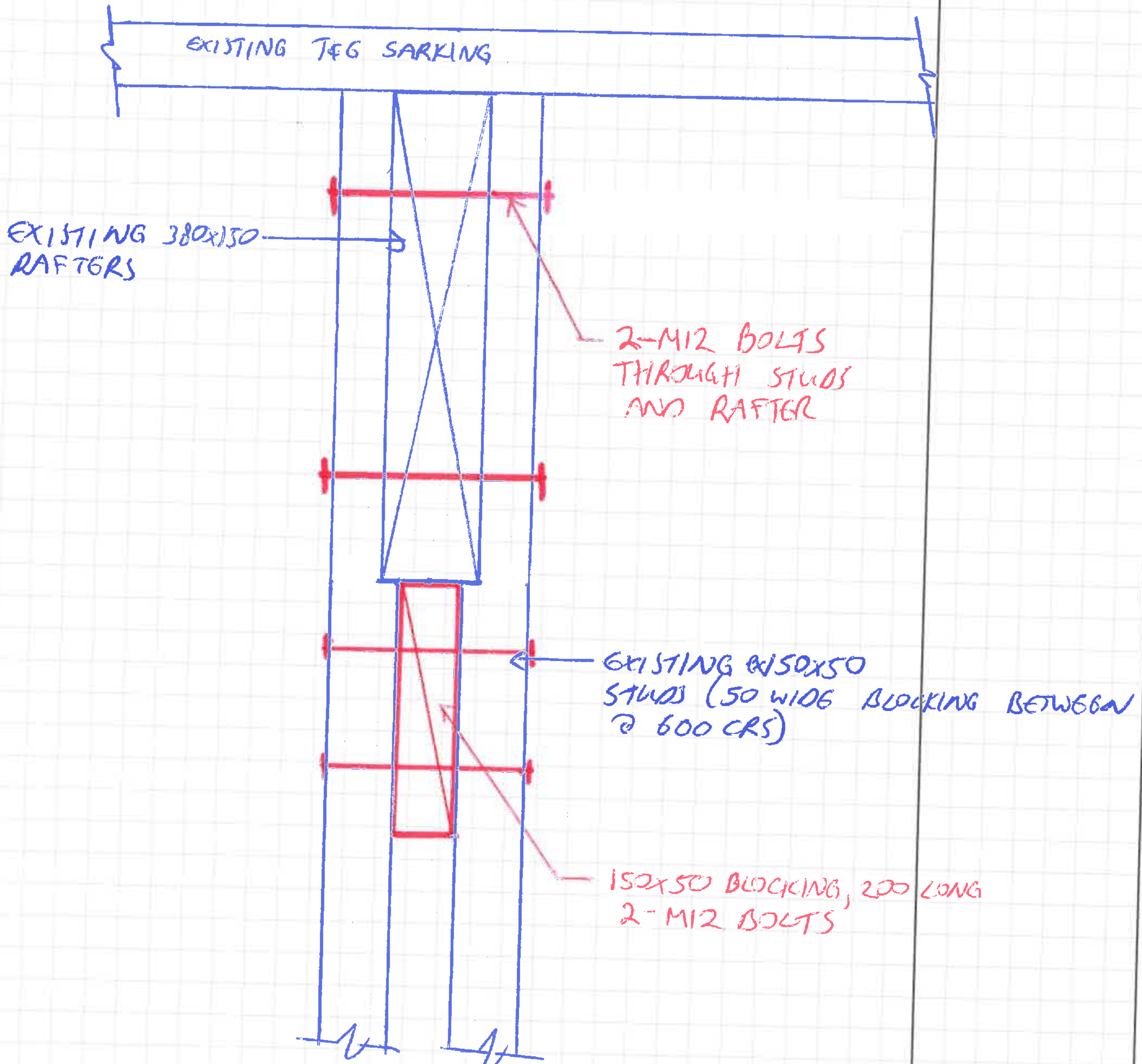
SOUTH BOUNDARY WALL - STEEL WHALING BEAMS DETAILS

F14-06/02

Date - 3 FEB 2016	Eng. GN	Job No. 40249	Sheet No. SK 11

Project
SEISMIC STRENGTHENING
BLOCK A - SACRED HEART COLLEGE, LOWER HUTT

CALCULATIONS



MAIN BLOCK: FIRST FLOOR RAFTER TO STUD STRENGTHENING DETAIL

F14-06/02

Date 21 DEC 2015	Eng. GV	Job No. 40249	Sheet No. MB (1)
Project: SACRED HEART – BLOCK A			

CALCULATIONS

SCOPE: SEISMIC STRENGTHENING OF EXISTING 2-STOREY SCHOOL CLASSROOM BLOCK TO ACHIEVE A MINIMUM SEISMIC CAPACITY OF 67% NBS

GEOMETRY:- REFER STRUCTURAL LAYOUT PLANS

PHILOSOPHY:

1. MAIN BLOCK/1975 ADDITION: GROUND FLOOR

a) LONGITUDINAL – (i) INCREASE STIFFNESS TO 1975 ADDITION TO REDUCE LATERAL LOADS ON MAIN BLOCK WALLS BY CONSTRUCTING A CHEVRON BRACE FRAME (LIMITED BY CAPACITY OF EXISTING CONCRETE-ENCASED STEEL FRAMES).
(ii) INCREASE DIAPHRAGM IN-PLANE CAPACITY FOR LOAD TRANSFER TO 'WALL B'
(iii) INCREASE FLOOR TO WALL TRANSFER CAPACITY.
(iv) INCREASE LATERAL-LOAD RESISTING CAPACITY OF WALLS.

b) TRANSVERSE – (i) INCREASE FLOOR TO WALL TRANSFER CAPACITY
(ii) INCREASE LATERAL-LOAD RESISTING CAPACITY OF WALLS

FIRST FLOOR:

a) LONGITUDINAL – INCREASE ROOF TO WALL TRANSFER CAPACITY

b) TRANSVERSE – NO STRENGTHENING WORK REQUIRED

2. PREFECTS WING:

a) FIRST FLOOR – TRANSVERSE & LONGITUDINAL – RELINE SOME EXISTING WALLS & REPLACE 2 WINDOWS WITH BRACING ANGLES (TRANSVERSE SOUTH WALL)

b) GROUND FLOOR – TRANSVERSE & LONGITUDINAL – RELINE SOME EXISTING WALLS & REMOVE BRICK VENEER TO SOUTH EXTERNAL WALL.

3. STAFF WING:

a) FIRST FLOOR – NO STRENGTHENING WORK REQUIRED.

b) GROUND FLOOR – TRANSVERSE & LONGITUDINAL – FORM PORTAL FRAMES BETWEEN EXISTING COLUMNS & INCREASE DUCTILITY AT BASE OF COLUMNS.

4) SOUTH BOUNDARY WALL: –
– REDUCE VERTICAL SPAN OF BRICK WALL

MB2

Project:	Block A Sacred Heart College	Date:	8-Jan-16
Location:	65 Laings Road	Engineer:	GV
	Lower Hutt	Job No.	40249

DETERMINATION OF AS/NZS1170 SEISMIC COEFFICIENT

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

Location = Lower Hutt

First Mode Period (>0.4 sec) = 0.4

State = Ultimate

Site Subsoil Category: Deep/Soft Soil (Class D)

Structural Ductility Factor μ = 1.25

From AS/NZS1170 $C_h(T_1)$ =	3.00	S_p =	0.925
$C(T) = C_h(T_1)RZN(T,D)$ =	1.56	R =	1.30
$K_u = (\mu-1)T_1 / 0.7 + 1$ =	1.14	Z =	0.40
$Cd(T_1)$ = C(T)Sp/Ku =	**1.26**	N(T,D) =	1

EQUIVALENT STATIC METHOD

Building Weight Determination

Roof

Roofing	0.35 kPa x 1368m2	478.8
1/2 Upper Concrete Walls	23.5kN/m3x0.178mx2.7m/2x18.72m	105.7
1/2 Upper Walls External	0.35 kN/m x 167m	58.5
1/2 Upper Walls Internal	0.30 kN/m x 316m	94.8
	W Roof =	**737.8**

Upper Floor

	Area Upper Floor	*1368 m2*
1/2 Upper Walls External	0.35 kN/m x 167m	58.5
1/2 Upper Walls Internal	0.30 kN/m x 316m	94.8
1/2 Upper Concrete Walls	23.5kN/m3x0.178mx2.7m/2x18.72m	105.7
Upper Floor 23.5kN/m3	x(0.127mx740m^2+0.152mx628m^2)	4451.7
Seismic Live	0.3 x 3.0kPa x U. F.area m2 x LLR	307.8
Conc Floor Beams+Upstand	23.5kN/m3 x 41.24m3	969.1
1/2 new concrete wall	23.5kN/m3 x 0.2m x 3.8m/2x7.645m	69.0
1/2 Lower Conc Walls	23.5kN/m3x0.178mx3.8m/2x101m	801.1
Lower Conc Door Spandrels	23.5kN/m3x0.178mx1.0mx7.5m^2	31.4
1/2 Lower Walls External	0.35 kN/m x 43m	15.1
1/2 Lower Walls Internal	0.30 kN/m x 30m	9.0
1/2 Conc Encased Steel Cols	3.923kN/m x 2.34m x 18	165.2
	W Upper Floor =	**7078.4**
(Live Load Reduction Factor)	$\psi_a=0.3+(3\div\sqrt{A})$ *where* $1>\psi_a>0.5$	0.50

Upper Floor LLR (ψ_a)

Sub Floor

	Area Lower Floor	*1294 m2*
1/2 Lower Walls External	0.35 kN/m x 43m	15.1
1/2 Lower Walls Internal	0.30 kN/m x 30m	9.0
Lower Floor	0.4 kPa x L.F. Area m2	517.6
Seismic Live	0.3 x 3.0kPa x S.F.area m2 x LLR	582.3
1/2 new concrete wall	23.5kN/m3 x 0.2m x 3.8m/2x7.645m	69.0
1/2 Lower Conc Walls	23.5kN/m3x0.203mx2.65mx101m	1274.3
Ground Floor Beams	23.5kN/m3 x 58m^3	1363.0
	W Lower Floor =	**3830.2**
(Live Load Reduction Factor)	$\psi_a=0.3+(3\div\sqrt{A})$ *where* $1>\psi_a>0.5$	0.50
	Wt =	11646.4
V = Cd Wt	**V =**	**14705.1 kN**

Lower Floor LLR (ψ_a)

Bracing Distribution

Level	Wi	Hi	WiHi	Ratio WiHi/SumWiHi	Vi = 0.92(Ratio x V) (+8% V for roof level)	Vi Cum.
Roof	738	7.28	5371	0.136	3011.8	3011.8
First Floor	7078	4.45	31499	0.796	10764.0	13775.8
Subfloor	3830	0.71	2719	0.069	929.3	14705.1
	11646		39589			

mB3

Project: Sacred Heart School - Block A — CENTER OF MASS — J40249

Along

ID	Length	Height	kN/m	kN	x	y	xkN	ykN	kN
Roof				479	10.525	37.419	5041.48	17923.7	479
First Floor Timber Walls				307	10.525	37.419	3231.18	11487.6	307
Longitudinal Concrete Wall - A				191	0.089	4.457	16.999	851.287	191
Longitudinal Concrete Wall - B				191	13.018	4.457	2486.44	851.287	191
Longitudinal Concrete Wall - C	3.55		7.9477		9.9695	65.935	281.283	1860.31	28.2143
New Concrete Wall				68.9885	25.452	31.7659	1755.89	2191.48	68.9885
First Floor Slab				4452	10.525	37.419	46857.3	166589	4452
SLL - First Floor				307.8	10.525	37.419	3239.6	11517.6	307.8
Conc Floor Beams Upstand				969	10.525	37.419	10198.7	36259	969
Ground Floor Timber Walls				24	10.525	37.419	252.6	898.056	24
Transverse Concrete Walls:									
2	3.727		7.9477		3.623	8.839	107.317	261.821	29.6211
2A	4.229		7.9477		8.544	8.839	287.171	297.086	33.6108
3	9.049		7.9477		4.026	12.497	289.545	898.768	71.9187
4	10.058		7.9477		5.029	23.5204	402.008	1880.17	79.938
5	8.604		7.9477		4.272	30.8356	292.128	2108.6	68.382
6	10.058		7.9477		5.029	39.9796	402.008	3195.89	79.938
7	10.058		7.9477		5.029	49.1236	402.008	3926.84	79.938
8	10.058		7.9477		5.029	58.2676	402.008	4657.79	79.938
9	8.839		7.9477		5.029	67.4116	353.286	4735.65	70.2497
Concrete Columns:									
1				9.17962	13.209	15.256	121.254	140.044	9.17962
2				9.17962	13.209	19.828	121.254	182.014	9.17962
3				9.17962	13.209	27.753	121.254	254.762	9.17962
4				9.17962	13.209	35.779	121.254	328.438	9.17962
5				9.17962	13.209	43.806	121.254	402.122	9.17962
6				9.17962	13.209	51.832	121.254	475.798	9.17962
7				9.17962	13.209	57.318	121.254	526.158	9.17962
8				9.17962	19.737	15.256	181.178	140.044	9.17962
9				9.17962	19.737	19.828	181.178	182.014	9.17962
10				9.17962	19.737	27.753	181.178	254.762	9.17962
11				9.17962	19.737	35.779	181.178	328.438	9.17962
12				9.17962	19.737	43.806	181.178	402.122	9.17962
13				9.17962	19.737	51.832	181.178	475.798	9.17962
14				9.17962	19.737	57.318	181.178	526.158	9.17962
15				9.17962	25.452	27.753	233.64	254.762	9.17962
16				9.17962	25.452	35.779	233.64	328.438	9.17962
17				9.17962	25.452	43.806	233.64	402.122	9.17962
18				9.17962	25.452	51.832	233.64	475.798	9.17962
							79350.5	278472	**7,777kN** = W_t
				Center of Mass Coordinates:			**x=10.20m**	**y=35.81m**	

MB4

TORSIONAL ANALYSIS

Job No. 40249

Wall I.D. Bending on x Axis	Wall Height h (m)	Wall Length l (m)	Wall Width w (m)	Wall Location x_1 (m)	Wall Location y_1 (m)	Sectional Area A (m^2)	Wall 2nd Mom Area Ixx (m^4)	Bending and Shear Stiffness $h^3/3I$	Bending and Shear Stiffness 2.64h/A	Bending and Shear Stiffness Σ	Y dirn. Stiffness R_y/E	Relative Stiffness $R_y/\Sigma R_y$
A	4.75	0.18	8.92	4.46	-0.09	1.588	0.004	8521	8	8529	0.000	0.000
B	4.75	0.18	8.92	4.46	-13.02	1.588	0.004	8521	8	8529	0.000	0.000
C	6.223	0.18	3.55	65.94	-9.97	0.632	0.002	48147	26	48173	0.000	0.000
2	4.7	3.73	0.18	8.84	-3.62	0.663	0.768	45	19	64	0.016	0.028
2A	4.7	4.23	0.18	8.84	-8.54	0.753	1.122	31	16	47	0.021	0.038
3	4.7	9.05	0.18	12.50	-4.03	1.611	10.991	3	8	11	0.092	0.167
4	4.7	10.06	0.18	23.52	-5.03	1.790	15.093	2	7	9	0.108	0.197
5	6.223	8.60	0.18	30.84	-4.27	1.532	9.448	9	11	19	0.052	0.094
6	6.223	10.06	0.18	39.98	-5.03	1.790	15.093	5	9	14	0.069	0.125
7	6.223	10.06	0.18	49.12	-5.03	1.790	15.093	5	9	14	0.069	0.125
8	6.223	10.06	0.18	58.27	-5.03	1.790	15.093	5	9	14	0.069	0.125
9	6.223	8.84	0.18	67.41	-5.03	1.573	10.243	8	10	18	0.055	0.099
NewWall	3.835	0.20	8.03	19.14	-25.45	1.606	0.005	3512	6	3518	0.000	0.001

$\Sigma R_y/E =$ **0.552**

Wall I.D. Bending on y Axis	Wall Height h (m)	Wall Length l (m)	Wall Width w (m)	Wall Location x_1 (m)	Wall Location y_1 (m)	Sectional Area A (m^2)	Wall 2nd Mom Area Iyy (m^4)	Bending and Shear Stiffness $h^3/3I$	Bending and Shear Stiffness 2.64h/A	Bending and Shear Stiffness Σ	X dirn. Stiffness R_x/E	Relative Stiffness $R_x/\Sigma R_x$
A	4.75	8.92	0.18	4.46	-0.09	1.588	10.528	3	8	11	0.089	0.293
B	4.75	8.92	0.18	4.46	-13.02	1.588	10.528	3	8	11	0.089	0.293
C	6.223	3.55	0.18	65.94	-9.97	0.632	0.664	121	26	147	0.007	0.022
2	4.7	0.18	3.73	8.84	-3.62	0.663	0.002	19758	19	19776	0.000	0.000
2A	4.7	0.18	4.23	8.84	-8.54	0.753	0.002	17412	16	17429	0.000	0.000
3	4.7	0.18	9.05	12.50	-4.03	1.611	0.004	8138	8	8145	0.000	0.000
4	4.7	0.18	10.06	23.52	-5.03	1.790	0.005	7321	7	7328	0.000	0.000
5	6.223	0.18	8.60	30.84	-4.27	1.532	0.004	19865	11	19876	0.000	0.000
6	6.223	0.18	10.06	39.98	-5.03	1.790	0.005	16994	9	17003	0.000	0.000
7	6.223	0.18	10.06	49.12	-5.03	1.790	0.005	16994	9	17003	0.000	0.000
8	6.223	0.18	10.06	58.27	-5.03	1.790	0.005	16994	9	17003	0.000	0.000
9	6.223	0.18	8.84	67.41	-5.03	1.573	0.004	19337	10	19348	0.000	0.000
NewWall	3.835	8.03	0.20	19.14	-25.45	1.606	8.630	2	6	8	0.118	0.390

$\Sigma R_x/E =$ **0.302**

Shear Centre

$\Sigma x R_y = 0$ $x' = \Sigma x_1 R_y / \Sigma P_y =$ **35.34 m**

$\Sigma y R_x = 0$ $y' = \Sigma y_1 R_x / \Sigma R_x =$ **-13.99 m**

Centre of Area

x = **35.81** m

y = **-10.20** m

Solution for Loads on Walls

Wall I.D.	R_x/E	R_y/E	x: $x = x_1 - x'$	y: $y = y_1 - y'$	x^2R_y/E	y^2R_x/E	Shear from Torsion $T_{px}yR_x/J_p$	Shear from Torsion $T_{py}xR_y/J_p$	Direct Shear $P_xR_x/\Sigma R_x$	Direct Shear $P_yR_y/\Sigma R_y$	Total Shear in X dirn. +ve T_{px} F_x	Total Shear in X dirn. -ve T_{px} F_x	Total Shear in Y dirn. +ve T_{py} F_y	Total Shear in Y dirn. -ve T_{py} F_y
A	0.089	0.000	-30.88	13.90	0.11	17.12	816.0	-0.7	4033.8	2.9	**4850**	**-3218**	**2**	**4**
B	0.089	0.000	-30.88	0.97	0.11	0.08	57.2	-0.7	4033.8	2.9	**4091**	**-3977**	**2**	**4**
C	0.007	0.000	30.60	4.02	0.02	0.11	18.1	0.1	309.7	0.5	**328**	**-292**	**1**	**0**
2	0.000	0.016	-26.50	10.37	11.01	0.01	0.3	-78.0	2.3	391.7	**3**	**-2**	**314**	**470**
2A	0.000	0.021	-26.50	5.45	14.84	0.00	0.2	-105.1	2.6	527.7	**3**	**-2**	**423**	**633**
3	0.000	0.092	-22.84	9.97	48.07	0.01	0.8	-395.1	5.6	2301.7	**6**	**-5**	**1907**	**2697**
4	0.000	0.108	-11.82	8.96	15.14	0.01	0.8	-240.5	6.2	2708.1	**7**	**-5**	**2468**	**2949**
5	0.000	0.052	-4.50	9.72	1.05	0.00	0.3	-43.9	2.3	1298.9	**3**	**-2**	**1255**	**1343**
6	0.000	0.069	4.64	8.96	1.49	0.00	0.3	60.1	2.7	1722.8	**3**	**-2**	**1783**	**1663**
7	0.000	0.069	13.79	8.96	13.11	0.00	0.3	178.5	2.7	1722.8	**3**	**-2**	**1901**	**1544**
8	0.000	0.069	22.93	8.96	36.26	0.00	0.3	296.8	2.7	1722.8	**3**	**-2**	**2020**	**1426**
9	0.000	0.055	32.07	8.96	56.26	0.00	0.3	329.3	2.4	1366.1	**3**	**-2**	**1695**	**1037**
NewWall	0.118	0.000	-16.20	-11.46	0.07	15.48	-895.2	-0.9	5369.3	7.1	**4474**	**-6265**	**6**	**8**
				Σ =	**197.55**	**32.85**				Σ =	**13776**	**-13776**	**13776**	**13776**

Total Floor Shear (P_x) 13776

Total Floor Shear (P_y) 13776

Torque T_{px} from P_x (0.1d from CoR) 152690.4 where d = 72.91

Torque T_{py} from P_y (0.1b from CoR) 43246.0 where b = 26.67

$1/E^*J_p = 1/E\Sigma(y^2R_x + x^2R_y + J)$ where J = 0

$1/E^*J_p =$ 230.40

$T_{px}/J_p =$ 662.7 *1/E

$T_{py}/J_p =$ 187.7 *1/E

MB4A

Probable Strength of Concrete Wall

Job Name:	Block A, Sacred Heart College	Job No.	40249
	65 Laings Road, Lower Hutt	Engineer	GV
Wall:	Walls A & B - Strengthened (HD16-300 Vert; HD12-150 Horiz)	Date	23/02/2016

M* =	29793 kN-m	M_{prob} =	19881 kN-m	67 %NBS
V* =	5778 kN	V_{pob} =	3958 kN	69 %NBS
N* =	496 kN		6028 kN	(for wall outside PPHZ)
	Note: Use negative N* for uplift load	Check internal force equilibrium=		0 OK

Input parameters for flexural strengh calculation

Effective wall thickness for flexural	B =	290 mm
Total wall length	L_w =	8920 mm
Expected compressive strength	f'_c =	30 MPa
Expected tensile strength of reinforcement	f_y =	260 MPa
Concrete compression strain	ε_c	0.004
Steel reinforcement yield strain	ε_{sy}	0.0013
Expected axial load on wall	N* =	496 kN
Neutral axis depth	N.A =	658 mm
Equivalent stress block depth	α =	559 mm
Axial load stress	$\sigma_{c\ axial}$ =	0.19 MPa
Young's modulus of concrete	E_c =	25084 MPa
Section curvature	ψ =	6.07E-06

Input parameters for shear strength calculation

Effective wall shear thickness	t_{wall} =	290 mm
Gross area of wall	A_g =	2586800 mm^2
wall shear reinforcement diameter	Φ =	12 mm
Area of a single shear reinforcement	A_v =	113 mm^2
Yield strength of shear reinforcement	f_{yt} =	500 MPa
Number reinforcement layer	n =	1 Layer(s)
Horizontal shear reinforcement spacing c/c	S_2 =	150 mm

0.0040

Steel Layer	N°	D	A	d'	εy	σ	F	M
AS 1	2	15.875	396	50	0.0013	260	1.03E+05	5.15E+06
HD16	1	16	201	100	0.0025	500	1.01E+05	1.01E+07
AS 2	2	9.525	143	355	0.0013	260	3.71E+04	1.32E+07
HD16	1	16	201	400	0.0025	500	1.01E+05	4.02E+07
AS 3	2	9.525	143	660	0.0000	-3	-4.27E+02	-2.82E+05
HD16	1	16	201	700	0.0000	-6	-1.16E+03	-8.12E+05
AS 4	2	9.525	143	965	-0.0013	-260	-3.71E+04	-3.58E+07
HD16	1	16	201	1000	-0.0025	-500	-1.01E+05	-1.01E+08
AS 5	2	19.05	570	1274	-0.0013	-260	-1.48E+05	-1.89E+08
HD16	1	16	201	1300	-0.0025	-500	-1.01E+05	-1.31E+08
AS 6	2	19.05	570	1621	-0.0013	-260	-1.48E+05	-2.40E+08
HD16	1	16	201	1600	-0.0025	-500	-1.01E+05	-1.61E+08
AS 7	2	9.525	143	1855	-0.0013	-260	-3.71E+04	-6.87E+07
HD16	1	16	201	1900	-0.0025	-500	-1.01E+05	-1.91E+08
AS 8	2	9.525	143	2160	-0.0013	-260	-3.71E+04	-8.00E+07
HD16	1	16	201	2200	-0.0025	-500	-1.01E+05	-2.21E+08
AS 9	2	9.525	143	2465	-0.0013	-260	-3.71E+04	-9.13E+07
HD16	1	16	201	2500	-0.0025	-500	-1.01E+05	-2.51E+08
AS 10	2	9.525	143	2770	-0.0013	-260	-3.71E+04	-1.03E+08
HD16	1	16	201	2800	-0.0025	-500	-1.01E+05	-2.81E+08
AS 11	2	9.525	143	3075	-0.0013	-260	-3.71E+04	-1.14E+08
HD16	1	16	201	3100	-0.0025	-500	-1.01E+05	-3.12E+08
AS 12	2	9.525	143	3380	-0.0013	-260	-3.71E+04	-1.25E+08
HD16	1	16	201	3400	-0.0025	-500	-1.01E+05	-3.42E+08

MB4B

AS 13	2	9.525	143	3685	-0.0013	-260	-3.71E+04	-1.37E+08
HD16	1	16	201	3700	-0.0025	-500	-1.01E+05	-3.72E+08
AS 14	2	9.525	143	3990	-0.0013	-260	-3.71E+04	-1.48E+08
HD16	1	16	201	4000	-0.0025	-500	-1.01E+05	-4.02E+08
AS 15	2	9.525	143	4295	-0.0013	-260	-3.71E+04	-1.59E+08
HD16	1	16	201	4300	-0.0025	-500	-1.01E+05	-4.32E+08
AS 16	2	9.525	143	4600	-0.0013	-260	-3.71E+04	-1.70E+08
HD16	1	16	201	4600	-0.0025	-500	-1.01E+05	-4.62E+08
AS 17	2	9.525	143	4905	-0.0013	-260	-3.71E+04	-1.82E+08
HD16	1	16	201	4900	-0.0025	-500	-1.01E+05	-4.93E+08
AS 18	2	9.525	143	5210	-0.0013	-260	-3.71E+04	-1.93E+08
HD16	1	16	201	5200	-0.0025	-500	-1.01E+05	-5.23E+08
AS 19	2	9.525	143	5515	-0.0013	-260	-3.71E+04	-2.04E+08
HD16	1	16	201	5500	-0.0025	-500	-1.01E+05	-5.53E+08
AS 20	2	9.525	143	5820	-0.0013	-260	-3.71E+04	-2.16E+08
HD16	1	16	201	5800	-0.0025	-500	-1.01E+05	-5.83E+08
AS 21	2	9.525	143	6125	-0.0013	-260	-3.71E+04	-2.27E+08
HD16	1	16	201	6100	-0.0025	-500	-1.01E+05	-6.13E+08
AS 22	2	9.525	143	6430	-0.0013	-260	-3.71E+04	-2.38E+08
HD16	1	16	201	6400	-0.0025	-500	-1.01E+05	-6.43E+08
AS 23	2	9.525	143	6735	-0.0013	-260	-3.71E+04	-2.50E+08
HD16	1	16	201	6700	-0.0025	-500	-1.01E+05	-6.74E+08
AS 24	2	9.525	143	7040	-0.0013	-260	-3.71E+04	-2.61E+08
HD16	1	16	201	7000	-0.0025	-500	-1.01E+05	-7.04E+08
AS 25	2	9.525	143	7345	-0.0013	-260	-3.71E+04	-2.72E+08
HD16	1	16	201	7300	-0.0025	-500	-1.01E+05	-7.34E+08
AS 26	2	9.525	143	7650	-0.0013	-260	-3.71E+04	-2.83E+08
HD16	1	16	201	7600	-0.0025	-500	-1.01E+05	-7.64E+08
AS 27	2	9.525	143	7955	-0.0013	-260	-3.71E+04	-2.95E+08
HD16	1	16	201	7900	-0.0025	-500	-1.01E+05	-7.94E+08
AS 28	2	9.525	143	8260	-0.0013	-260	-3.71E+04	-3.06E+08
HD16	1	16	201	8200	-0.0025	-500	-1.01E+05	-8.24E+08
AS 29	2	9.525	143	8565	-0.0013	-260	-3.71E+04	-3.17E+08
HD16	1	16	201	8500	-0.0025	-500	-1.01E+05	-8.55E+08
AS 30	2	15.875	681	8870	-0.0013	-260	-1.77E+05	-1.57E+09
HD16	1	16	201	8800	-0.0025	-500	-1.01E+05	-8.85E+08
						Steel	-3.64E+06	-1.88E+10
						Concrete	4.13E+06	1.15E+09
						Axial load	-4.96E+05	-2.21E+09

MB4C

Probable Strength of Concrete Wall

Job Name: **Block A, Sacred Heart College**
65 Laings Road, Lower Hutt
Wall: **Wall C - Strengthened (2-HD16 each end)**

Job No. 40249
Engineer GV
Date 23/02/2016

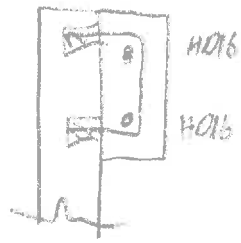
M* =	**2041 kN-m**	**M_{prob} =**	**1950 kN-m**	**96 %NBS**
V* =	**328 kN**	**V_{prob} =**	**493 kN**	**100 %NBS**
N* =	**73 kN**		**1544 kN**	(for wall outside PPHZ)

Note: Use negative N* for uplift load

Check internal force equilibrium= 0 OK

Input parameters for flexural strengh calculation

Effective wall thickness for flexural	B =	305 mm
Total wall length	L_w =	3550 mm
Expected compressive strength	f'_c =	30 MPa
Expected tensile strength of reinforcement	f_y =	260 MPa
Concrete compression strain	ε_c	0.004
Steel reinforcement yield strain	ε_{sy}	0.0013
Expected axial load on wall	N* =	73 kN
Neutral axis depth	N.A =	120 mm
Equivalent stress block depth	α =	102 mm
Axial load stress	$\sigma_{c\ axial}$ =	0.07 MPa
Young's modulus of concrete	E_c =	25084 MPa
Section curvature	ψ =	3.33E-05



Input parameters for shear strength calculation

Effective wall shear thickness	t_{wall} =	305 mm
Gross area of wall	A_g =	1082750 mm^2
wall shear reinforcement diameter	Φ =	9.525 mm
Area of a single shear reinforcement	A_v =	71 mm^2
Yield strength of shear reinforcement	f_{yt} =	260 MPa
Number reinforcement layer	n =	2 Layer(s)
Horizontal shear reinforcement spacing c/c	S_2 =	305 mm

0.0040

Steel Layer	N°	D	A	d'	εy	σ	F	M
AS 1	2	15.875	824	50	0.0013	260	2.14E+05	1.07E+07
AS 2	6	9.525	428	128	-0.0003	-53	-2.25E+04	-2.88E+06
HD16	1	16	201	240	-0.0025	-500	-1.01E+05	-2.41E+07
HD16	1	16	201	340	-0.0025	-500	-1.01E+05	-3.42E+07
AS 3	2	9.525	143	355	-0.0013	-260	-3.71E+04	-1.32E+07
AS 4	2	9.525	143	660	-0.0013	-260	-3.71E+04	-2.45E+07
AS 5	2	9.525	143	965	-0.0013	-260	-3.71E+04	-3.58E+07
AS 6	2	9.525	143	1270	-0.0013	-260	-3.71E+04	-4.71E+07
AS 7	2	9.525	143	1575	-0.0013	-260	-3.71E+04	-5.84E+07
AS 8	2	9.525	143	1880	-0.0013	-260	-3.71E+04	-6.97E+07
AS 9	2	9.525	143	2185	-0.0013	-260	-3.71E+04	-8.10E+07
AS 10	2	9.525	143	2490	-0.0013	-260	-3.71E+04	-9.23E+07
AS 11	2	9.525	143	2795	-0.0013	-260	-3.71E+04	-1.04E+08
AS 12	2	9.525	143	3100	-0.0013	-260	-3.71E+04	-1.15E+08
HD16	1	16	201	3350	-0.0025	-500	-1.01E+05	-3.37E+08
AS 13	2	9.525	143	3405	-0.0013	-260	-3.71E+04	-1.26E+08
HD16	1	16	201	3450	-0.0025	-500	-1.01E+05	-3.47E+08
AS 14	2	15.875	396	3500	-0.0013	-260	-1.03E+05	-3.60E+08
						Steel	-7.21E+05	-1.86E+09
						Concrete	7.94E+05	4.05E+07
						Axial load	-7.30E+04	-1.30E+08

M04D

Probable Strength of Concrete Wall

Job Name:	**Block A, Sacred Heart College**	**Job No.**	40249
	65 Laings Road, Lower Hutt	**Engineer**	GV
Wall:	**Wall 2 - Strengthened (2-HD16 each end)**	**Date**	23/02/2016

M* =	**2209 kN-m**	**M_{prob} =**	**1959 kN-m**	**89 %NBS**
V* =	**470 kN**	**V_{pob} =**	**483 kN**	**100 %NBS**
N* =	**70 kN**		**1140 kN**	(for wall outside PPHZ)
	Note: Use negative N* for uplift load	Check internal force equilibrium=		0 OK

Input parameters for flexural strengh calculation

Effective wall thickness for flexural	**B =**	203 mm
Total wall length	**L_w =**	3727 mm
Expected compressive strength	**f'_c =**	30 MPa
Expected tensile strength of reinforcement	**f_y =**	260 MPa
Concrete compression strain	**ε_c**	0.004
Steel reinforcement yield strain	**ε_{sy}**	0.0013
Expected axial load on wall	**N* =**	70 kN
Neutral axis depth	**N.A =**	156 mm
Equivalent stress block depth	**α =**	133 mm
Axial load stress	**$\sigma_{c\ axial}$ =**	0.09 MPa
Young's modulus of concrete	**E_c =**	25084 MPa
Section curvature	**ψ =**	2.56E-05

Input parameters for shear strength calculation

Effective wall shear thickness	**t_{wall} =**	203 mm
Gross area of wall	**A_g =**	756581 mm^2
wall shear reinforcement diameter	**Φ =**	9.525 mm
Area of a single shear reinforcement	**A_v =**	71 mm^2
Yield strength of shear reinforcement	**f_{yt} =**	260 MPa
Number reinforcement layer	**n =**	2 Layer(s)
Horizontal shear reinforcement spacing c/c	**S_2 =**	305 mm

0.0040

Steel Layer	N°	D	A	d'	εy	σ	F	M
AS 1	2	15.875	396	50	0.0013	260	1.03E+05	5.15E+06
HD16	1	16	201	75	0.0023	462	9.28E+04	6.96E+06
HD16	1	16	201	175	-0.0025	-500	-1.01E+05	-1.76E+07
AS 2	2	9.525	143	355	-0.0013	-260	-3.71E+04	-1.32E+07
AS 3	2	9.525	143	660	-0.0013	-260	-3.71E+04	-2.45E+07
AS 4	2	9.525	143	965	-0.0013	-260	-3.71E+04	-3.58E+07
AS 5	2	9.525	143	1270	-0.0013	-260	-3.71E+04	-4.71E+07
AS 6	2	9.525	143	1575	-0.0013	-260	-3.71E+04	-5.84E+07
AS 7	2	9.525	143	1880	-0.0013	-260	-3.71E+04	-6.97E+07
AS 8	2	9.525	143	2185	-0.0013	-260	-3.71E+04	-8.10E+07
AS 9	2	9.525	143	2490	-0.0013	-260	-3.71E+04	-9.23E+07
AS 10	2	9.525	143	2795	-0.0013	-260	-3.71E+04	-1.04E+08
AS 11	2	9.525	143	3100	-0.0013	-260	-3.71E+04	-1.15E+08
AS 12	2	9.525	143	3405	-0.0013	-260	-3.71E+04	-1.26E+08
HD16	1	16	201	3552	-0.0025	-500	-1.01E+05	-3.57E+08
HD16	1	16	201	3652	-0.0025	-500	-1.01E+05	-3.67E+08
AS 13	2	15.875	396	3677	-0.0013	-260	-1.03E+05	-3.78E+08
						Steel	-6.16E+05	-1.87E+09
						Concrete	6.86E+05	4.55E+07
						Axial load	-7.00E+04	-1.30E+08

NB4E

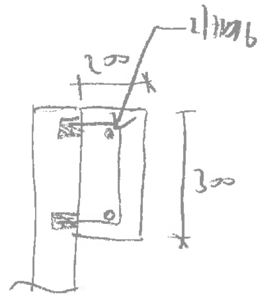
Probable Strength of Concrete Wall

Job Name:	**Block A, Sacred Heart College**	**Job No.**	40249
	65 Laings Road, Lower Hutt	**Engineer**	GV
Wall:	**Wall 2A - Strengthened (2-HD16 each end)**	**Date**	23/02/2016

M* =	**2975 kN-m**	**M_{prob} =**	**2426 kN-m**	**82 %NBS**
V* =	**633 kN**	**V_{pob} =**	**549 kN**	**87 %NBS**
N* =	**80 kN**		**1294 kN**	(for wall outside PPHZ)
	Note: Use negative N* for uplift load	Check internal force equilibrium=		0 OK

Input parameters for flexural strengh calculation

Effective wall thickness for flexural	B =	203 mm
Total wall length	L_w =	4229 mm
Expected compressive strength	f'_c =	30 MPa
Expected tensile strength of reinforcement	f_y =	260 MPa
Concrete compression strain	ε_c	0.004
Steel reinforcement yield strain	ε_{sy}	0.0013
Expected axial load on wall	N* =	80 kN
Neutral axis depth	N.A =	173 mm
Equivalent stress block depth	α =	147 mm
Axial load stress	$\sigma_{c\ axial}$ =	0.09 MPa
Young's modulus of concrete	E_c =	25084 MPa
Section curvature	ψ =	2.31E-05



Input parameters for shear strength calculation

Effective wall shear thickness	t_{wall} =	203 mm
Gross area of wall	A_g =	858487 mm^2
wall shear reinforcement diameter	Φ =	9.525 mm
Area of a single shear reinforcement	A_v =	71 mm^2
Yield strength of shear reinforcement	f_{yt} =	260 MPa
Number reinforcement layer	n =	2 Layer(s)
Horizontal shear reinforcement spacing c/c	S_2 =	305 mm

0.0040

Steel Layer	N°	D	A	d'	εy	σ	F	M
AS 1	2	15.875	396	50	0.0013	260	1.03E+05	5.15E+06
HD16	1	16	201	75	0.0025	500	1.01E+05	7.54E+06
HD16	1	16	201	175	-0.0025	-500	-1.01E+05	-1.76E+07
AS 2	2	9.525	143	355	-0.0013	-260	-3.71E+04	-1.32E+07
AS 3	2	9.525	143	660	-0.0013	-260	-3.71E+04	-2.45E+07
AS 4	2	9.525	143	965	-0.0013	-260	-3.71E+04	-3.58E+07
AS 5	2	9.525	143	1270	-0.0013	-260	-3.71E+04	-4.71E+07
AS 6	2	9.525	143	1575	-0.0013	-260	-3.71E+04	-5.84E+07
AS 7	2	9.525	143	1880	-0.0013	-260	-3.71E+04	-6.97E+07
AS 8	2	9.525	143	2185	-0.0013	-260	-3.71E+04	-8.10E+07
AS 9	2	9.525	143	2490	-0.0013	-260	-3.71E+04	-9.23E+07
AS 10	2	9.525	143	2795	-0.0013	-260	-3.71E+04	-1.04E+08
AS 11	2	9.525	143	3100	-0.0013	-260	-3.71E+04	-1.15E+08
AS 12	2	9.525	143	3405	-0.0013	-260	-3.71E+04	-1.26E+08
AS 13	2	9.525	143	3710	-0.0013	-260	-3.71E+04	-1.37E+08
AS 14	2	9.525	143	4015	-0.0013	-260	-3.71E+04	-1.49E+08
HD16	1	16	201	4054	-0.0025	-500	-1.01E+05	-4.08E+08
HD16	1	16	201	4154	-0.0025	-500	-1.01E+05	-4.18E+08
AS 15	2	15.875	396	4179	-0.0013	-260	-1.03E+05	-4.30E+08
						Steel	-6.83E+05	-2.31E+09
						Concrete	7.63E+05	5.62E+07
						Axial load	-8.00E+04	-1.69E+08

MB4F

Probable Strength of Concrete Wall

Job Name:	Block A, Sacred Heart College	Job No.	40249
	65 Laings Road, Lower Hutt	Engineer	GV
Wall:	Wall 3 - Strengthened (HD12-300 Vert; HD12-150 Horiz)	Date	23/02/2016

M* =	12676 kN-m	M_{prob} =	13764 kN-m	100 %NBS
V* =	2697 kN	V_{pob} =	3109 kN	100 %NBS
N* =	190 kN		5548 kN	(for wall outside PPHZ)
	Note: Use negative N* for uplift load	Check internal force equilibrium=		0 OK

Input parameters for flexural strengh calculation

Effective wall thickness for flexural	B =	303 mm
Total wall length	L_w =	9049 mm
Expected compressive strength	f'_c =	30 MPa
Expected tensile strength of reinforcement	f_y =	260 MPa
Concrete compression strain	ε_c	0.004
Steel reinforcement yield strain	ε_{sy}	0.0013
Expected axial load on wall	N* =	190 kN
Neutral axis depth	N.A =	425 mm
Equivalent stress block depth	α =	361 mm
Axial load stress	$\sigma_{c\ axial}$ =	0.07 MPa
Young's modulus of concrete	E_c =	25084 MPa
Section curvature	ψ =	9.4E-06

Input parameters for shear strength calculation

Effective wall shear thickness	t_{wall} =	303 mm
Gross area of wall	A_g =	2741847 mm^2
wall shear reinforcement diameter	Φ =	12 mm
Area of a single shear reinforcement	A_v =	113 mm^2
Yield strength of shear reinforcement	f_{yt} =	500 MPa
Number reinforcement layer	n =	1 Layer(s)
Horizontal shear reinforcement spacing c/c	S_2 =	150 mm

0.0040

Steel Layer	N°	D	A	d'	εy	σ	F	M
AS 1	2	15.875	396	50	0.0013	260	1.03E+05	5.15E+06
HD12	1	12	113	100	0.0025	500	5.65E+04	5.65E+06
AS 2	2	9.525	143	355	0.0007	132	1.88E+04	6.67E+06
HD12	1	12	113	400	-0.0025	-500	-5.65E+04	-2.26E+07
AS 3	2	9.525	143	660	-0.0013	-260	-3.71E+04	-2.45E+07
HD12	1	12	113	700	-0.0025	-500	-5.65E+04	-3.96E+07
AS 4	2	9.525	143	965	-0.0013	-260	-3.71E+04	-3.58E+07
HD12	1	12	113	1000	-0.0025	-500	-5.65E+04	-5.65E+07
AS 5	2	9.525	143	1270	-0.0013	-260	-3.71E+04	-4.71E+07
HD12	1	12	113	1300	-0.0025	-500	-5.65E+04	-7.35E+07
AS 6	2	9.525	143	1575	-0.0013	-260	-3.71E+04	-5.84E+07
HD12	1	12	113	1600	-0.0025	-500	-5.65E+04	-9.05E+07
AS 7	2	9.525	143	1880	-0.0013	-260	-3.71E+04	-6.97E+07
HD12	1	12	113	1900	-0.0025	-500	-5.65E+04	-1.07E+08
AS 8	2	9.525	143	2185	-0.0013	-260	-3.71E+04	-8.10E+07
HD12	1	12	113	2200	-0.0025	-500	-5.65E+04	-1.24E+08
AS 9	2	9.525	143	2490	-0.0013	-260	-3.71E+04	-9.23E+07
HD12	1	12	113	2500	-0.0025	-500	-5.65E+04	-1.41E+08
AS 10	2	9.525	143	2795	-0.0013	-260	-3.71E+04	-1.04E+08
HD12	1	12	113	2800	-0.0025	-500	-5.65E+04	-1.58E+08
AS 11	2	9.525	143	3100	-0.0013	-260	-3.71E+04	-1.15E+08
HD12	1	12	113	3100	-0.0025	-500	-5.65E+04	-1.75E+08
AS 12	2	9.525	143	3405	-0.0013	-260	-3.71E+04	-1.26E+08
HD12	1	12	113	3400	-0.0025	-500	-5.65E+04	-1.92E+08

AS 13	2	9.525	143	3710	-0.0013	-260	-3.71E+04	-1.37E+08
HD12	1	12	113	3700	-0.0025	-500	-5.65E+04	-2.09E+08
AS 14	2	9.525	143	4015	-0.0013	-260	-3.71E+04	-1.49E+08
HD12	1	12	113	4000	-0.0025	-500	-5.65E+04	-2.26E+08
AS 15	2	9.525	143	4320	-0.0013	-260	-3.71E+04	-1.60E+08
HD12	1	12	113	4300	-0.0025	-500	-5.65E+04	-2.43E+08
AS 16	2	9.525	143	4625	-0.0013	-260	-3.71E+04	-1.71E+08
HD12	1	12	113	4600	-0.0025	-500	-5.65E+04	-2.60E+08
AS 17	2	9.525	143	4930	-0.0013	-260	-3.71E+04	-1.83E+08
HD12	1	12	113	4900	-0.0025	-500	-5.65E+04	-2.77E+08
AS 18	2	9.525	143	5235	-0.0013	-260	-3.71E+04	-1.94E+08
HD12	1	12	113	5200	-0.0025	-500	-5.65E+04	-2.94E+08
AS 19	2	9.525	143	5540	-0.0013	-260	-3.71E+04	-2.05E+08
HD12	1	12	113	5500	-0.0025	-500	-5.65E+04	-3.11E+08
AS 20	2	9.525	143	5845	-0.0013	-260	-3.71E+04	-2.17E+08
HD12	1	12	113	5800	-0.0025	-500	-5.65E+04	-3.28E+08
AS 21	2	9.525	143	6150	-0.0013	-260	-3.71E+04	-2.28E+08
HD12	1	12	113	6100	-0.0025	-500	-5.65E+04	-3.45E+08
AS 22	2	9.525	143	6455	-0.0013	-260	-3.71E+04	-2.39E+08
HD12	1	12	113	6400	-0.0025	-500	-5.65E+04	-3.62E+08
AS 23	2	9.525	143	6760	-0.0013	-260	-3.71E+04	-2.50E+08
HD12	1	12	113	6700	-0.0025	-500	-5.65E+04	-3.79E+08
AS 24	2	9.525	143	7065	-0.0013	-260	-3.71E+04	-2.62E+08
HD12	1	12	113	7000	-0.0025	-500	-5.65E+04	-3.96E+08
AS 25	2	9.525	143	7370	-0.0013	-260	-3.71E+04	-2.73E+08
HD12	1	12	113	7300	-0.0025	-500	-5.65E+04	-4.13E+08
AS 26	2	9.525	143	7675	-0.0013	-260	-3.71E+04	-2.84E+08
HD12	1	12	113	7600	-0.0025	-500	-5.65E+04	-4.30E+08
AS 27	2	9.525	143	7980	-0.0013	-260	-3.71E+04	-2.96E+08
HD12	1	12	113	7900	-0.0025	-500	-5.65E+04	-4.47E+08
AS 28	2	9.525	143	8285	-0.0013	-260	-3.71E+04	-3.07E+08
HD12	1	12	113	8200	-0.0025	-500	-5.65E+04	-4.64E+08
AS 29	2	9.525	143	8590	-0.0013	-260	-3.71E+04	-3.18E+08
HD12	1	12	113	8500	-0.0025	-500	-5.65E+04	-4.81E+08
AS 30	2	9.525	143	8895	-0.0013	-260	-3.71E+04	-3.30E+08
HD12	1	12	113	8800	-0.0025	-500	-5.65E+04	-4.98E+08
AS 31	2	15.875	396	8999	-0.0013	-260	-1.03E+05	-9.26E+08
						Steel	-2.60E+06	-1.34E+10
						Concrete	2.79E+06	5.04E+08
						Axial load	-1.90E+05	-8.60E+08

MB4H

Probable Strength of Concrete Wall

Job Name:	**Block A, Sacred Heart College**	**Job No.**	40249
	65 Laings Road, Lower Hutt	**Engineer**	GV
Wall:	**Wall 4 - 2.591m Strengthened (HD16-300 Vert; HD12-150 Horiz)**	**Date**	23/02/2016

M* =	**13860 kN-m**	**M_{prob} =**	**9245 kN-m**	**67 %NBS**
V* =	**2949 kN**	**V_{pob} =**	**1370 kN**	**46 %NBS**
N* =	**273 kN**		**3323 kN**	(for wall outside PPHZ)
	Note: Use negative N* for uplift load	Check internal force equilibrium=		0 OK

Input parameters for flexural strengh calculation

Effective wall thickness for flexural	**B =**	203 mm
Total wall length	**L_w =**	10058 mm
Expected compressive strength	**f'_c =**	30 MPa
Expected tensile strength of reinforcement	**f_y =**	260 MPa
Concrete compression strain	**ε_c**	0.004
Steel reinforcement yield strain	**ε_{sy}**	0.0013
Expected axial load on wall	**N* =**	273 kN
Neutral axis depth	**N.A =**	460 mm
Equivalent stress block depth	**α =**	391 mm
Axial load stress	**$\sigma_{c\ axial}$ =**	0.13 MPa
Young's modulus of concrete	**E_c =**	25084 MPa
Section curvature	**ψ =**	8.69E-06

Input parameters for shear strength calculation

Effective wall shear thickness	**t_{wall} =**	203 mm
Gross area of wall	**A_g =**	2041774 mm^2
wall shear reinforcement diameter	**Φ =**	9.525 mm
Area of a single shear reinforcement	**A_v =**	71 mm^2
Yield strength of shear reinforcement	**f_{yt} =**	260 MPa
Number reinforcement layer	**n =**	2 Layer(s)
Horizontal shear reinforcement spacing c/c	**S_2 =**	305 mm

0.0040

Steel Layer	N°	D	A	d'	εy	σ	F	M
AS 1	2	15.875	396	50	0.0013	260	1.03E+05	5.15E+06
HD16	1	16	201	75	0.0025	500	1.01E+05	7.54E+06
AS 2	2	9.525	143	355	0.0009	182	2.59E+04	9.20E+06
HD16	1	16	201	349	0.0019	385	7.73E+04	2.70E+07
AS 3	2	9.525	143	660	-0.0013	-260	-3.71E+04	-2.45E+07
HD16	1	16	201	623	-0.0025	-500	-1.01E+05	-6.26E+07
AS 4	2	9.525	143	965	-0.0013	-260	-3.71E+04	-3.58E+07
HD16	1	16	201	897	-0.0025	-500	-1.01E+05	-9.02E+07
AS 5	2	9.525	143	1270	-0.0013	-260	-3.71E+04	-4.71E+07
HD16	1	16	201	1171	-0.0025	-500	-1.01E+05	-1.18E+08
AS 6	2	9.525	143	1575	-0.0013	-260	-3.71E+04	-5.84E+07
HD16	1	16	201	1445	-0.0025	-500	-1.01E+05	-1.45E+08
AS 7	2	9.525	143	1880	-0.0013	-260	-3.71E+04	-6.97E+07
HD16	1	16	201	1719	-0.0025	-500	-1.01E+05	-1.73E+08
AS 8	2	9.525	143	2185	-0.0013	-260	-3.71E+04	-8.10E+07
HD16	1	16	201	1993	-0.0025	-500	-1.01E+05	-2.00E+08
AS 9	2	9.525	143	2490	-0.0013	-260	-3.71E+04	-9.23E+07
HD16	1	16	201	2267	-0.0025	-500	-1.01E+05	-2.28E+08
AS 10	2	9.525	143	2795	-0.0013	-260	-3.71E+04	-1.04E+08
HD16	1	16	201	2541	-0.0025	-500	-1.01E+05	-2.55E+08
AS 11	2	9.525	143	3100	-0.0013	-260	-3.71E+04	-1.15E+08
AS 12	2	9.525	143	3405	-0.0013	-260	-3.71E+04	-1.26E+08
AS 13	2	9.525	143	3710	-0.0013	-260	-3.71E+04	-1.37E+08
AS 14	2	9.525	143	4015	-0.0013	-260	-3.71E+04	-1.49E+08

MB4I

AS 15	2	9.525	143	4320	-0.0013	-260	-3.71E+04	-1.60E+08
AS 16	2	9.525	143	4625	-0.0013	-260	-3.71E+04	-1.71E+08
AS 17	2	9.525	143	4930	-0.0013	-260	-3.71E+04	-1.83E+08
AS 18	2	9.525	143	5235	-0.0013	-260	-3.71E+04	-1.94E+08
AS 19	2	9.525	143	5540	-0.0013	-260	-3.71E+04	-2.05E+08
AS 20	2	9.525	143	5845	-0.0013	-260	-3.71E+04	-2.17E+08
AS 21	2	9.525	143	6150	-0.0013	-260	-3.71E+04	-2.28E+08
AS 22	2	9.525	143	6455	-0.0013	-260	-3.71E+04	-2.39E+08
AS 23	2	9.525	143	6760	-0.0013	-260	-3.71E+04	-2.50E+08
AS 24	2	9.525	143	7065	-0.0013	-260	-3.71E+04	-2.62E+08
AS 25	2	9.525	143	7370	-0.0013	-260	-3.71E+04	-2.73E+08
AS 26	2	9.525	143	7675	-0.0013	-260	-3.71E+04	-2.84E+08
AS 27	2	9.525	143	7980	-0.0013	-260	-3.71E+04	-2.96E+08
AS 28	2	9.525	143	8285	-0.0013	-260	-3.71E+04	-3.07E+08
AS 29	2	9.525	143	8590	-0.0013	-260	-3.71E+04	-3.18E+08
AS 30	2	9.525	143	8895	-0.0013	-260	-3.71E+04	-3.30E+08
AS 31	2	9.525	143	9200	-0.0013	-260	-3.71E+04	-3.41E+08
AS 32	2	9.525	143	9505	-0.0013	-260	-3.71E+04	-3.52E+08
AS 33	2	9.525	143	9810	-0.0013	-260	-3.71E+04	-3.63E+08
AS 30	2	15.875	396	10008	-0.0013	-260	-1.03E+05	-1.03E+09
						Steel	-1.75E+06	-8.27E+09
						Concrete	2.02E+06	3.95E+08
						Axial load	-2.73E+05	-1.37E+09

MB4J

Probable Strength of Concrete Wall

Job Name:	Block A, Sacred Heart College	Job No.	40249
	65 Laings Road, Lower Hutt	Engineer	GV
Wall:	Wall 9 - Strengthened (2-HD16 each end)	Date	23/02/2016

M* =	10548 kN-m	M_{prob} =	8094 kN-m	77 %NBS
V* =	1695 kN	V_{pob} =	1193 kN	70 %NBS
N* =	240 kN		2803 kN	(for wall outside PPHZ)
	Note: Use negative N* for uplift load	Check internal force equilibrium=		0 OK

Input parameters for flexural strengh calculation

Effective wall thickness for flexural	B =	190 mm
Total wall length	L_w =	8839 mm
Expected compressive strength	f'_c =	30 MPa
Expected tensile strength of reinforcement	f_y =	260 MPa
Concrete compression strain	ε_c	0.004
Steel reinforcement yield strain	ε_{sy}	0.0013
Expected axial load on wall	N* =	240 kN
Neutral axis depth	N.A =	351 mm
Equivalent stress block depth	α =	298 mm
Axial load stress	$\sigma_{c\ axial}$ =	0.14 MPa
Young's modulus of concrete	E_c =	25084 MPa
Section curvature	ψ =	1.14E-05

Input parameters for shear strength calculation

Effective wall shear thickness	t_{wall} =	190 mm
Gross area of wall	A_g =	1679410 mm^2
wall shear reinforcement diameter	Φ =	9.525 mm
Area of a single shear reinforcement	A_v =	71 mm^2
Yield strength of shear reinforcement	f_{yt} =	260 MPa
Number reinforcement layer	n =	2 Layer(s)
Horizontal shear reinforcement spacing c/c	S_2 =	305 mm

Steel Layer	N°	D	A	d'	εy	σ	F	M (0.0040)
AS 1	2	15.875	396	50	0.0013	260	1.03E+05	5.15E+06
AS 2	2	9.525	143	355	0.0000	-9	-1.24E+03	-4.40E+05
HD16	2	16	402	355	0.0000	-9	-3.50E+03	-1.24E+06
AS 3	2	9.525	143	660	-0.0013	-260	-3.71E+04	-2.45E+07
AS 4	2	9.525	143	965	-0.0013	-260	-3.71E+04	-3.58E+07
AS 5	2	9.525	143	1270	-0.0013	-260	-3.71E+04	-4.71E+07
AS 6	2	9.525	143	1575	-0.0013	-260	-3.71E+04	-5.84E+07
AS 7	2	9.525	143	1880	-0.0013	-260	-3.71E+04	-6.97E+07
AS 8	2	9.525	143	2185	-0.0013	-260	-3.71E+04	-8.10E+07
AS 9	2	9.525	143	2490	-0.0013	-260	-3.71E+04	-9.23E+07
AS 10	2	9.525	143	2795	-0.0013	-260	-3.71E+04	-1.04E+08
AS 11	2	9.525	143	3100	-0.0013	-260	-3.71E+04	-1.15E+08
AS 12	2	9.525	143	3405	-0.0013	-260	-3.71E+04	-1.26E+08
AS 13	2	9.525	143	3710	-0.0013	-260	-3.71E+04	-1.37E+08
AS 14	2	9.525	143	4015	-0.0013	-260	-3.71E+04	-1.49E+08
AS 15	2	9.525	143	4320	-0.0013	-260	-3.71E+04	-1.60E+08
AS 16	2	9.525	143	4625	-0.0013	-260	-3.71E+04	-1.71E+08
AS 17	2	9.525	143	4930	-0.0013	-260	-3.71E+04	-1.83E+08
AS 18	2	9.525	143	5235	-0.0013	-260	-3.71E+04	-1.94E+08
AS 19	2	9.525	143	5540	-0.0013	-260	-3.71E+04	-2.05E+08
AS 20	2	9.525	143	5845	-0.0013	-260	-3.71E+04	-2.17E+08
AS 21	2	9.525	143	6150	-0.0013	-260	-3.71E+04	-2.28E+08
AS 22	2	9.525	143	6455	-0.0013	-260	-3.71E+04	-2.39E+08
AS 23	2	9.525	143	6760	-0.0013	-260	-3.71E+04	-2.50E+08

MB4K

AS 24	2	9.525	143	7065	-0.0013	-260	-3.71E+04	-2.62E+08
AS 25	2	9.525	143	7370	-0.0013	-260	-3.71E+04	-2.73E+08
AS 26	2	9.525	143	7675	-0.0013	-260	-3.71E+04	-2.84E+08
AS 27	2	9.525	143	7980	-0.0013	-260	-3.71E+04	-2.96E+08
AS 28	2	9.525	143	8285	-0.0013	-260	-3.71E+04	-3.07E+08
HD16	1	16	201	8511	-0.0025	-500	-1.01E+05	-8.56E+08
AS 29	2	9.525	143	8590	-0.0013	-260	-3.71E+04	-3.18E+08
HD16	1	16	201	8611	-0.0025	-500	-1.01E+05	-8.66E+08
AS 30	2	15.875	396	8789	-0.0013	-260	-1.03E+05	-9.05E+08
						Steel	-1.21E+06	-7.25E+09
						Concrete	1.45E+06	2.16E+08
						Axial load	-2.40E+05	-1.06E+09

F14-06/02

Date	Eng.	Job No.	Sheet No.
3 MAR 2016	GN	40249	MB4L

Project: SACRED HEART BLOCK A

CALCULATIONS

CHECK UPLIFT FORCES ON STRENGTHENED WALLS:

WALL ID	M_{OT} (67% NDS) (kNm)	LEVER ARM (m)	UPLIFT (kN)	0.9G (kN)	NET UPLIFT (kN)	ISCHEBECK ANCHOR TYPE
C	1,367	3.21	426	37	389	1-40/16
2	1,480	3.54	418	35	383	1-40/16
2A	1,993	4.03	495	40	455	1-40/16
9	7,067	8.34	847	120	727	1-52/26

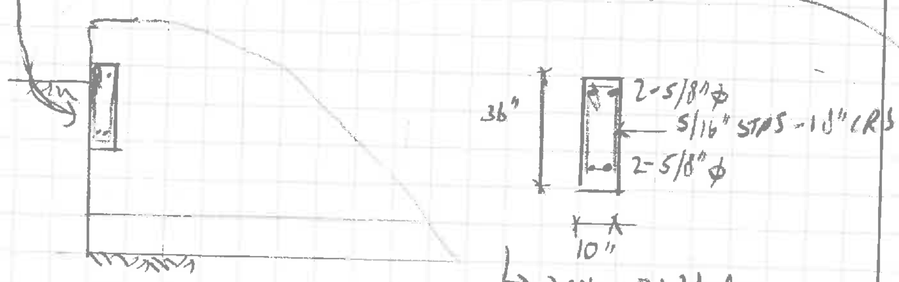
CHECK COMPRESSION FORCES ON STRENGTHENED WALLS:

WALL ID	Σ(C+0.9G) (kN)	A REQ'D* (m²)	PAD SIZE ADOPTED (m x m)
C	463	4.63	2.2x2.2***
2	453	4.53	2.2x2.2
2A	535	5.35	2.3x2.3
9	967	9.67**	NIL

*** WEST END ONLY AS WALL 9 FOOTING PROVIDES ADEQUATE AREA.

* ASSUMING ϕ dependable = 100kPa

** A = EXISTING PERIMETER FOOTING AT NORTH END AND EXISTING FOOTING UNDER WALL



$\hookrightarrow \phi M_b = 71.2$kNm

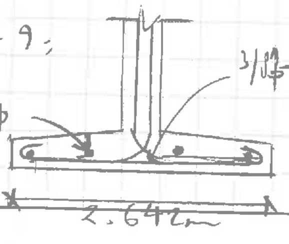
$\rightarrow$ MAX $L = \sqrt{\frac{71.2 \times 8}{100 \times 0.254}} = 4.74$m

$\Rightarrow$ TOTAL AREA PROVIDED (EXISTING)

$= 7.39 \times 2.642 + 4.74 \times 0.305 = 20.97m^2 > 9.67m^2$

∴ NO ADDITIONAL PADS REQ'D.

WALL 9:



$\rightarrow \phi M_b$ (LONG.) $= 35.7$kNm $\rightarrow$ MAX $L = \sqrt{\frac{264.2 \times 8}{35.7}} = 7.7$m

$\rightarrow \phi M_b = 32.5$kNm $\rightarrow$ MAX $L = \sqrt{\frac{32.5 \times 2}{35.1}} = 1.36m > 1.13m$ — FULL FOOTING WIDTH

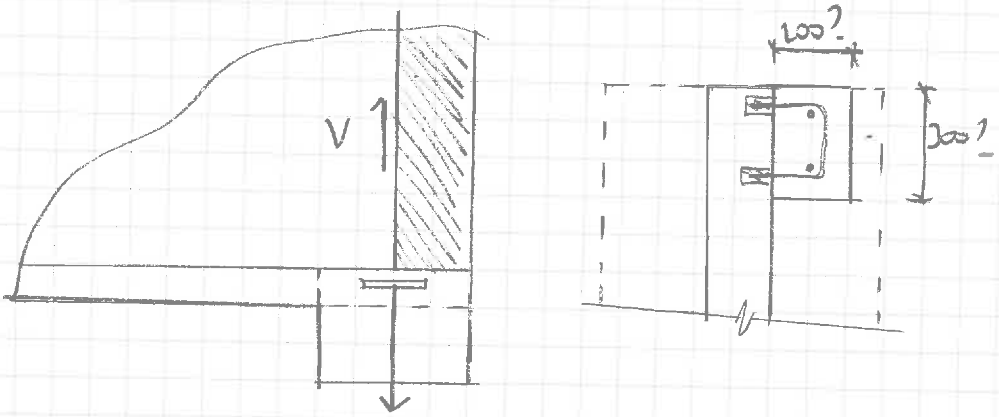
F14-06/02

Date 7 - MAR 2016	Eng. GW	Job No. 40249	Sheet No. MB4 M

Project
SACRED HEART BLOCK A

CALCULATIONS

LOAD TRANSFER (UPLIFT) INTO ANCHOR:



(1) GET LOADS INTO FLANGE:

WALL ID	NET UPLIFT (kN)	H (m)	V* (kN/m)	Avf REQ'D* (mm²/m)	Avf (2N12-150c/c) mm²/m
C	389	6.223	62.51		
2	383	4.7	81.49		
2A	455	4.7	96.81		
9	727	6.223	116.82 ◀ GOVERNS	312	1507 — OK

* SURFACE ROUGHENED TO 2mm AMPLITUDE

→ CAN GET LOAD INTO FLANGE.

(2) CHECK FLANGE CRUSHING IN COMPRESSION:

→ $\frac{727kN}{0.3(0.2)} = 12.12MPa$ — OK ($f_{cu} = \alpha_1 \beta f'_c = 0.85 \times 0.75 \times 30 = 19.13MPa$)

(3) CHECK LOAD TRANSFERRED FROM FLANGE INTO FOOTING:

WALL ID	NET UPLIFT (kN)	A_s REQ'D (500MPa) (mm²)	STARTERS REQ'D
C	389	864	4-HD20
2	383	851	4-HD20
2A	455	1,011	4-HD20
9	727	1,616	4-HD25

(CHECK As max FOR 200x200 ≤ 0.08 x 300 x 200 = 4800mm² — OK)

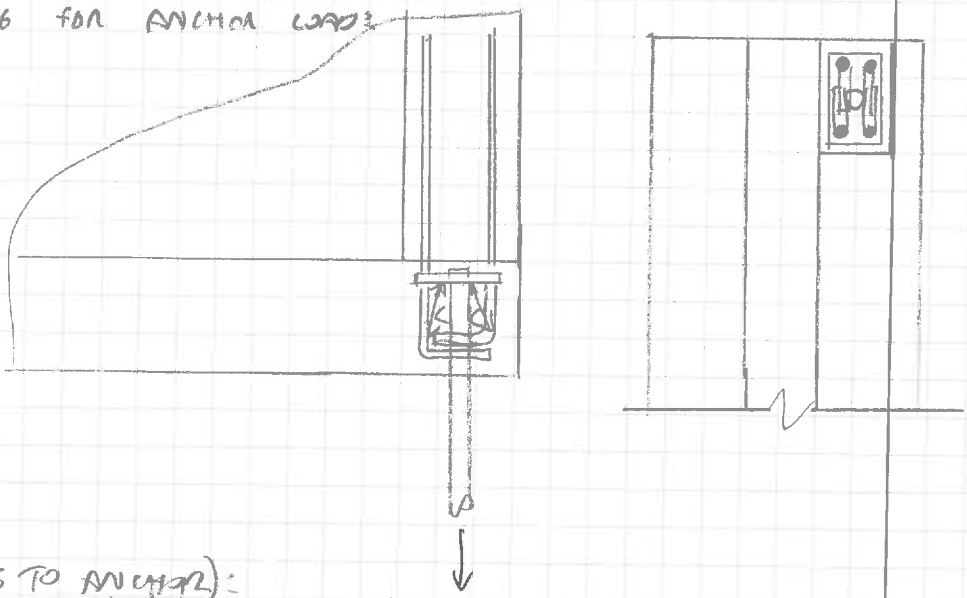
F14-06/02

Date	Eng.	Job No.	Sheet No.
7 - MAR 2016	GW	40249	MB4N

Project: SACRED HEART BLOCK A

CALCULATIONS

(4) STRUT-a-TIE FOR ANCHOR LOADS



WELD (PLATE TO ANCHOR):

$\frac{727kN}{\pi(52)} = \frac{4.45kN/mm}{2 SIDES} = 2.23kN/mm$ EACH SIDE → MAX IS 1.96kN/mm FOR 12FWAR

∴ NEED LARGER ANCHOR → USING 73/53 → $\left[\frac{727}{\pi(73)}\right]/2 = 1.59kN/mm$ → 12FWAR

FOR 40/16 ANCHORS:

$\left[\frac{455}{\pi(40)}\right]/2 = 1.81 kN/mm$ → 12FWAR OK

COMPRESSION STRUT:

$f_{cn} = \alpha_1 \beta_n f'_c$

$= 0.85 \times 0.6 \times 30MPa = 15.3MPa$

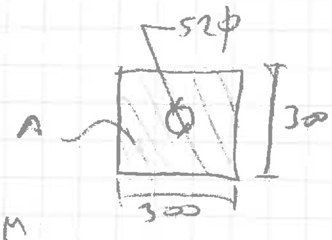
↑ NO SHEAR STEEL

→ A_c REQD $= \frac{727E3}{15.3(0.75)} = 63,355mm^2$ ≡ 300x300 PLATE (90,000mm²)

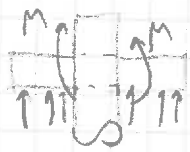
PRESSURE ON PLATE:

$= \frac{727E3}{300^2 - \frac{52^2 \times \pi}{4}} = 8,273$ kPa

A



→ FLEXURE IN PLATE



$M^* = \left[8273 \times 0.3m \times \frac{0.10^2}{2}\right]/2 = 6.20kNm \leq \phi M_b = \phi f_y \frac{bd^2}{6}$

↑ 2-WAY BENDING

F14-06/02

Date 22 MAR 2016	Eng. GW	Job No. 40249	Sheet No. MB40

CALCULATIONS

Project

SACRED HEART BLOCK A

→ d req'd $\geq \sqrt{\dfrac{M^* \times 6}{\phi f_y b}} = \sqrt{\dfrac{6.205E6 \times 6}{0.9(300)(300)}} = 21.4mm$ → 30mm PLATE

300x300x30 PL

F14-06/02

Date 6 JAN 2016	Eng. GW	Job No. 40249	Sheet No. MBS

Project

SACRED HEART BLOCK A

CALCULATIONS

FLOOR TO WALL CONNECTIONS:

1. WALLS A & B

V_{EU} = 4850 kN (WALL A WORST CASE - APPLY TO BOTH)

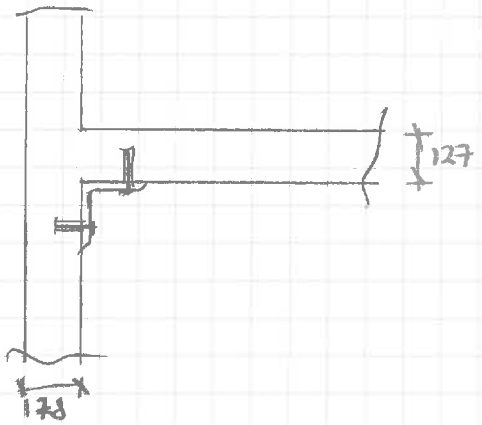
EXISTING $\phi V_n = \phi(A_v f_y + N^*)\mu$; μ = 1.4λ for λ = 1.0

= 1.0(2,600(260))1.4

ϕV_n = 946 kN

∴ REQUIRE ADDITIONAL 4,850 × 0.67 − 946 = 2,303 kN

USING STEEL ANGLE & BOLTS:



WALL TO FLOOR CONNECTION IS 6.87m LONG

ALLOWING FOR 50mm END DISTANCE EACH END, AND

ϕV_{ur} (M12 CHEMSET, 90 EMBEDMENT) = 33.5 kN

NEED $\frac{2303}{33.5}$ = 68.8 → 69 ANCHORS ≡ M12 - 100 CRS CHEMSET ANCHORS (6.8-8, 90 EMBEDMENT)

2. WALLS 3 & 4 (WALL 4 WORST CASE)

V_{EU} = 2,949 kN

EXISTING ϕV_n = 1.0(4,703)(260)(1.4) = 1,712 kN

→ REQUIRE ADDITIONAL 2,949 × 0.67 − 1,712 = $\frac{264 \text{ kN}}{33.5}$ = 8 - M12 CHEMSETS

→ M12 CHEMSETS @ 1.0m CRS (6.8, 90 EMBEDMENT)

MB5a

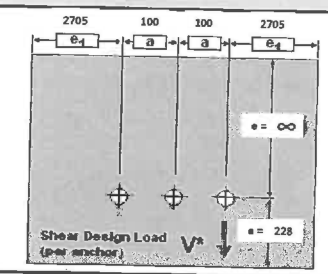
Chemical Anchoring - ChemSet Anchor Stud Design Calculator

Ramset™ Non-Cracked Concrete - Epcon™ C6 | EPCON C6 | EPCON C6

Anchor Type: Threaded Rod - Gr 8.8 **Anchor Size** d_b = M 12

Input Description (Strength Limit State Design)	Input Data (per anchor)		
1. Number of anchors (n)	n =	1	-
2. Anchor Spacing (a)	a =	100	mm
3. Concrete Edge Distance (e)	e =	228	mm
4. Concrete Cylinder Strength (f'c)	f'c =	30	MPa
5. Seismic Crack (S_{cr}) or Non-Cracked (N)	S_{cr} or N	N	-
6. Effective Depth (h>6xdh)	h =	90	mm
7. Anchor Stud size (d_b) - M8 → M24	d_b =	12	mm
8. Concrete Edge Distance Corner (e1)	e_1 =	2705	mm
9. Internal to a row (I) or end of row (E)	I or E	E	row
10. Dry Hole (D) or Wet hole (W)	D or W	D	-
11. Min Concrete Sub'te Thickness (b_m)	b_m =	118	mm
12. Anchor Stud Grade (5.8, 8.8, 316 SS)	Grade =	8.8	Gr
13. Fixture Thickness (t)	t =	8	mm
14. Effective Length (L_e)	L_e =	98	mm
15. Design Tensile Load-per anchor (N*)	N* =	0	kN
16. Design Shear Load-per anchor (V*)	V* =	0	kN
17. Direction of Shear design load (α)	α =	0	°
18. Service Temperature (°C)	-40°C to	+45°C	-

Plan View - Generic (Dimensions in (mm))



Project Details	
Project Name:-	Walls A & B to Floor Connection
Project Site Address:-	Sacred Heart Block A
Company Name:-	Certa Engineering Ltd
Design Identification:-	40249, GV
Date:-	23/02/2016

ChemSet™ Anchor Stud "Specification"

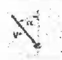
Typ Gr 8.8 Thr'd Rod M12 x 118 mm long

Epcon™ C6 Series "Specification"

C6-18

Hole Diameters (mm)	Capacity Reduction Factors
Drill d_h = 14	Conc. Tension/Shear ϕ = 0.6
Fixture d_f = 15	Steel Tension/Shear ϕ = 0.8

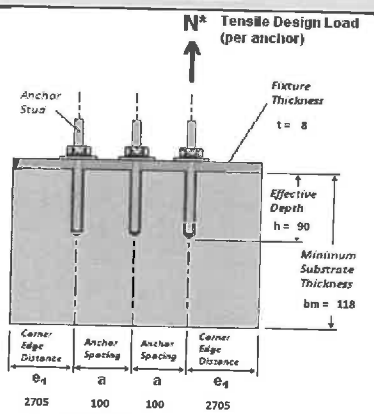
Direction of Shear Design Load - α



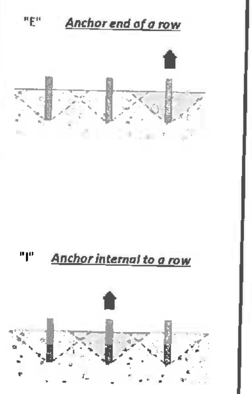
α = 0° - towards edge
α = 180° - away from edge

Output Description (Strength Limit State Design)	Output Data (per anchor)		
DESIGN O.K.	MIN. CRITERIA for a,e & h - O.K.		
Des. Red. Ult. CONC. Tensile Capacity	ϕN_{urc} =	24.3	kN
Red. Char. Ult. STEEL Tensile Capacity	ϕN_{us} =	54.0	kN
Des. Red. Ult. CONC. Shear Capacity	ϕV_{urc} =	51.6	kN
Red. Char. Ult. STEEL Shear Capacity	ϕV_{us} =	33.5	kN
Drill hole diameter	d_h =	14	mm
TENSION O.K.			
Design Red. Ult. Tensile Capacity	ϕN_{ur} =	24.3	kN
Tension Design Check	$N^*/\phi N_{ur}$ =	0.00	< 1
SHEAR O.K.			
Design Red. Ult. Shear Capacity	ϕV_{ur} =	33.5	kN
Shear Design Check	$V^*/\phi V_{ur}$ =	0.00	< 1
COMBINED TENSION SHEAR O.K.			
Combined Check - $N^*/\phi N_{ur} + V^*/\phi V_{ur}$ =		0.00	< 1.2

Elevation View - Generic (Dimensions in (mm))



Anchor Loaded



Anchor Size	d_b	Metric	8	10	12	16	20	24	30	36
Drill hole diameter	d_h	(mm)	10	12	14	18	24	26	N/A	N/A
Stressed Area	A_b	(mm²)	37	58	84	157	245	353	N/A	N/A
Anchor Stud Yield Strength	f_y	(MPa)	640	640	640	640	640	640	N/A	N/A
Red.Char. Ult. Steel Tensile Capacity	ϕN_{us}	(kN)	23.4	37.1	54.0	100.5	156.8	225.9	N/A	N/A
Red.Char. Ult. Steel Shear capacity	ϕV_{us}	(kN)	14.5	23.0	33.5	62.3	97.2	140.1	N/A	N/A
Edge distance for no conc.cone reduction	e_c	(mm)	35	40	50	65	80	100	N/A	N/A
Anchor spacing for no conc.cone reduction	a_c	(mm)	50	60	75	100	120	145	N/A	N/A
Absolute Minimum edge dist. & anc'r spac.	e_m & a_m	(mm)	25	30	35	50	60	75	N/A	N/A

Effective Depth - h		Design Reduced Ultimate tensile capacity ϕN_{ur} (kN per anchor) Based on edge distance (e_c) and anchor spacing (a_c) for no conc.cone reduction							
60	(mm)	11.2							
65	(mm)	12.7							
70	(mm)	14.1	15.5						
80	(mm)	17.3	18.9						
90	(mm)	20.6	22.6	24.3					
100	(mm)	23.4	26.4	28.4					
110	(mm)	23.4	30.5	32.8	36.8				
125	(mm)	23.4	36.9	39.7	44.6				
140	(mm)	23.4	37.1	47.1	52.8				
150	(mm)	23.4	37.1	52.2	58.6	64.1			
160	(mm)	23.4	37.1	54.0	64.5	70.6	75.9		
170	(mm)	23.4	37.1	54.0	70.7	77.3	83.2		
180	(mm)	23.4	37.1	54.0	77.0	84.2	90.6		
190	(mm)	23.4	37.1	54.0	83.5	91.3	98.3	N/A	
220	(mm)	23.4	37.1	54.0	100.5	113.8	122.4	N/A	
240	(mm)	23.4	37.1	54.0	100.5	129.7	139.5	N/A	N/A
270	(mm)	23.4	37.1	54.0	100.5	154.7	166.4	N/A	N/A
330	(mm)	23.4	37.1	54.0	100.5	156.8	224.9	N/A	N/A
350	(mm)	23.4	37.1	54.0	100.5	156.8	225.9	N/A	N/A

The design engineer should ensure the structural element is capable of supporting these loads. Refer to Ramset™ Specifiers Anchoring Resource Book ANZ for more information or explanation of Tech. Data.

F14-06/02

Date	Eng.	Job No.	Sheet No.
6 JAN 2016	GV	40249	MB 6

Project

SACRED HEART BLOCK A

CALCULATIONS

LOAD TRANSFER THROUGH FLOOR TO WALL B

V_{EU} = 2584 kN

FROM DSA HAVE 891 kN EXISTING CAPACITY (34% NBS)

NEED AN ADDITIONAL 2,584x0.67 − 891 = 840 kN

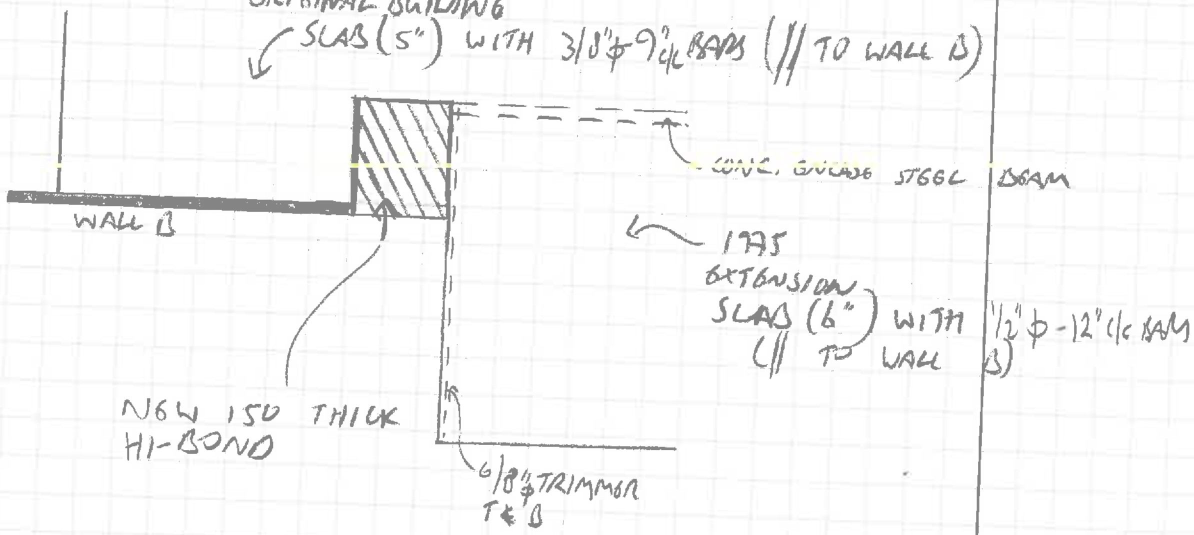
EXTENDING SLAB INTO PREFECTS WING STAIRWELL (LANDING ONLY)

PROVIDES ADDITIONAL 1.4m WIDTH OF CONCRETE

↳ 3/8"ϕ BARS @ 9" CRS → CAN USE ADDITIONAL 6 BARS

→ ϕN_6 = 6x18.53 = 111 kN − NG.

→ EXTEND SLAB FULL WIDTH TO WALL B:
(REQUIRES RELOCATING PREFECTS WING STAIRS)



→ THIS ALLOWS LOAD TO BE TRANSFERRED DIRECTLY TO WALL B.

(MINIMUM STEEL = 0.0014(150)(1000) = 210mm²/m ≡ HD12-500CRS

→ USE HD12-200CRS EACH WAY (DRILL & EPOXY STARTERS 200 INTO EXISTING SLABS/WALL)

3 MAR 2016

J40249 MB6A

3.3.4.1 HIBOND FORMWORK TABLES *continued*

0.75mm HIBOND FORMWORK SPAN CAPABILITIES

D_s mm	Slab Weight kPa	Concrete Quantity m^3/m^2	Maximum Span (L) mm Single Allow.	Single 5mm limit	Double or End Allow.	Double or End 5mm limit	Internal Allow.	Internal 5mm limit
110	2.03	0.0825	2500	2050	2800	2450	3150	2950
120	2.26	0.0925	2500	2000	2800	2350	3050	2850
130	2.50	0.1025	2500	1950	2750	2300	2900	2800
140	2.74	0.1125	2500	1900	2650	2250	2750	2700
→ 150	2.97	0.1225	2400	1900	2550	2200	2600	2600
160	3.21	0.1325	2350	1850	2450	2150	2500	2500
170	3.44	0.1425	2300	1800	2350	2150	2400	2400
180	3.68	0.1525	2250	1800	2250	2100	2300	2300
190	3.91	0.1625	2200	1750	2150	2050	2250	2250
200	4.15	0.1725	2150	1750	2100	2050	2150	2150
210	4.38	0.1825	2150	1700	2000	2000	2100	2100
220	4.62	0.1925	2100	1700	1950	1950	2000	2000
230	4.85	0.2025	2050	1650	1900	1900	1950	1950
240	5.09	0.2125	2000	1650	1850	1850	1900	1900
250	5.32	0.2225	2000	1600	1800	1800	1850	1850
260	5.56	0.2325	1950	1600	1750	1750	1800	1800
270	5.79	0.2425	1900	1600	1700	1700	1750	1750
280	6.03	0.2525	1900	1550	1650	1650	1700	1700
290	6.26	0.2625	1850	1550	1600	1600	1650	1650
300	6.50	0.2725	1850	1550	1600	1600	1650	1650

→ 2400mm > 2325mm ∴ NO PROPPING REQUIRED

0.95mm HIBOND FORMWORK SPAN CAPABILITIES

D_s mm	Slab Weight kPa	Concrete Quantity m^3/m^2	Maximum Span (L) mm Single Allow.	Single 5mm limit	Double or End Allow.	Double or End 5mm limit	Internal Allow.	Internal 5mm limit
110	2.05	0.0825	2650	2200	2900	2500	3700	3050
120	2.29	0.0925	2650	2100	2850	2450	3650	2950
130	2.52	0.1025	2600	2050	2850	2400	3650	2850
140	2.76	0.1125	2600	2000	2850	2350	3650	2800
150	2.99	0.1225	2600	2000	2850	2300	3600	2750
160	3.23	0.1325	2500	1950	2800	2250	3500	2700
170	3.46	0.1425	2450	1900	2750	2200	3400	2650
180	3.70	0.1525	2400	1850	2700	2150	3300	2600
190	3.93	0.1625	2350	1850	2650	2150	3200	2550
200	4.17	0.1725	2300	1800	2600	2100	3100	2550
210	4.40	0.1825	2300	1800	2550	2100	3050	2500
220	4.64	0.1925	2250	1750	2500	2050	2950	2450
230	4.88	0.2025	2200	1750	2450	2000	2850	2450
240	5.11	0.2125	2150	1750	2400	2000	2800	2400
250	5.35	0.2225	2150	1700	2400	2000	2700	2400
260	5.58	0.2325	2100	1700	2350	1950	2650	2350
270	5.82	0.2425	2100	1650	2300	1950	2600	2350
280	6.05	0.2525	2050	1650	2300	1900	2500	2300
290	6.29	0.2625	2000	1650	2250	1900	2450	2300
300	6.52	0.2725	2000	1600	2250	1900	2400	2250

3 MAR 2016

J40249 M06B

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES continued

0.75mm HIBOND – SINGLE SPANS

Medium term superimposed loads (kPa)

1.5Q = 1.5(3.0kPa) = 4.5kPa – OK (NO SDL IN CORRIDOR)

L_{ss} mm	Slab thickness (D_s) mm 110	120	130	140	150	160	170	180	190	200
2000	16.2	19.6	21.0							
2200	13.3	16.1	17.2	19.3	21.4					
2400	11.2	13.5	14.3	16.0	17.7	19.5	21.4			
2600	9.5	11.4	12.1	13.5	14.9	16.4	17.9	19.4	20.8	
2800	8.2	9.8	10.4	11.5	12.7	13.9	15.1	16.3	17.5	18.8
3000	7.1	8.5	9.0	9.9	10.9	11.9	12.9	13.9	14.8	15.9
3200	6.2	7.4	7.8	8.6	9.4	10.3	11.1	11.9	12.7	13.6
3400	5.5	6.5	6.9	7.5	8.2	8.9	9.6	10.3	10.9	11.6
3600	4.9	5.8	6.1	6.6	7.2	7.8	8.4	8.9	9.5	10.1
3800	4.4	5.2	5.4	5.9	6.4	6.9	7.4	7.8	8.3	8.7
4000	4.0	4.7	4.8	5.3	5.7	6.1	6.5	6.9	7.2	7.6
4200	3.6	4.2	4.3	4.7	5.1	5.4	5.8	6.1	6.3	6.7
4400	2.9	3.8	3.9	4.2	4.5	4.8	5.1	5.4	5.6	5.8
4600	2.3	3.3	3.6	3.8	4.1	4.3	4.6	4.8	5.0	5.1
4800	1.8	2.6	3.2	3.5	3.7	3.9	4.1	4.3	4.4	4.5
5000		2.0	2.9	3.2	3.3	3.5	3.7	3.8	3.9	4.0
5200		1.6	2.3	2.9	3.0	3.2	3.3	3.4	3.5	3.6
5400			1.8	2.6	2.8	2.9	3.0	3.1	3.1	3.1
5600				2.1	2.5	2.6	2.7	2.7	2.8	2.8
5800				1.6	2.3	2.4	2.5	2.5	2.5	2.5
6000					1.8	2.2	2.2	2.2	2.2	2.2

0.75mm HIBOND – SINGLE SPANS

Long term superimposed loads (kPa)

L_{ss} mm	Slab thickness (D_s) mm 110	120	130	140	150	160	170	180	190	200
2000	16.2	19.6	21.0							
2200	13.3	16.1	17.2	19.3	21.4					
2400	11.2	13.5	14.3	16.0	17.7	19.5	21.4			
2600	9.5	11.4	12.1	13.5	14.9	16.4	17.9	19.4	20.8	
2800	8.2	9.8	10.4	11.5	12.7	13.9	15.1	16.3	17.5	18.8
3000	7.1	8.5	9.0	9.9	10.9	11.9	12.9	13.9	14.8	15.9
3200	6.2	7.4	7.8	8.6	9.4	10.3	11.1	11.9	12.7	13.6
3400	5.4	6.5	6.9	7.5	8.2	8.9	9.6	10.3	10.9	11.6
3600	4.3	5.7	6.1	6.6	7.2	7.8	8.4	8.9	9.5	10.1
3800	3.4	4.6	5.4	5.9	6.4	6.9	7.4	7.8	8.3	8.7
4000	2.6	3.6	4.8	5.3	5.7	6.1	6.5	6.9	7.2	7.6
4200	2.0	2.8	3.9	4.7	5.1	5.4	5.8	6.1	6.3	6.7
4400		2.2	3.1	4.2	4.5	4.8	5.1	5.4	5.6	5.8
4600		1.6	2.4	3.3	4.1	4.3	4.6	4.8	5.0	5.1
4800			1.8	2.6	3.5	3.9	4.1	4.3	4.4	4.5
5000				2.0	2.8	3.5	3.7	3.8	3.9	4.0
5200					2.1	2.9	3.3	3.4	3.5	3.6
5400					1.6	2.3	3.0	3.1	3.1	3.1
5600						1.7	2.4	2.7	2.8	2.8
5800							1.8	2.5	2.5	2.5
6000								2.0	2.2	2.2

F14-06/02

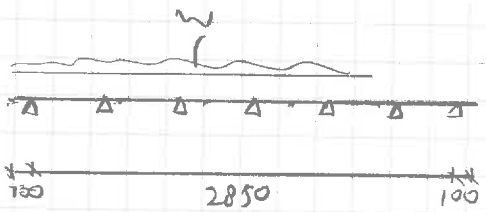
Date 3 MAR 2016	Eng. GW	Job No. 40249	Sheet No. MB6C

Project

SACRED HEART BLOCK A

CALCULATIONS

SIZE SHELF ANGLE TO SUPPORT HIBOND SLAB



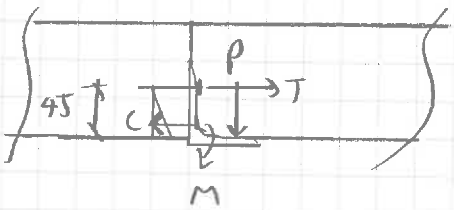
$W^* = 1.2G + 1.5Q = [1.2(2.91) + 1.5(3.0)] \times \frac{2.33m}{2} = 9.31 \text{ kN/m}$

ϕV_{urc} (M12 CHEMSET) = 4.5 kN → REQUIRE $\frac{9.31 \times 3.05}{4.5} = 6.3$ → 7 ANCHORS MINIMUM ≡ M12-475CRS CHEMSET ANCHORS

NOW, SHELF ANGLE:

$M^* = \frac{9.31 \times 0.475^2}{8} = 0.26 \text{ kNm}$ → 75×5 EA OK BY INSPECTION.

CHECK TENSION PULL-OUT ON ANCHORS:



$P^* = 9.31 \times 0.475m = 4.42$ kN/ANCHOR

$M^* = 4.42 \times 0.035m = 0.155 \text{ kNm}$

$T^* = \frac{0.155}{\frac{2}{3} 0.045} = 5.2 \text{ kN} < \phi N_{urc} = 31.4 \text{ kN}$ - OK

COMBINED ACTIONS $= \frac{5.2}{31.4} + \frac{4.42}{4.5} = 1.15 < 1.2$ - OK

F14-06/02

Date 21 DEC 2015	Eng. GN	Job No. 40249	Sheet No. MB7

CALCULATIONS

Project

SACRED HEART - BLOCK A

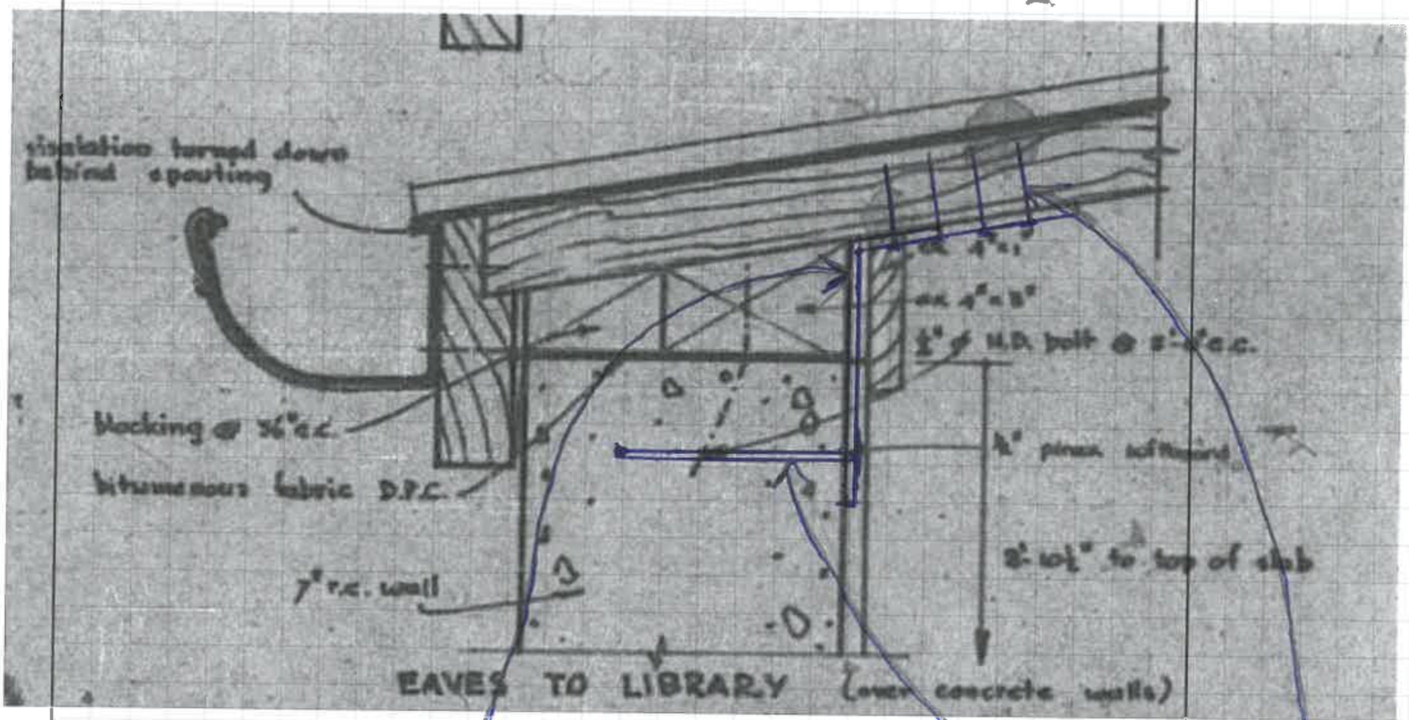
ROOF DIAPHRAGM TO CONCRETE WALL CONNECTION:

FROM DSA, SHEET 31, MAXIMUM LOAD RESISTANCE OF WALLS = 928kN

DIAPHRAGM TO WALL CONNECTION LENGTH = 7.07m

→ $\frac{928kN}{7.07m} = 131 kN/m$

TO ACHIEVE 67% NBS → 2993 x 67% = 2,005kN - 605kN = $\frac{1,400 kN}{2}$ = 700kN/WALL (TIMBER WALLS)



6mm CUSTOM ANGLE

178mm

CHOUST ANCHORS @ 200 CRS

4 ROWS SCREWS (8Gx40LG)

→ $\frac{700 kN}{7.07m}$ = 99.0 kN/m

1) ROOF TO ANGLE CONNECTION: (SARKING IS 50mm THICK)
- USE SCREWS - SAY 8GAUGEx40 SCREWS, ØQn = 0.8 (Ø) x 1.15 x 1.229kN (STEEL) = 1.229kN/SCREW

→ REQUIRE $\frac{99.0}{1.229}$ = 81 SCREWS/m @ 11.5mm CRS! - NG

→ TRY 3 ROWS @ 34mm CRS - BETTER BUT MINIMUM = 10da = 42mm CRS

→ TRY 4 ROWS @ 46mm CRS - OK

4 ROWS 8Gx40LG SCREWS @ 45mm CRS

F14-06/02

Date 21 DEC 2015	Eng. GW	Job No. 40249	Sheet No. MBS 8

Project

SACRED HEART - BLOCK A

CALCULATIONS

② ANGLE TO WALL CONNECTION:

USING M12 BOLT (CHEMSET ANCHOR, EPCON C6), ϕV_{urc} = 21.0kN/ANCHOR (EXCLUDING END BOLTS, THESE HAVE ϕV_{urc} = 5.3kN EACH)

→ 700 − 2×5.3 = $\frac{689.4 kN}{21.0 kN/ANCHOR}$ = 33 ANCHORS

→ 7,074 − 2×100 (END DISTANCE) = $\frac{6874 mm}{34}$ = 202 → 200mm c/s

M12-200 c/s CHEMSET ANCHORS, EPCON C6, 125mm EMBEDMENT

TRANSVERSE L1 WALLS UPGRADE

FROM DSA, SHEET 31, DEPENDABLE CAPACITY = 50kN + 1334kN = 1,384kN (46% NBS)

HOWEVER DEMAND WAS BASED ON μ=1.25

IN REALITY HAVE μ=3 IN TIMBER FRAMED WALLS:

→ 2,993 × $\frac{0.51}{1.26}$ = 1,211 kN < 1,384kN (100%NBS) − OK

NO FURTHER STRENGTHENING REQD @ L1

(BACK UP CHECK: CONSIDER L1 AS A PART @ FIRST FLOOR SLAB: μ_p=3 → C_{HTP} = 0.91

→ $\frac{0.91}{1.26}$ × 2,993kN = 2,162 kN > 1,384 kN (64%NBS)

F14-06/02

Date	Eng.	Job No.	Sheet No.
7 JAN 2016	GV	40249	M39

Project

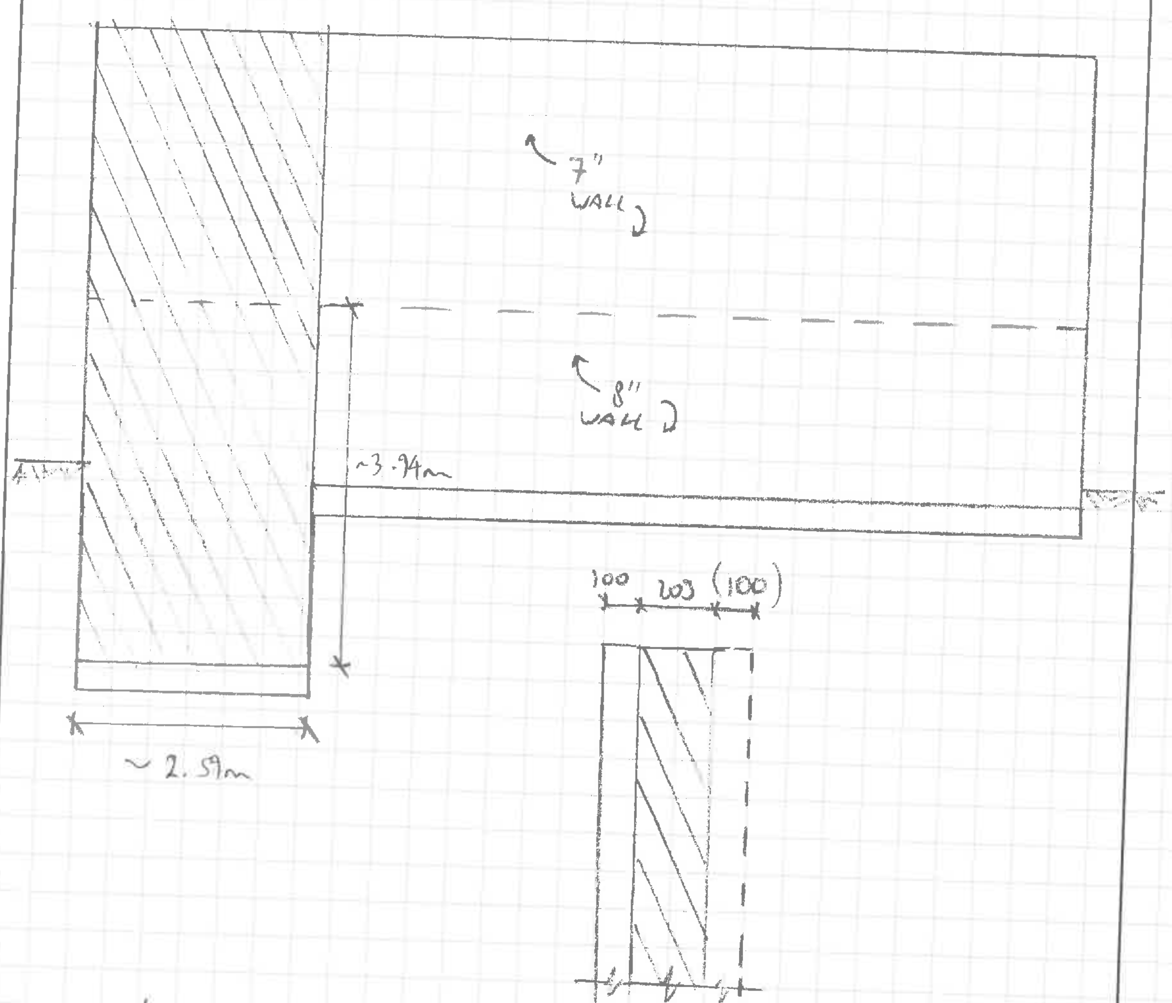
SACRED HEART BLOCK A

CALCULATIONS

WALL 4

- REQUIRE ADDITIONAL SHEAR & FLEXURAL CAPACITY

TRY INCREASING SHEAR CAPACITY FOR PORTION OF WALL ONLY:



$\phi V_n = \phi(V_c + V_s)$

$V_c = 0.17\left(\sqrt{f'_c} + \frac{N^*}{A_g}\right)A_{cv}$

$N^* = 23.5(0.1)(2.59)(3.94) = 24\,kN$

$A_g = 100 \times 2591 = 259100\,mm^2$

$A_{cv} = td = 100 \times 0.8 \times 2591 = 207280\,mm^2$

$\rightarrow V_c = 0.17\left(\sqrt{30} + \frac{23981}{259100}\right)(207280)$

$= 196\,kN$ (EACH SIDE).

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Date -7 JAN 2016	Eng. GV	Job No. 40249	Sheet No. MB10

Project

SACRED HEART BLOCK A

CALCULATIONS

$V_{s_1} = A_v f_{yt} \frac{d}{s_2}$ for H012-150

$= \frac{113(500)(0.8 \times 2591)}{150}$

$V_s = 781$ kN (EACH SIDE)

→ $\phi V_n = 0.75(196+781)$

$= 733$ kN (EACH SIDE)

→ $V_p = 1,614 + 733 = 2,347$ kN < 2,949 kN (80% NBS) - OK

FROM SHEET , $M_{PROB} = 9,245$ kNm < 13,860 kNm (67% NBS) - OK

F14-06/02

Date 23 DEC 2015	Eng. GV	Job No. 40249	Sheet No. MB11

Project: SACRED HEART – BLOCK A

CALCULATIONS

CHECK VENEER TO SOUTH WALL OF ORIGINAL BUILDING

- 4½" BRICK VENEER = 198kg/m² (REQUIRES EH TIES @ 600mm MAX (H) & 400mm MAX (V))

- SPECIFICATIONS SHOW No 8 SWG (4.064mm ϕ) TIES EVERY 4th COURSE & 5 TIES/SQUARE YARD
  ↳ AREA/TIE ≈ 0.305 x 0.394 = 0.12m²

USING $C_pT_p = 1.52$ ($h_i = 1.85m$, $h_n = 7.3m$, $\mu_p = 1.0$, $R_p = 1.0$, $T_p = 0.4s$)

$P_{en} = 1.52(17\ kN/m^3)(0.11m)(0.12m^2) = 0.35kN$

$\phi N_T = 1.0(260)(4.064^2)(\frac{\pi}{4}) = 3.37kN > P_{en}$ (100% NBS) – OK

BRICKWORKER

NOTE: General clauses shall be read where they apply to this trade.

1. BRICKS All bricks shall be of approved manufacture and conform to N.Z.S.S. No. 366 and shall be grade 'A' only. Submit samples for approval before proceeding with work, and samples shall exhibit multicolours in

2. which there shall be bricks in shades of orange, red, blue and purple. The approximate proportions shall be 80% red and orange with 20% of blues and purples or other approved colour mixed in by the Bricklayer to form a pleasant pattern.

2. MORTAR shall be composed of not less than 1 part of cement or cement-lime mixture to 3 parts sand, in no case shall the cement-lime mixture contain more than one third lime.

Lime shall be well mixed with the sand and water and allowed to stand for at least 48 hours before being used. Immediately before using gauge with cement. No mortar which has become set or dead shall be used.

3. WORKMANSHIP: Build the whole of the brickwork as shown on drawings. Fully flush all joints with mortar. Carry up in even heights with no part rising more than 3 ft. above adjoining work. Properly bend angles and intersections and keep all perpends true. Form all openings and chases necessary to accommodate ventilators flashings pipes etc. Well wet bricks before use.

4. JOINTS shall not exceed 3/8" in thickness of size Facing brickwork shall be weatherstruck as work proceeds.

5. WALL TIES: Secure brick veneer walls to the wall framing with No. 8 gauge galvanised iron wire ties to detail. Build in ties at every fourth course, at all angles, openings and ends of walls. Provide five ties to each square yard at intermediate points. Well bed ties into the brickwork, and secure to studs.

F14-06/02

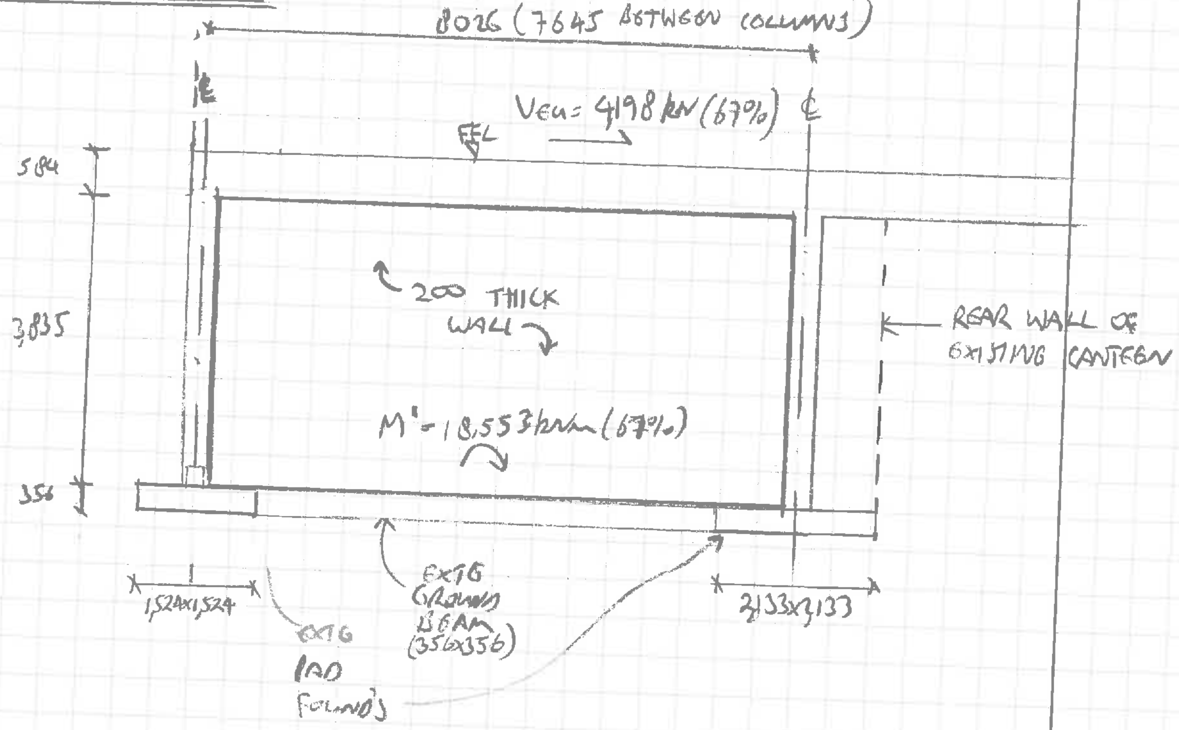
Date 11 JAN 2016	Eng. GV	Job No. 40249	Sheet No. MB 13

Project

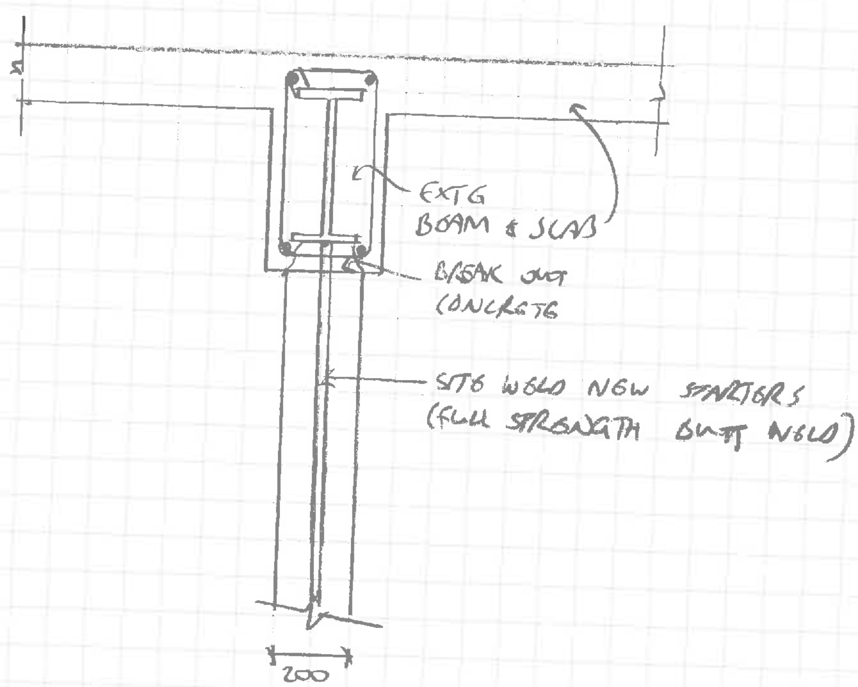
SACRED HEART BLOCK A

CALCULATIONS

NEW WALL:



1. LOAD INTO TOP OF WALL:



$V_{eu} = \frac{4,198 \text{ kN}}{7.65 \text{ m}} = 549 \text{ kN/m}$

→ A_{vf} REQ'D $= \left(\frac{4,198e3}{0.75(0.7)} - 0\right)(500) = 15992 \text{ mm}^2$ (HD16-100crs OR 2-HD16-200crs)

F14-06/02

Date 11 JAN 2016	Eng. GV	Job No. 40249	Sheet No. MB14

Project

SACRED HEART BLOCK A

CALCULATIONS

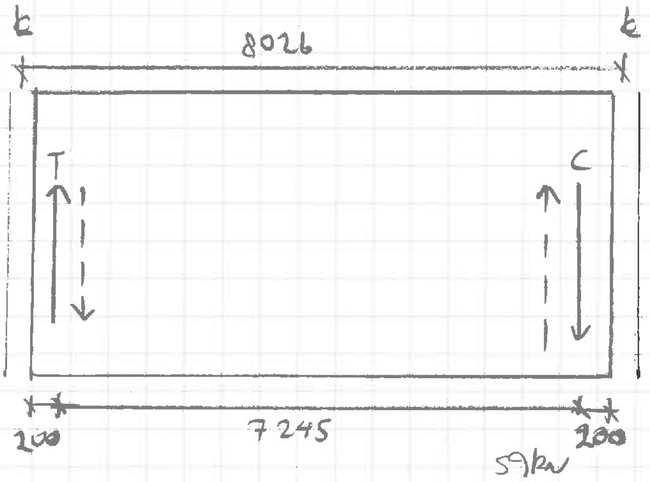
2. WALL FLEXURE & SHEAR

FROM SHEETS MB15 & MB16, USE 2/HD16 - 200 (V) & 2/HD16 - 125 (H)

3. LOAD TRANSFER FROM WALL TO FOUNDATIONS

a) BASE SHEAR: FROM SHEET MB16, 2/HD16-200 STARTERS OK. (OR HD16-100)

b) FLEXURE: → RESULTS IN UPLIFTS AT EACH END.



59kN

$T = C = \frac{M}{e} = \frac{18{,}553}{7.245} = 2{,}561\,kN - 0.9G = 2502\,kN$

ϕN_T (ISCHEBECK TITAN ANCHOR, 52/26) = 730kN → REQUIRE 4 - 52/26 ANCHORS (OR 2-103/78 ANCHORS)

TRY CONNECTING TO COLUMNS TO INCREASE LEVER ARM:

$\rightarrow T = C = \frac{18553}{8.026m} = 2{,}312\,kN - 0.9G = 2{,}147\,kN$ → 3 ANCHORS → USE 4 FOR SYMMETRY (OR 2-103/78 ANCHORS)

59+106=165kN

→ TIE IN TO MAKE USE OF GRAVITY LOADS IN COLUMNS.

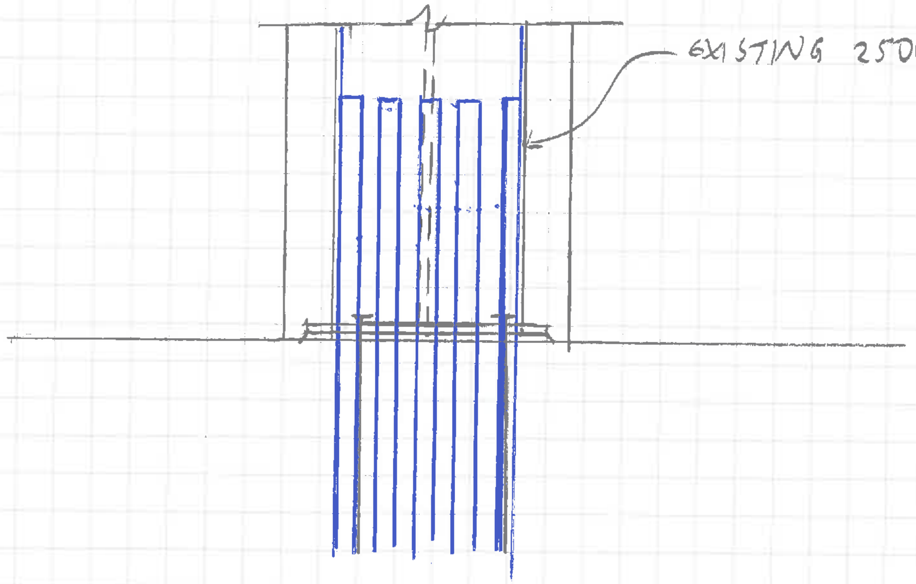
F14-06/02

Date	Eng.	Job No.	Sheet No.
3 MAR 2016	GN	4024A	MB14A

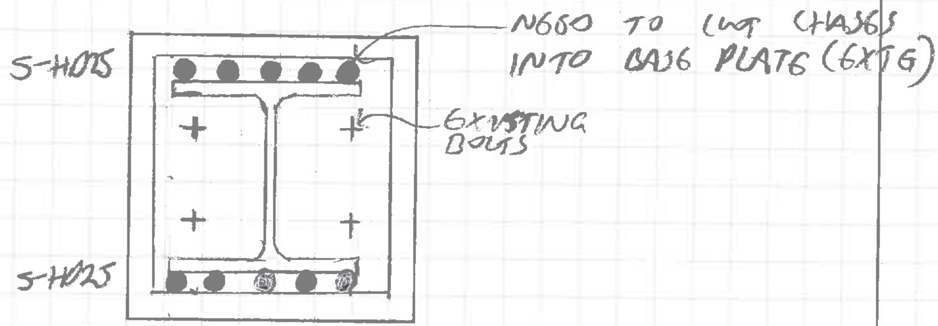
Project: SACRED HEART BLOCK A

CALCULATIONS

GET LOAD INTO FOOTING:



$\frac{214763}{0.9(500)} = 477 mm^2 \equiv$ 10-HD25's ($A_s = 4910 mm^2$)



WELD BARS TO UC FLANGES

USING 8FW (2 SIDES), $\phi v_w = 1.30$ kN/mm

$\rightarrow \frac{2147}{10 \times 2 \times 1.30} = 83$ mm PER RUN $\rightarrow$ SAY WELD 300mm LENGTH

F14-06/02

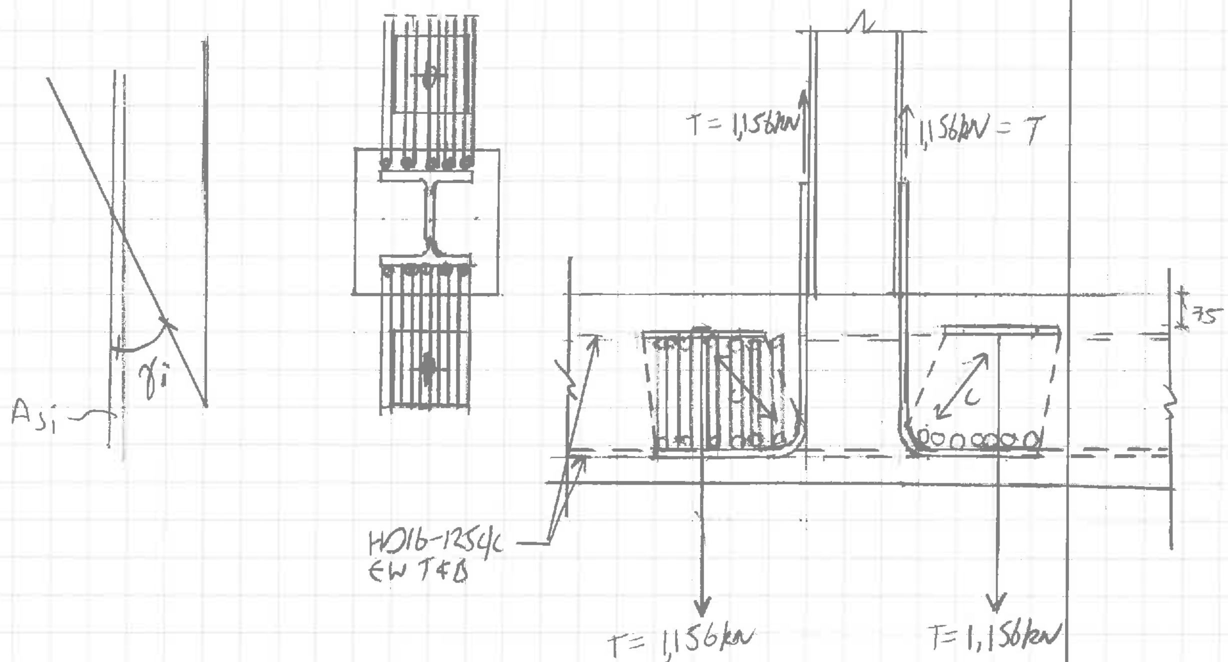
Date	Eng.	Job No.	Sheet No.
3 MAR 2016	GW	40249	MB14B

Project: SACRED HEART BLOCK A

CALCULATIONS

USE A STRUT-AND-TIE MODEL TO TRANSFER LOADS:

$$C = \frac{1{,}156\ kN}{\cos 26^\circ} = 1{,}291\ kN$$



$$f_{cu} = \alpha_1 \beta_n f'_c$$

$$= 0.85 \times 0.75 \times 30MPa = 19.13MPa$$

(0.75 ← NEED SHEAR STEEL ACROSS STRUT)

$$\phi F_{ns} = 0.75 f_{cu} A_c$$

$$\Rightarrow A_c\ REQ'D = \frac{1{,}291E3}{0.75(19.13)} = 90{,}000\ mm^2$$ ≡ **300x300 PLATE AT TOP OF STRUT**

SHEAR STEEL MUST HAVE $\sum \frac{A_{si}}{b s_i} f_y \sin\gamma_i \geq 1.5MPa$ TRY 4-HD10 @100c/c

$$= \frac{4(78.5)(500)\sin 26^\circ}{380 \times 100} \geq 1.5MPa$$

→ 1.81MPa ≥ 1.5MPa - OK → **4HD10-100c/c ACROSS STRUT**

SHEAR WALL ANALYSIS PROGRAMME

MS15

1. "Page down" twice and enter wall geometry and material properties.
2. Hit "Home" then "Tab" across and enter reinforcing areas and positions. NOTE: Start at the top of the table and work down.
3. Hit "Home", then "Page down" three times to start analysis
4. Guess a "depth to neutral axis" value. This will give a axial load value. Adjust depth to neutral axis until the desired axial load is reached.
5. Do the same for overstrength. Then "page down" again and repeat for the wall reversed. To print results press "Alt"+P.
6. Repeat steps 3 to 5 for extra axial loads.
7. To obtain an interaction diagram, omit steps 3 to 6, just press "Alt"+A ,followed by "Alt"+I

No. of bars	39
Wall Rein As (mm)	402
Compression Flange Rein (As)mm	
Tension flange Rein (As)mm	
First bar position mm	50
Last bar position mm	50
Reinforcment Crs	199
Input	
Out put	

MAX: STEEL:
HD16 - 200 EACH FACE
$A_v = 402/0.2 = 2010 mm^2/m$
$\rightarrow \rho_t = \frac{2010}{(200 \times 1000 - 2010)} = 0.0102$
$0.01005 \leq \frac{16}{f_y} = 0.032$ - OK FOR MAX. STEEL

SHEAR WALL ANALYSIS PROGRAMME DATE : 08/01/16
****

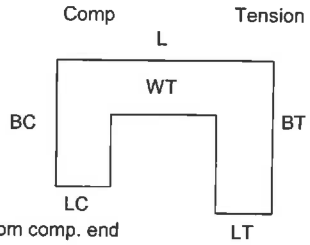
Job number : 40249
Designer : GV
Title : Sacred Heart Block A

Location: New Wall

→ MIN. STEEL:
$\rho_n \geq \frac{\sqrt{f'_c}}{4 f_y}$
$\frac{2010}{200 \times 1000} \geq \frac{\sqrt{30}}{4(500)}$
$0.0101 \geq 0.0027$ - OK FOR MIN. STEEL

GEOMETRY

Wall length, (L) =	7645	mm
Comp. flange length, (LC) =		mm
Comp. flange width, (BC) =		mm
Tens. flange length, (LT) =		mm
Tens. flange width, (BT) =		mm
Web thickness, (WT) =	200	mm
X-sectional Area =	1529000	mm^2
Position of C.O.G =	3823	mm from comp. end



MATERIAL PROPERTIES

Concrete or Masonry? C/M	c	=>	Ultimate strain =	0.0030
Concrete strength =	30	MPa		
Rein. yield strength =	500	MPa		
Overstrength yield =	675	MPa		
Youngs modulus,rein =	200000	MPa		

WALL ANALYSIS

Required N* =	207	kN
Usage	1.00	
Usage Φo	1.00	

Ideal axial load =	243	kN		
Ideal moment capacity =	26026	kNm		
Dependable axial load =	207	kN	(confined) phi =	0.85
Depend. moment capacity =	22122	kNm		
Dependable axial load =	217	kN	(unconfined) phi =	0.89
Depend. moment capacity =	23147	kNm		

			beta 1 =	0.85	
Depth to neutral axis, c =	1255	mm	a =	1067	mm

Axial load =	207	kN
O'strength moment capacity=	34340	kNm

Depth to neutral axis, c = 1307 mm a = 1111 mm

WALL ANALYSIS (Wall reversed)

Required N* =	207	kN
Usage	1.00	
Usage Φo	1.00	

Ideal axial load =	243	kN		
Ideal moment capacity =	26026	kNm		
Dependable axial load =	207	kN	(confined) phi =	0.85
Depend. moment capacity =	22122	kNm		
Dependable axial load =	216	kN	(unconfined) phi =	0.89
Depend. moment capacity =	23147	kNm		

Depth to neutral axis = 1255 mm a = 1067 mm

Axial load =	207	kN
O'strength moment capacity=	34340	kNm

Depth to neutral axis = 1307 mm a = 1111

MB16

SHEAR CAPACITIES

Date: 11/01/16 Job No: 40249
Job Name: Sacred Heart Block A
Location: New Wall

Wall Ductility μ= 1.25

Seismic parameters

Elastic Coeff Cμ= 1.25	0.970	
Wall Coeff Cμ= 1.25	0.970	
β= Cμ=1.25 / Cμ= 1.25	1.000	

Demand/Capacities

V* Demand VE	4198	kN	M* Demand μ= 1.25	18553	kN.m
V*elastic	4198	kN	M*Elastic μ= 1.25	18553	kN.m
			Mu	22122	kN.m
			Mo	34340	kN.m

M*Elastic < Mu **Elastic design**

Wall Shear Demand

Φo	1.851	
wv	1.0	
wv.Φo.VE	7770	kN
μ.VE	5248	kN
V*wall	5248	kN
V*wall (If different than above)		kN

V*Wall **5248** kN

Wall Shear Design

NG+ucQ	1	kN	L	7645	mm
ϕ	0.75		bw	200	mm
f'c	30	MPa	Ag	1529000	mm2
fyt	500	MPa	S	125	mm

vn	5.720	MPa	vn <=	6.0	OK
vc	1.096	MPa	vc <=	1.10	Fails
VCactual	1.095	MPa			
vn-VCactual	4.625	MPa	vn-vc >=	0.70	OK

S Spacing	125	mm
Bars size	16	Dia
A Bar area	201	mm2
No. Legs	2	

Av	231.226	mm2
Avmin	35.000	mm2
Avregd	231	mm2

Avreqd **231** mm2 Avprvd 402.00 mm2 OK

Wall Starter Design

MIN. 2mm AMPLITUDE REQ'D UNDER WALL

Input variables below if different than above

V*wall		kN
NG+ucQ	207	kN
Lwall		mm

Input Variables

μf	1.00
fy	500

S Spacing	200	mm
Bars size	2 x 16	Dia
A Bar area	2x 201	mm2 = 402mm²

Avf (total)	13579	mm2
Avf/m	1776	mm2/m

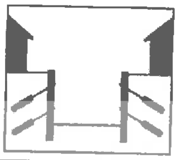
Avreqd (T)	**13579**	mm2	Avprvd	2x 7683	mm2 = 15366mm² - OK
Avreqd	**1776**	mm2/m	Avprvd	2x 1005.00	mm2/m = 2010mm²/m - OK

2 LAYERS OF VERT. STEEL + STARTERS.

40249
MB17

ISCHEBECK®

TITAN Injection Anchors
Grouted tie-back anchors



Design examples

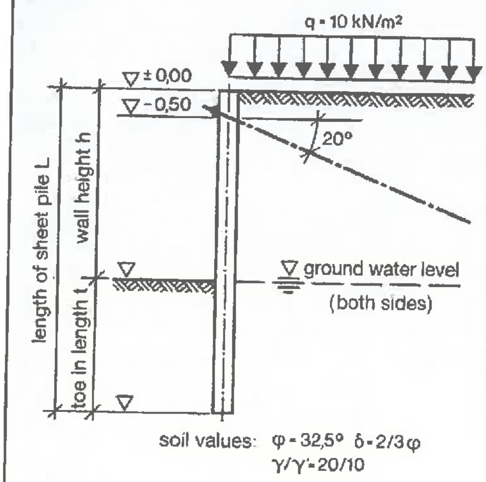
wall height h	bending moment	length of sheet pile L	toe-in length t	sheet pile ABRBED profile	anchor spacing a	horizontal anchor force AH	effective anchor force	anchor length	double U-channel
(m)	(kNm/m)	(m)	(m)	type/steel	(m)	(kN)	(kN)	(m)	
3,00	12,88	4,17	1,17	PU6 StSp 37 KL1 StKE 300	3,00	77,87	82,87	≈ 9,00	2] [200 St 37
3,50	20,81	4,85	1,35	PU6 StSp 37 KL1 StKE 300	3,00	100,04	106,46	≈ 9,00	2] [200 St 37
4,00	31,42	5,54	1,54	PU6 StSp 37 KL2 StKE 300	3,00	125,14	133,17	≈ 10,00	2] [200 St 37
4,50	45,02	6,23	1,73	PU6 StSp 37 KL2/7StKE 300	2,40	122,46	130,32	≈ 10,00	2] [200 St 37
5,00	61,92	6,91	1,91	PU6 StSp 37 KL2/7StKE 300	2,40	122,47	130,33	≈ 10,50	2] [200 St 37
5,50	82,63	7,59	2,09	PU8 StSp 37 KL3 StSp 300	2,40	144,86	154,16	≈ 11,00	2] [200 St 37
6,00	107,43	8,28	2,28	PU8 StSp 37	1,80	126,83	134,97	≈ 12,00	2] [200 St 37
5,50	136,62	8,96	2,46	PU8 StSp 37	1,80	146,39	155,79	≈ 12,50	2] [200 St 37
7,00	170,69	9,64	2,64	PU12 StSp 37	1,20	111,59	118,75	≈ 13,00	2] [200 St 37

Anchor/pile type	TITAN 30/16	TITAN 30/11	TITAN 40/16	TITAN 52/26	TITAN 73/53	TITAN 103/78
Nominal outside diam.	30 mm 1 3/16 in	30 mm 1 3/16 in	40 mm 1 9/16 in	52 mm 2 1/16 in	73 mm 2 7/8 in	103 mm 4 1/16 in
Effective outside diam.	27.2 mm 1 1/16 in	26.2 mm 1 2/64 in	37.1 mm 1 30/64 in	48.8 mm 1 15/16 in	69.9 mm 2 3/4 in	100.4 mm 3 15/16 in
Inside diam.	16 mm 5/8 in	11 mm 7/16 in	16 mm 5/8 in	26 mm 1 1/32 in	53 mm 2 1/16 in	78 mm 3 1/16 in
Ultimade load	220 kN 49.5 kips	320 kN 72.0 kips	660 kN 148.4 kips	929 kN 209 kips	1160 kN 260.8 kips	1950 kN 438.4 kips
Yield point	180 kN 40.5 kips	260 kN 58.4 kips	525 kN 118.1 kips	730 kN 160.8 kips	970 kN 218.1 kips	1570 kN 352 9 kips
Yield stress $T_{0.2}$	470 N/mm² 68.2 ksi	580 N/mm² 84.1 ksi	590 N/mm² 85.6 ksi	550 N/mm² 79.7 ksi	590 N/mm² 85.6 ksi	500 N/mm² 72.5 ksi
Cross section (A)	382 mm² 0.592 in²	446 mm² 0.691 in²	879 mm² 1.362 in²	1337 mm² 2.08 in²	1631 mm² 2.53 in²	3146 mm² 4.88 in²
Allow shear force (Q)	58 kN 13 kips	88 kN 19.8 kips	164 kN 36.9 kips	240 kN 53.9 kips	329 kN 74 kips	535 kN 120.3 kips
Allow shear stress	180 N/mm² 26.2 ksi	230 N/mm² 33.4 ksi	200 N/mm² 29.0 ksi	200 N/mm² 29.0 ksi	200 N/mm² 29.0 ksi	180 N/mm² 26.1 ksi
Moment of inertia	2.37 cm⁴ 0.057 in⁴	2.24 cm⁴ 0.054 in⁴	8.98 cm⁴ 0.216 in⁴	25.6 cm⁴ 0.62 in⁴	78.5 cm⁴ 1.89 in⁴	317 cm⁴ 7.62 in⁴
Plastic moment of resistance	2.67 cm³ 0.163 in³	2.78 cm³ 0.169 in³	7.83 cm³ 0.478 in³	16.44 cm³ 1.0 in³	32.1 cm³ 1.958 in³	89.6 cm³ 5.466 in³
Weight	3.0 kg/m 2.02 lbs/ft	3.5 kg/m 2.35 lbs/ft	6.9 kg/m 4.64 lbs/ft	10.5 kg/m 7.14 lbs/ft	12.8 kg/m 8.6 lbs/ft	24.7 kg/m 16.6 lbs/ft
thread left hand right hand	left	left	left	right	right	right
lengths	4 m 12' - 2"	2, 3, 4 m 6'-7"/9'-10" 12' - 2"	3 m 9' - 10"	3 m 9' - 10"	3 m 9' - 10"	3 m 9' - 10"

E. & O. E.
subject to change without notice

The allowable shear force is determined by the formula:

$$Q_{allow} = \frac{T_{0.2} * A}{\sqrt{3} * 1.75}$$



Principle tests performed with TITAN tie-back anchors:

Prof. Dr. Ing. Floss, Technical University Munich (Institute Prof. Ostermeier) project no. 9941/13 dd. 23. 10. 1989

Prof. Dr. Ing. Floss, Technical University Munich (Institute Prof. Ostermeier) project no. 9941b/12 dd. 30. 10. 1990

Prof. Dr. Ing. W. Blümel, Technical University Hannover, Institute for soil construction, dd. 20. 6. 1991

approval test no. 25-15467 dd. 4. 10. 1991 of FMPA Institute of the State of Baden-Württemberg

Government institute for material research and testing (BAM) Berlin report no. 1.3/12279 dd. 9. 6. 1992 on corrosion resistance of the TITAN INOX anchors.

1 mm = 0.03937 in 1 m = 3.281 ft 1 kN = 0.2248 Kip 1 MPA or 1 N/mm² = 0.145 KSI 1 BAR = 14.5 PSI 1 kN/m² = 0.02089 kip/sqft 1 MN/m² = 145 KSI

F14-06/02

Date 10 FEB 2016	Eng.	Job No. 40249	Sheet No. MS 18

Project

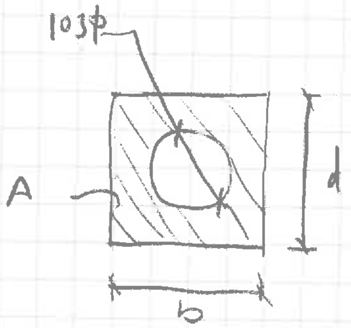
SACRED HEART BLOCK A

CALCULATIONS

4. PLATE TO TOP OF ANCHOR

PRESSURE ON PLATE =

$\frac{1156 kN}{0.081668 m^2} = 14,155 kPa$



FOR d=b=300, $A = 300^2 - 103^2 \frac{\pi}{4} = 81,668 mm^2$

FLEXURE IN PLATE:

$M^* = \left[(14,155 kPa \times 0.3m)\left(\frac{0.10^2}{2}\right)\right]/2 = 10.62 kNm < \phi M_b = \phi f_y \frac{bd^2}{6}$

2-WAY BENDING

$d \text{ req'd} \geq \sqrt{\frac{M^* \times 6}{\phi f_y b}}$

$= \sqrt{\frac{10.62E6 \times 6}{0.9(300)(300)}} = 28mm \rightarrow$ SAY 30mm PLATE

300×300×30 PL

WELD REQ'D:

$\rightarrow \frac{1156 kN}{\pi(103)} = \frac{3.57 kN/mm}{2 \text{ SIDES}} = 1.79 kN/mm$ EACH SIDE ≡ 12FWAR

F14-06/02

Date	Eng.	Job No.	Sheet No.
7 JAN 2016	GN	40249	MB19

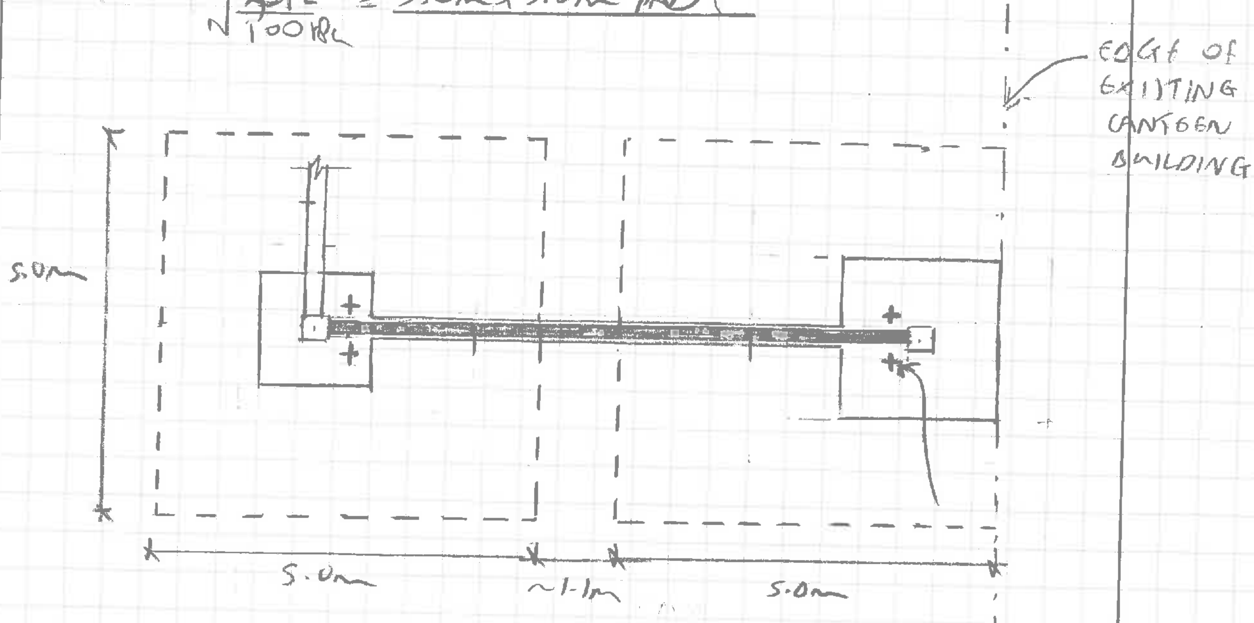
Project: SACRED HEART BLOCK A

CALCULATIONS

5. PADS FOR COMPRESSION:

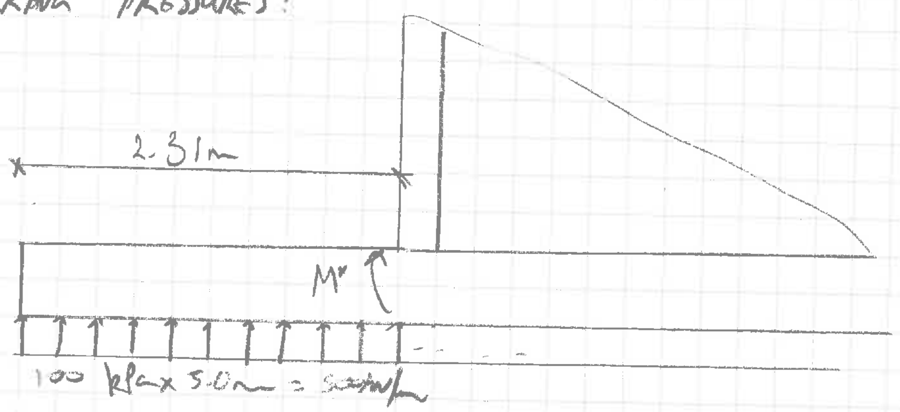
FROM SOILS TESTS, $q_{ult} \simeq 150kPa \rightarrow q_{DEPENDABLE}, \phi q = 0.8 \times 150 = 120kPa \rightarrow$ SAY 100kPa

$\rightarrow \sqrt{\frac{2312}{100kPa}} = 5.0m \times 5.0m$ PAD.



→ MAKE A SINGLE PAD 5.0m WIDE

DEPTH DICTATED BY FLEXURE INDUCED IN PAD BY BEARING PRESSURES:



$\rightarrow M^* = 500kN/m \times 2.31m = \frac{1155kNm}{5.0m} = 231kNm/m$ WIDTH

ϕM_b (HD16-125 c/c, 500 FOOTING) $= 0.85\left(\frac{201}{0.125}\right)(500)\left(406 - \frac{0.5\left(\frac{201}{0.125}\right)(500)}{0.85(1000)(25MPa)}\right) = 264kNm/m$ - OK

→ **HD16-125 EW**

F14-06/02

Date	Eng.	Job No.	Sheet No.
-1 FEB 2016	GV	40249	MB20

Project: SACRED HEART BLOCK A

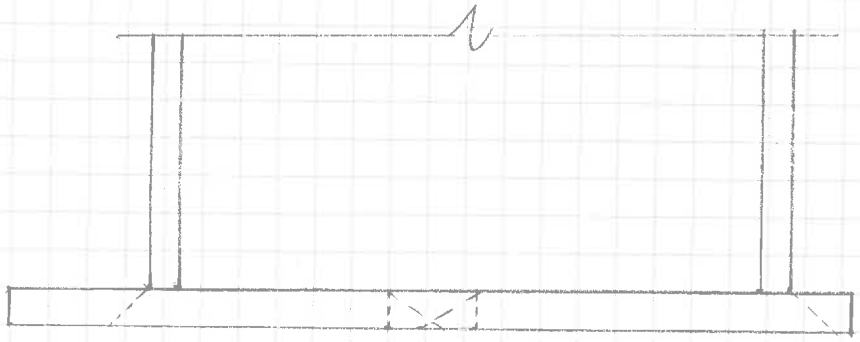
CALCULATIONS

EXISTING PAD HAS 12.7ϕ @ 152 c/c (356 DEEP):

$\phi M_b = 1.0 \left(\frac{127}{0.152}\right)(260\,MPa)\left(275 - \frac{0.5\left(\frac{127}{0.152}\right)(260\,MPa)}{0.85\,(1000)(30\,MPa)}\right) = 58.8\,kNm/m$ — NG

→ CUT AWAY EXISTING PAD & REPLACE WITH NEW PAD.

CHECK PUNCHING SHEAR:



$\phi V_n = \phi(V_s + V_c)$; $\phi = 0.75$

$V_c = v_c b_o d$; $v_c = MIN\{v_{c,a};\ v_{c,b};\ v_{c,c}\}$

$v_{c,a} = \frac{1}{6} k_{ds}\left(1 + \frac{2}{\beta_c}\right)\sqrt{f'_c} = \frac{1}{6}(0.702)\left(1 + \frac{2}{(3200/200)}\right)\sqrt{25}$ $\left(k_{ds} = \sqrt{\frac{200}{d}} = \sqrt{\frac{200}{406}} = 0.702\right)$

$= 0.658\,MPa$ ◄ GOVERNS

$v_{c,b} = \frac{1}{6} k_{ds}\left(\frac{\alpha_s d}{b_o} + 1\right)\sqrt{f'_c} = \frac{1}{6}(0.702)\left(\frac{15(406)}{10264} + 1\right)\sqrt{25}$

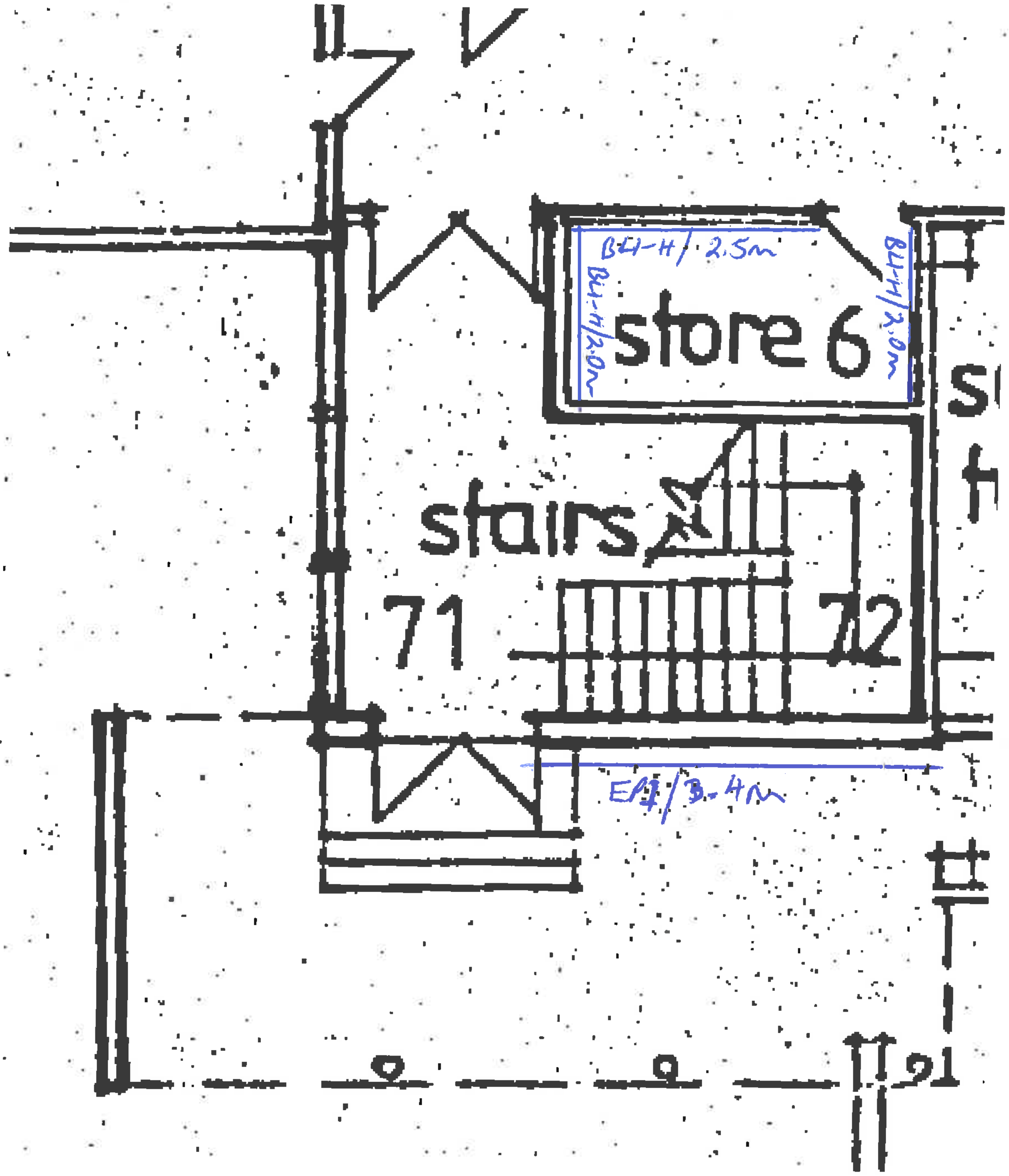
$= 0.932\,MPa$

$v_{c,c} = \frac{1}{3} k_{ds} \sqrt{f'_c} = \frac{1}{3}(0.702)(\sqrt{25})$

$= 1.172\,MPa$

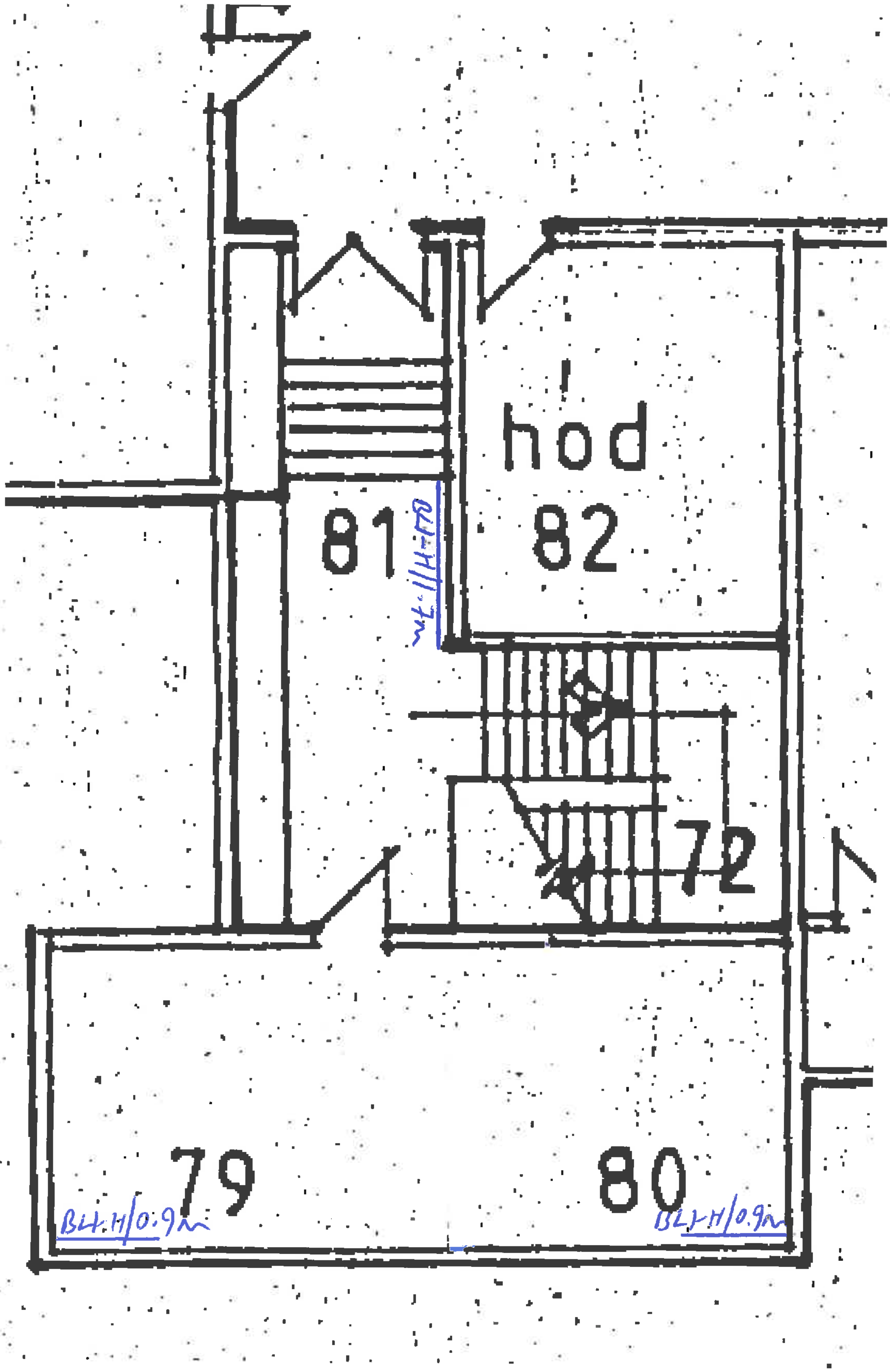
→ $V_c = 0.658(10264)(406) = 2{,}742\,kN > V^* = 2{,}561\,kN$ — OK (NO ADDITIONAL SHEAR STEEL REQ'D FOR PUNCHING SHEAR)

J40249



PREFECTS WING - GROUND FLOOR BRACING PLAN
1:50

J40249



PREFECTS WING – FIRST FLOOR BRACING PLAN

1:50

PWI

Project:	Block A Sacred Heart College - Prefects Wing	Date:	17-Dec-15
Location:	65 Laings Road	Engineer:	GV
	Lower Hutt	Job No.	40249

DETERMINATION OF AS/NZS1170 SEISMIC COEFFICIENT

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

Location = Lower Hutt
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
$C(T) = C_h(T_1)RZN(T,D)$ =	1.20	R =	1.00
$K_u = (\mu-1)T_1 / 0.7 + 1$ =	2.14	Z =	0.40
$Cd(T_1)$ = C(T)Sp/Ku =	**0.39**	N(T,D) =	1

EQUIVALENT STATIC METHOD

Building Weight Determination

Roof

Roofing	0.35 kPa x 65m2	22.8
1/2 Upper Walls External	0.35 kN/m x 37m	13.0
1/2 Upper Walls Internal	0.30 kN/m x 8m	2.4
	W Roof =	**38.1**

Upper Floor

	Area Upper Floor	*65 m2*
1/2 Upper Walls External	0.35 kN/m x 37m	13.0
1/2 Upper Walls Internal	0.30 kN/m x 8m	2.4
Upper Floor	0.4 kPa x L.F. Area m2	26.0
Seismic Live	0.3 x 3.0kPa x U. F.area m2 x LLR	39.3
1/2 Lower Walls External	0.35 kN/m x 21m	7.4
1/2 Lower Walls Internal	0.30 kN/m x 12m	3.6
	W Upper Floor =	**91.6**
(Live Load Reduction Factor)	$\psi_a=0.3+(3\div\sqrt{A})$ *where* $1>\psi_a>0.5$	0.67

Upper Floor LLR (ψ_a)

Sub Floor

	Area Lower Floor	*33 m2*
1/2 Lower Walls External	0.35 kN/m x 21m	7.4
1/2 Lower Walls Internal	0.30 kN/m x 12m	3.6
0	0	0.0
Lower Floor	0.4 kPa x L.F. Area m2	13.2
Seismic Live	0.3 x 3.0kPa x S.F.area m2 x LLR	24.4
1/2 Subfloor Concrete Walls	23.5kN/m3 x 0.7m/2 x 2.1m2	17.3
	W Lower Floor =	**65.8**
(Live Load Reduction Factor)	$\psi_a=0.3+(3\div\sqrt{A})$ *where* $1>\psi_a>0.5$	0.82
	Wt =	195.6
V = Cd Wt	**V =**	**76.7 kN**

Lower Floor LLR (ψ_a)

Bracing Distribution

Level	Wi	Hi	WiHi	Ratio WiHi/SumWiHi	Vi = 0.92(Ratio x V) (+8% V for roof level)	Vi Cum.	BU's (67%)
Roof	38	6.11	233	0.397	34.2	34.2	458
First Floor	92	3.35	307	0.524	37.0	71.1	953
Subfloor	66	0.7	46	0.079	5.5	76.7	1027
	196		586				

PW2

GIB EzyBrace® 2011 Software

GIB

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	E
214	**A**	1	3.76		2.46	Extg. Wall	Extg.	154	154
		2	3.12		5.28	Extg. Wall	Extg.	60	60
168	**B**	1	1.66		2.46	BL1-H	GIB®	207	168
154	**C**	1	3.76		2.46	Extg. Wall	Extg.	154	154

					Wind	Earthq.
Totals Achieved	W	#DIV/0!	EQ	117%	575	536
Timber Floor, design limit of 120 BU/m			***declined***		*OK*	*OK*
Totals Required (from Demand)						458

PW3

Sacred Heart College - Block A, Prefects Wing

GV J40249

GIB EzyBrace® 2011 Software

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	Bracing Units Achieved E
-30	**M**	1	3.66		5.28	Extg. Wall	Extg.	70	70
620	**N**	1	3.69		2	Extg. 2	Extg.2	310	310
		2	3.69		2	Extg. 2	Extg.2	310	310
180	**O**	1	0.9		2.46	BL1-H	GIB®	100	90
		2	0.9		2.46	BL1-H	GIB®	100	90

					Wind	Earthq.
Totals Achieved	W	#DIV/0!	EQ	190%	889	870
Timber Floor, design limit of 120 BU/m			***declined***		*OK*	*OK*
Totals Required (from Demand)						458

I:\CERTA\JOBFILES\40200\40249\Design\Seismic Strengthening\40249 Prefects Wing Bracing.xls

PW4

Sacred Heart College - Block A, Prefects Wing GV J40249

GIB EzyBrace® 2011 Software

GIB

LOWER 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	E
201	**A**	1	2.01		2.49	BL1-H	GIB®	248	201
201	**B**	1	2.01		2.49	BL1-H	GIB®	248	201
606	**C**	1	1		2.49	Concrete	Wall	606	606
-54	**D**	1	1		2.49	T&G Shea	Wall	65	65

					Wind	Earthq.
Totals Achieved	W	#DIV/0!	EQ	113%	1167	1074
Timber Floor, design limit of 120 BU/m			***declined***		*OK*	*OK*
Totals Required (from Demand)						953

PWS

GIB EzyBrace® 2011 Software

GIB

LOWER 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	Bracing Units Achieved E
→ 252	**M**	1	2.51		2.49	BL1-H	GIB®	310	252
148	**N**	1	3.66		2.49	Extg. Wall	Extg.	148	148
→ 426	**O**	1	3.4		2.49	EP1 (EXTERNAL)	Ecoply®	426	426
153	**P**	1	1		2.49	Rod Cross	Bracing	153	153

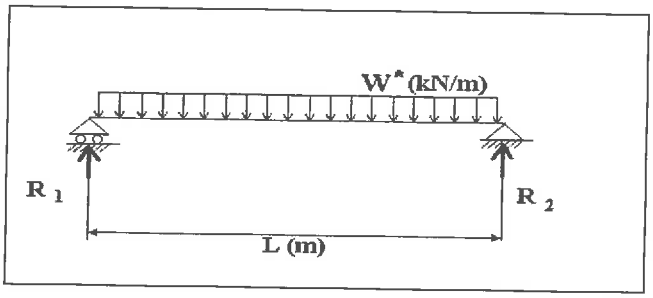
					Wind	Earthq.
Totals Achieved	W	#DIV/0!	EQ	103%	1037	979
Timber Floor, design limit of 120 BU/m			***declined***		*OK*	*OK*
Totals Required (from Demand)						953

PW6

AS/NZS1170 BEAM LOAD CALCULATION SHEET
Roof Beam Calculation Sheet

Job Name: Sacred Heart College - Block A
Seismi Strengthening
Date: 22-Mar-16

Job No. 40249
Engineer GV
Beam No. BM1



L = 2.1 m
Trib Width = 3.75 m
Q_{PT} = 1.4 kN

LOADING
Uniformly Distributed Loads

				Amount
1. Dead	Beam Self Weight			0.18 kN/m
	Roof	0.35 kPa x Trib Width		1.31 kN/m
				kN/m
	Total Dead Load		**G =**	**1.49 kN/m**

Q Point load critical

2. Roof Live Load		0.25 kPa x Trib Width	Qr =	1.33 kN/m
	Roof storage	0.00 kPa x Trib Width	**Qu =**	**0.00 kN/m**
		(0.5kPa if applicable)	**Q =**	**1.33 kN/m**

3. Site Wind Speed
$V_{(z)}$ = **44.00** **m/s**

Upward Wind Loads
$q_{(z)} = 0.5(\sigma_{air})V_{(z)}^2 x10^{-3}$ = 1.16 kPa

Downward Wind Loads
1.16 kPa

External Pressures
$p_e = C_{pe}K_aK_lK_pq_z$
K_a = 1.00
K_l = 1.00
K_p = 1.00

Cpe(min) = -0.9
p_e(min) = -1.05 kPa

Cpe(max) = 0.3
p_e(max) = 0.35 kPa

Internal Pressures
$p_i = C_{pi}q_z$

C_{pi}(max) = 0.6
pi(max) = 0.70 kPa

C_{pi}(min) = -0.3
pi(min) = -0.35 kPa

Combined Pressures
$p_z = (p_e - p_i)K_c$

K_c = 1.00
p_z(max) = -1.74 kPa
W_u(max) = **-6.53 kN/m**

K_c= 0.90
p_z(min) = 0.63 kPa
W_u(min) = **2.35 kN/m**

Load Combinations - Ultimate Limit State
W_{medium} = 3.79 kN/m
W_{short} = 5.19 kN/m
W* = 5.19 kN/m

Note: Roof Ψc = 0

1.2 G + 1.5 Q = **3.79 kN/m**
1.2G + Qu + Wu = **4.14 kN/m**
0.9G + Wu = **-5.19 kN/m**
M* = **2.86 kNm**

Beam Type PFC & Flitch **Size** 150PFC le=5m f_b = 300 Z = N/A

Ø = **0.9**
k_1= **1.0**
k_2= **1.0**
k_4, k_5 =1
ØMb =ø.k1.k4.k5.fb.Z = **15.10 kNm** **OKAY**
EI = **1676.00**

Load Combinations - Serviceability Limit States

	1kN Load	Long Term **$(G+0.4Q_u)$ Ws =**		G + 0.7Q = 2.42
				0.71x Wind ult = 4.64
		1.49 kN/m		**Short Ws =** 4.64 kN/m
Deflection =	0.1mm	0.2mm		0.7mm
		Span/ 9331		Span/ 2996
Limit	2.0mm	Span/ 500		Span/ 300
	OKAY	**OKAY**		**OKAY**

Reactions	**G**	**Q**	**$Wind_{down}$**	**$Wind_{up}$**	**Ult_{down}**	**Ult_{up}**
	1.56 kN	**1.40 kN**	**2.47 kN**	**-6.86 kN**	**4.35 kN**	**-5.45 kN**
Q = 0.25kPa UDL Reaction =		*0.98 kN*				

F14-06/02

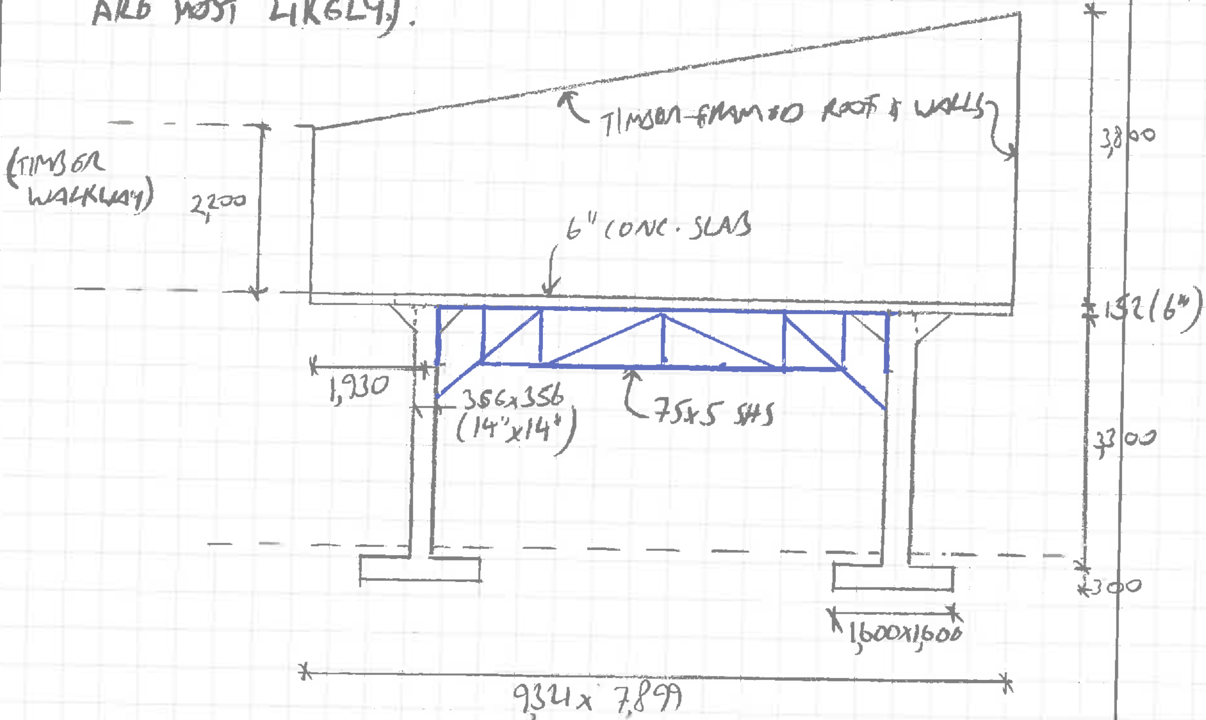
Date 17 DEC 2015	Eng. GV	Job No 40249	Sheet No. SW1	CALCULATIONS

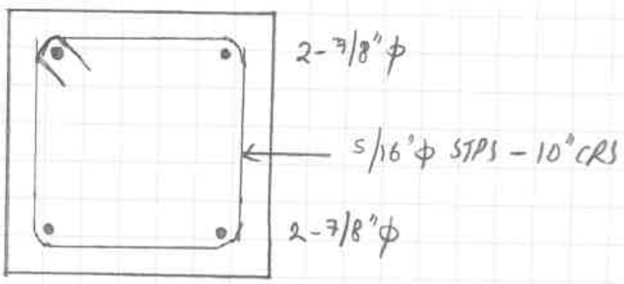
Project

SACRED HEART - BLOCK A

STAFF WING:

- REDUCE FLEXURE @ BASE OF COLUMNS BY FORMING A "FRAME" (2-DIRECTIONS)
- CHECK FRAME FOR μ=1.25 LOADS TO SEE IF CAN AVOID FORCING DUCTILITY INTO COLUMN BASES (WHERE HINGING WILL OCCUR & BAR LAPS ARE MOST LIKELY).





COLUMN SECTION

SW2

Project:	Block A Sacred Heart College - Staff Wing	Date:	17-Dec-15
Location:	65 Laings Road	Engineer:	GV
	Lower Hutt	Job No.	40249

DETERMINATION OF AS/NZS1170 SEISMIC COEFFICIENT

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

Location = Lower Hutt
First Mode Period (>0.4 sec) = 0.4
State = Ultimate
Site Subsoil Category: Deep/Soft Soil (Class D)
Structural Ductility Factor μ = 2

From AS/NZS1170 $C_h(T_1)$ =	3.00	S_p =	0.7
$C(T) = C_h(T_1)RZN(T,D)$ =	1.20	R =	1.00
$K_u = (\mu-1)T_1 / 0.7 + 1$ =	1.57	Z =	0.40
$Cd(T_1)$ = C(T)Sp/Ku =	**0.53**	N(T,D) =	1

EQUIVALENT STATIC METHOD

Building Weight Determination

Roof

Roofing	0.35 kPa x 9.3m x 7.9m	25.7
1/2 Upper Walls External	0.35kPa x 1/2 x 93m2	16.3
1/2 Upper Walls Internal	0.30kPa x 1/2 x 84m2	12.6
	W Roof =	**54.6**

Upper Floor

	Area Upper Floor	*74 m2*
1/2 Upper Walls External	0.35kPa x 1/2 x 93m2	16.3
1/2 Upper Walls Internal	0.30kPa x 1/2 x 84m2	12.6
0	0	0.0
Upper Floor	23.5kN/m3 x 0.152m x 9.3m x7.9m	262.4
Seismic Live	0.3 x 3.0kPa x U. F.area m2 x LLR	21.5
1/2 Concrete Columns	23.5kN/m3x4x0.448m3	22.5
	W Upper Floor =	**335.3**

Upper Floor LLR (Live Load Reduction Factor) $\psi_a=0.3+(3\div\sqrt{A})$ *where* $1>\psi_a>0.5$ 0.65

	Wt =	389.9
V = Cd Wt	**V =**	**208.4 kN**

Bracing Distribution

Level	Wi	Hi	WiHi	Ratio WiHi/SumWiHi	Vi = 0.92(Ratio x V) (+8% V for roof level)	Vi Cum.	
							67%NBS
Roof	55	6.3	344	0.237	62.1	62.1	41.6 kN
First Floor	335	3.3	1107	0.763	146.3	208.4	139.6 kN
	390		1450				

F14-06/02

Date 17 DEC 2015	Eng. GV	Job No. 40249	Sheet No. SW3

Project

SACRED HEART - BLOCK A

CALCULATIONS

FROM SPACEGASS ANALYSIS:

$M^*_{COLUMN\ BASE, \mu=1.25}$ = 157 kNm > M_{PROBS} = 85 kNm (54% NBS)

↳ ∴ NEED TO FORCE DUCTILITY INTO COLUMN BASES

→ WELD LAPS TOGETHER

$\phi N_t = 1.0 \times 260MPa \times 22.225^2 \times \frac{\pi}{4}$

= 101 kN

→ USING 6FW (f_{uw} = 480MPa)

ϕV_{uw} = 0.978 kN/mm

∴ REQUIRE MINIMUM $\frac{101}{0.978}$ = 103mm → SAY 150mm EACH END OF LAP

USING $\mu = 2$ → $M^*_{G+E_u}$ = 86 kNm > M_{PROBS} = 85 kNm (99% NBS) - OK

NOW, CHECK 'FRAME' FOR μ=1.25 INTERNAL FORCES:

V^*_{COLUMN} = 108 kN > V_{PROBS} = 104 kN (97% NBS) - OK

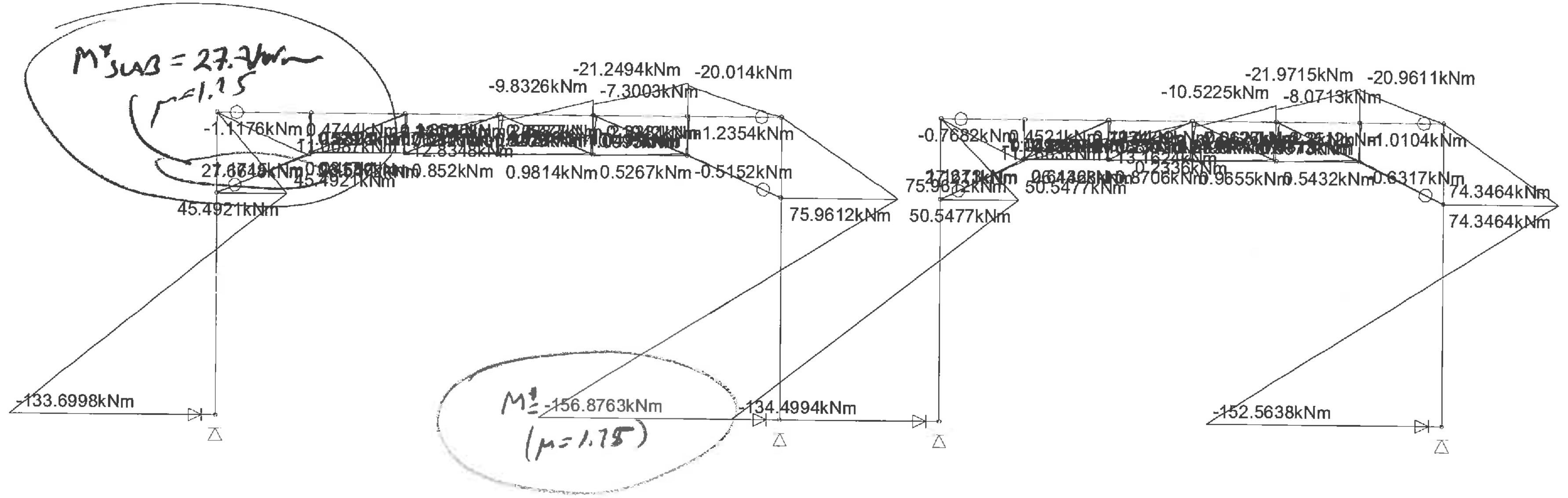
N^*_c (75x5 SHS) = 225 kN ≤ ϕN_{cx} (L_e = 2.0m) = 296 kN - OK

M^* (SLAB) = 27.7 kNm ≮ ϕM_b (1.216m x 0.151m, ½" Φ @ 12" ck - 4 BARS) = 20.4 kNm (74% NBS) - OK

SPACE GASS 12.26 - CERTA Engineering LTD

22 Dec 2015, 8:35 am

Load cases:
4 ——— (SW) G+Eu (mu=1.25)



J40249

SW4

Y
X
(0,0)

No general restraint

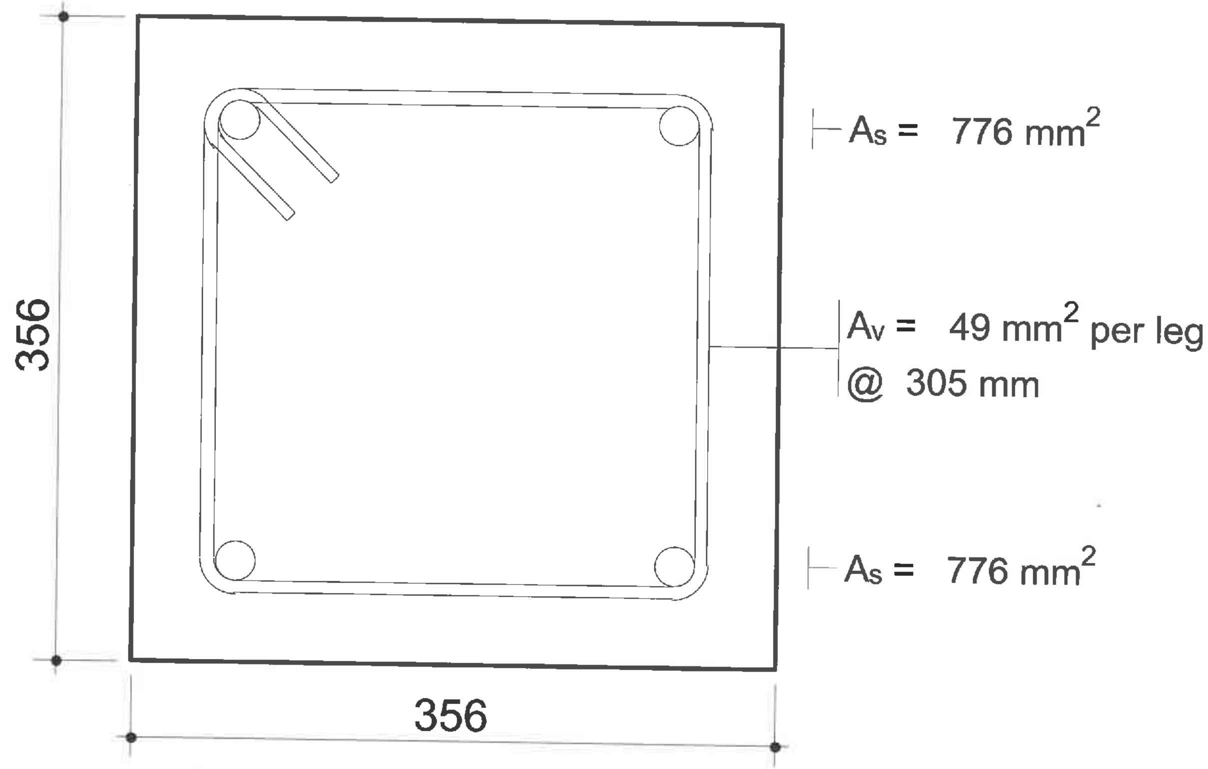
Materials:
1 CONCRETE-30
2 STEEL

Sections:
1 Section 1
3 75*5 SHS
4 Section 4

Job: I:\CERTA\JOBFILES\40200\...\Seismic Strengthening\40249 Staff Wing Columns
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: 1:64, Load: None, Disp: None, Moment: 4.296875, Shear: None, Axial: None, Torsion: None

Geometric Properties

	Gross Conc.	Trans (n=7.97)
Area (mm^2) x 10^3	126.7	137.6
Inertia (mm^4) x 10^6	1338.5	1496.9
y_t (mm)	178	178
y_b (mm)	178	178
S_t (mm^3) x 10^3	7519.7	8409.7
S_b (mm^3) x 10^3	7519.7	8409.7

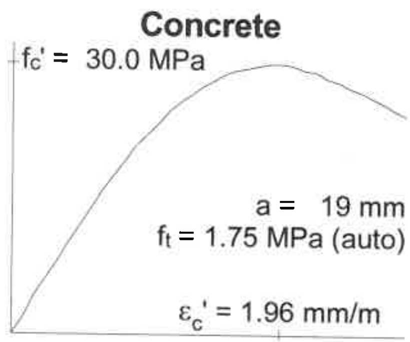


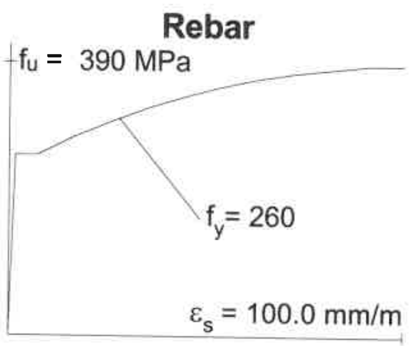
Crack Spacing

2 x dist + 0.1 d_b / ρ

Loading (N,M,V + dN,dM,dV)

-237.9 , -0.0 , 0.0 + 0.0 , 1.0 , 0.0





All dimensions in millimetres
Clear cover to transverse reinforcement = 38 mm

J40249 Sacred Heart College Block A - Staff Wing

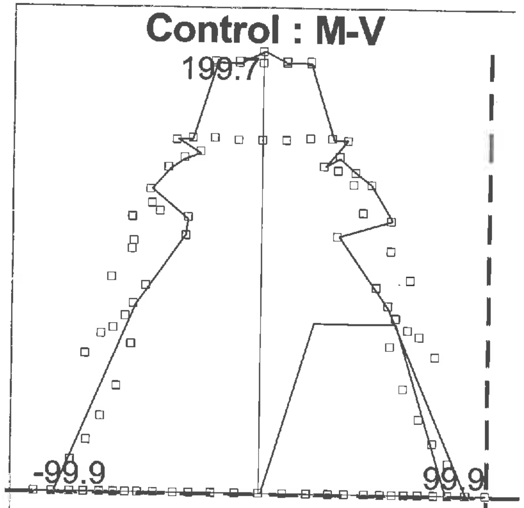
GV **2015/10/16**

SWS J4024A

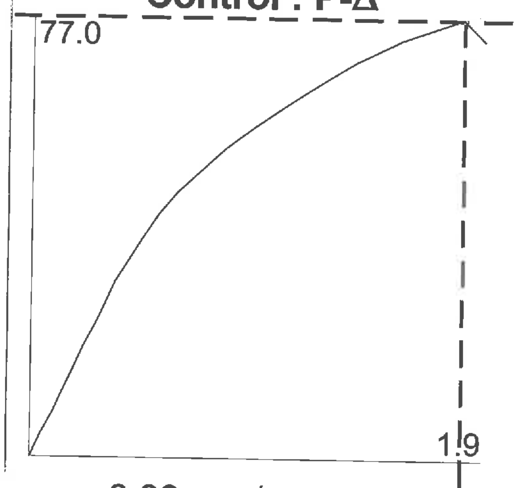
Response-2000 v 1.0.5

J40249 Sacred Heart College Block A - Staff Wing
GV 2015/12/22 - 9:06 am

Control : M-V



Control : P-Δ



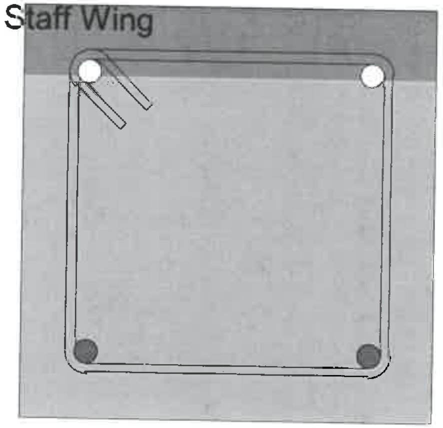
ε_{x0} = 6.99 mm/m

ϕ = 59.31 rad/km

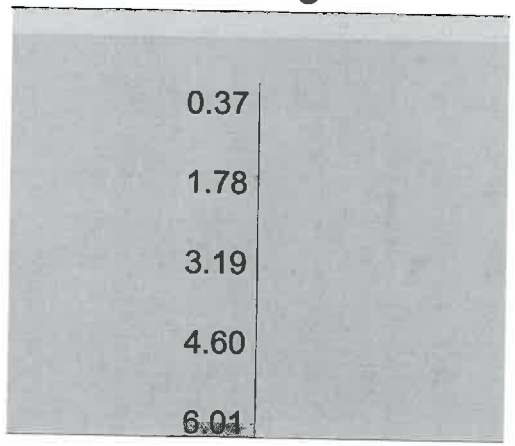
γ_{xy}(avg) = 0.00 mm/m

Axial Load = -237.9 kN
Moment:= 99.9 kNm
Shear = 0.0 kN

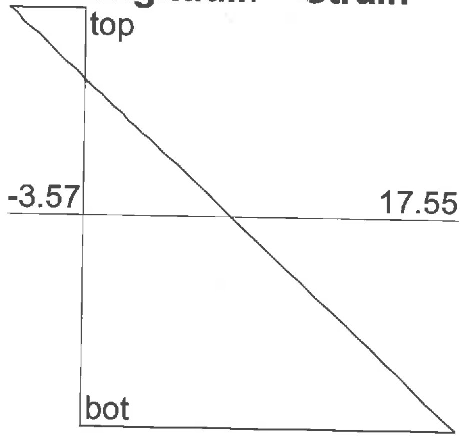
Cros Section



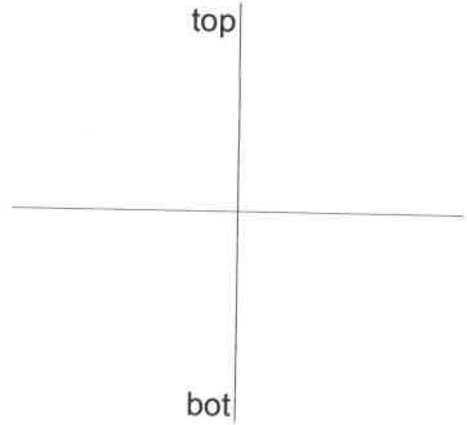
Crack Diagram



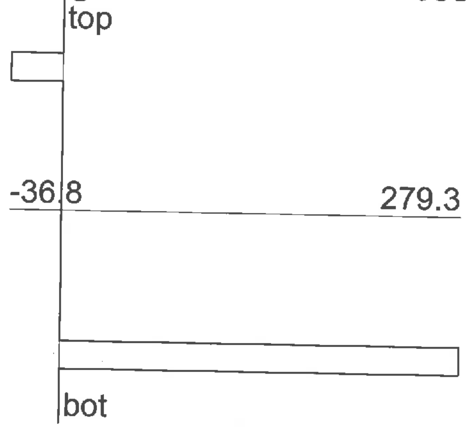
Longitudinal Strain



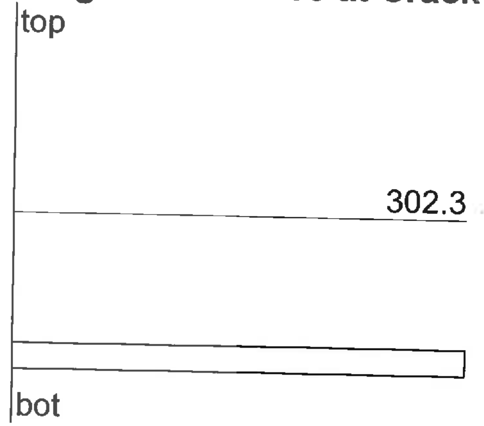
Shrinkage & Thermal Strain



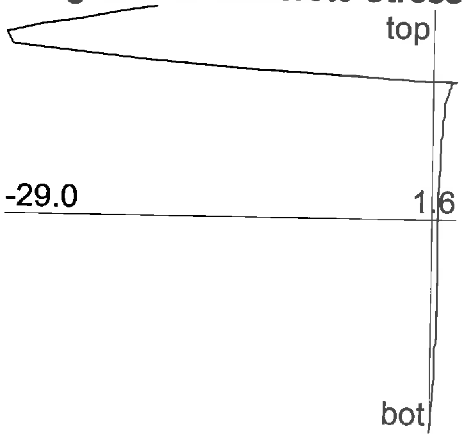
Long. Reinforcement Stress



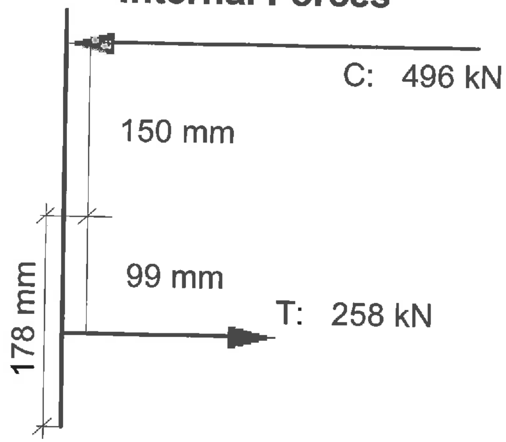
Long. Reinf Stress at Crack



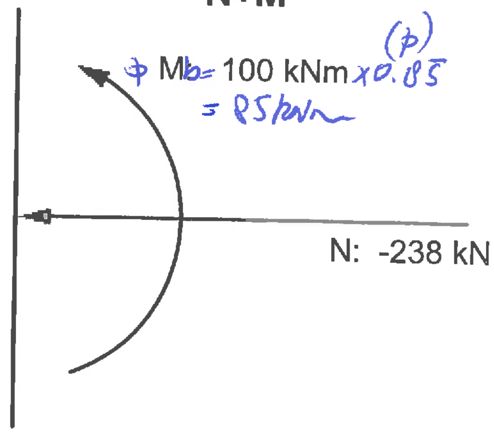
Longitudinal Concrete Stress



Internal Forces



N+M



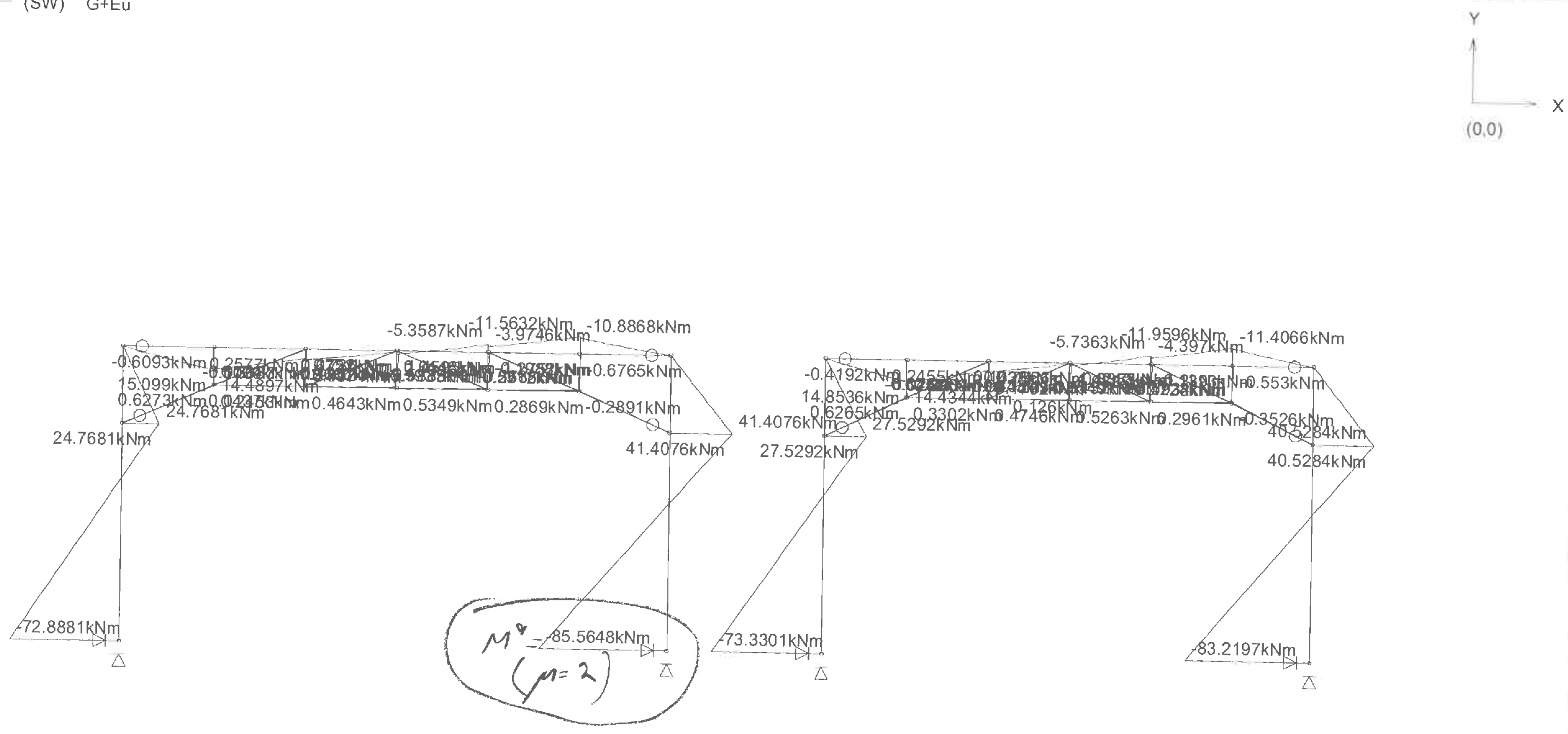
sw 6

J4024A

SPACE GASS 12.26 - CERTA Engineering LTD

Load cases:
3 (SW) G+Eu

22 Dec 2015, 9:02 am



No general restraint

Materials:
1 CONCRETE-30
2 STEEL

Sections:
1 Section 1
3 75*5 SHS
4 Section 4

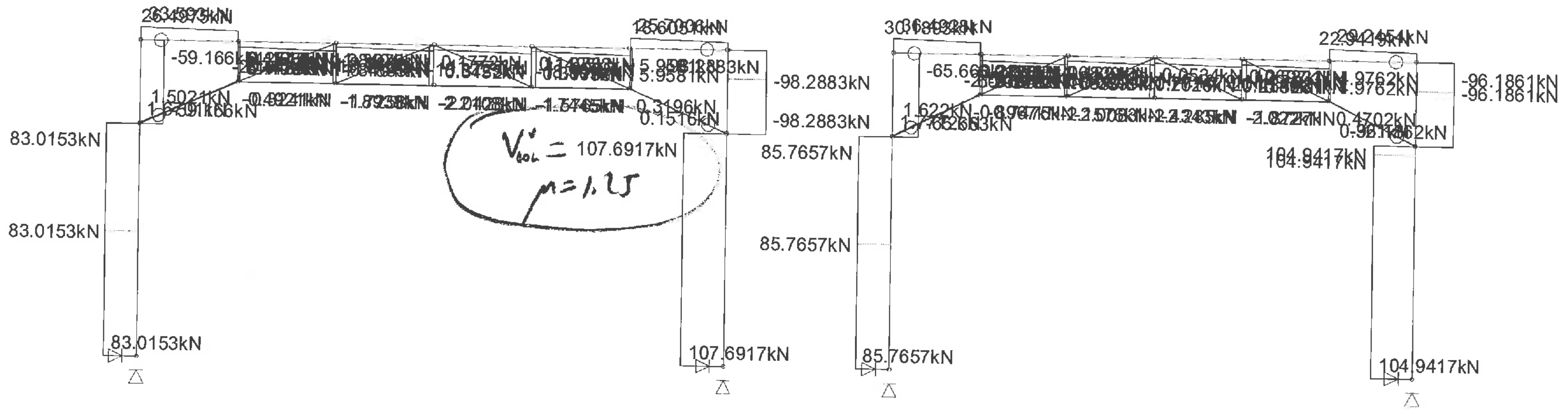
Job: I:\CERTA\JOBFILES\40200\...\Seismic Strengthening\40249 Staff Wing Columns
Units - Len: m, Sec: mm, Mat: MPa, Dens: T/m^3, Temp: Celsius, Force: kN, Mom: kNm, Mass: T, Acc: g's, Trans: mm, Stress: MPa
Scales - Frame: 1:64, Load: None, Disp: None, Moment: 4.296875, Shear: None, Axial: None, Torsion: None

J40249 SW7

SPACE GASS 12.26 - CERTA Engineering LTD

22 Dec 2015, 9:02 am

Load cases:
4 (SW) G+Eu (mu=1.25)



J4024A SW8

Materials:
1 CONCRETE-30
2 STEEL

Sections:
1 Section 1
3 75*5 SHS
4 Section 4

No general restraint

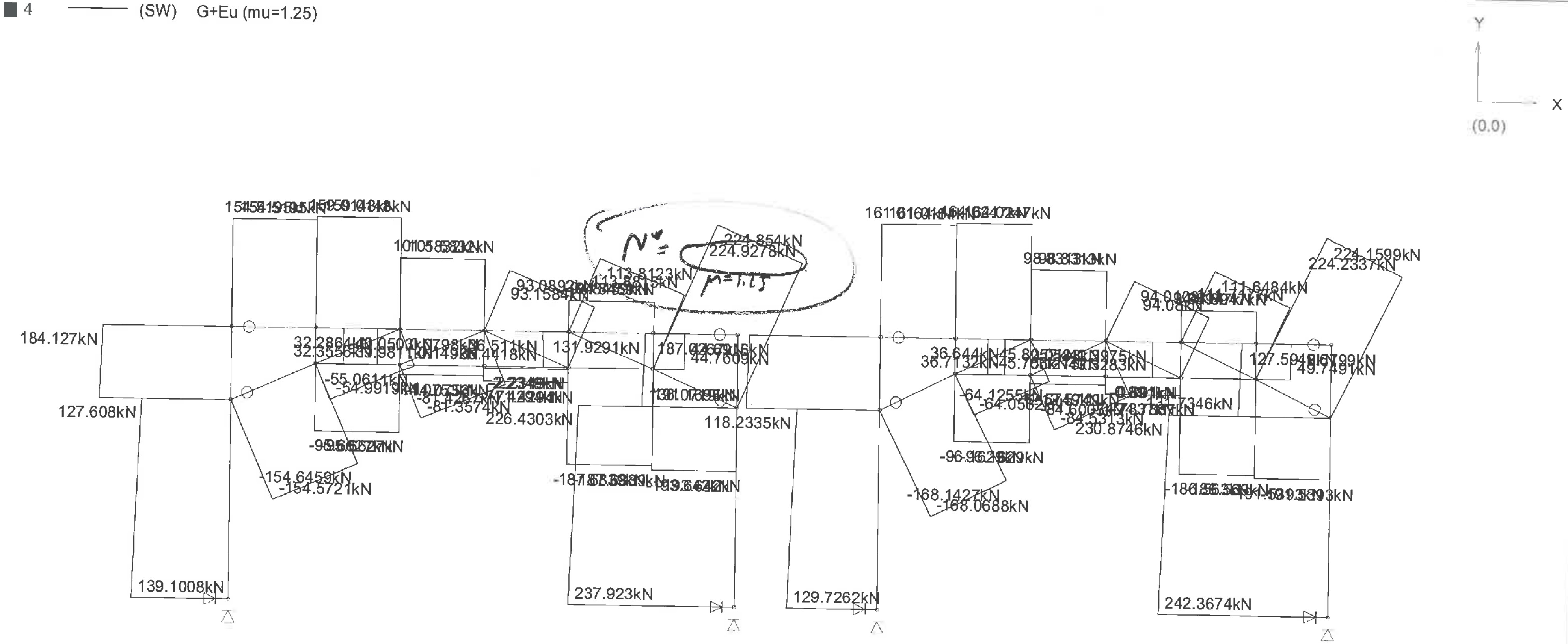
Job: I:\CERTA\JOBFILES\40200\...\Seismic Strengthening\40249 Staff Wing Columns
Units - Len: m, Sec: mm, Mat: MPa, Dens: T/m^3, Temp: Celsius, Force: kN, Mom: kNm, Mass: T, Acc: g's, Trans: mm, Stress: MPa
Scales - Frame: 1:64, Load: None, Disp: None, Moment: None, Shear: 17.4623, Axial: None, Torsion: None

J40249 SW9

SPACE GASS 12.26 - CERTA Engineering LTD

22 Dec 2015, 9:01 am

Load cases:
4 ——— (SW) G+Eu (mu=1.25)



No general restraint

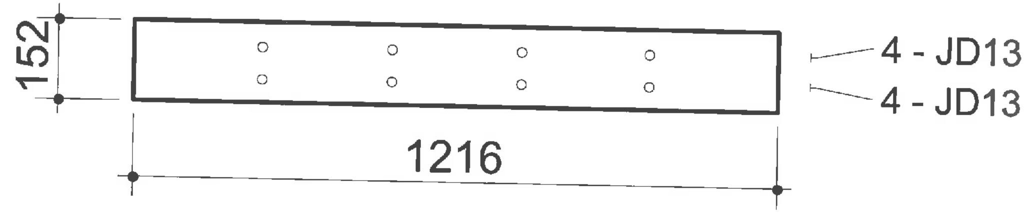
Materials:
1 CONCRETE-30
2 STEEL

Sections:
1 Section 1
3 75*5 SHS
4 Section 4

Job: I:\CERTA\JOBFILES\40200\...\Seismic Strengthening\40249 Staff Wing Columns
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: 1:64, Load: None, Disp: None, Moment: None, Shear: None, Axial: 8.498318, Torsion: None

Geometric Properties

	Gross Conc.	Trans (n=7.97)
Area (mm^2) x 10^3	184.8	191.9
Inertia (mm^4) x 10^6	355.9	362.1
y_t (mm)	76	76
y_b (mm)	76	76
S_t (mm^3) x 10^3	4682.4	4764.4
S_b (mm^3) x 10^3	4682.4	4764.4



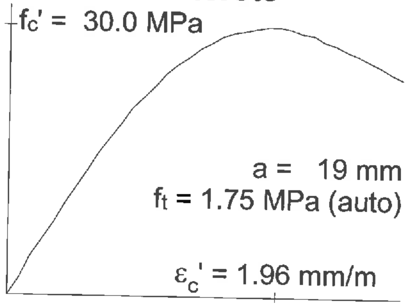
Crack Spacing

2 x dist + 0.1 d_b /ρ

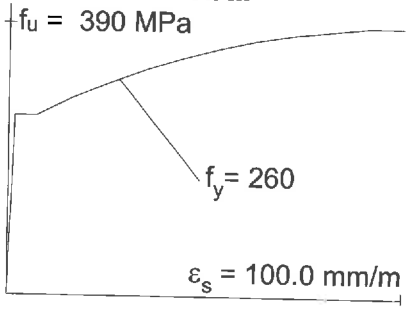
Loading (N,M,V + dN,dM,dV)

0.0 , -0.0 , 0.0 + 0.0 , 1.0 , 0.0

Concrete



Rebar



All dimensions in millimetres
Clear cover to reinforcement = 40 mm

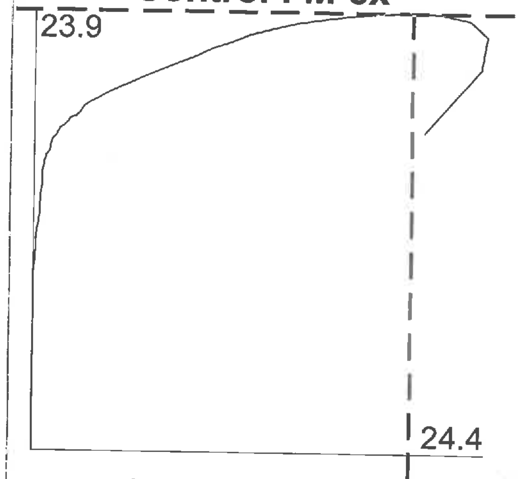
J40249 Sacred Heart - Block A: Staff Wing Slab

GV **2015/12/22**

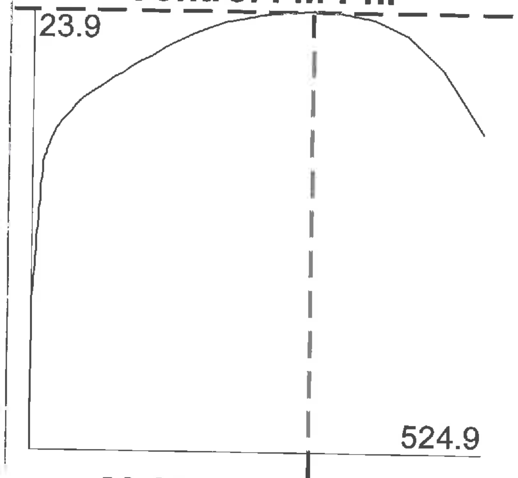
SW10 J402A

Response-2000 v 1.0.5
J40249 Sacred Heart - Block A: Staff Wing Slab
GV 2015/12/22 - 8:59 am

Control : M-ex



Control : M-Phi



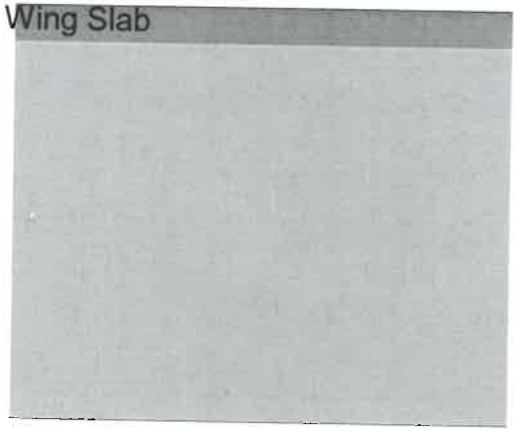
ε_{x0} = 20.35 mm/m

ϕ = 325.90 rad/km

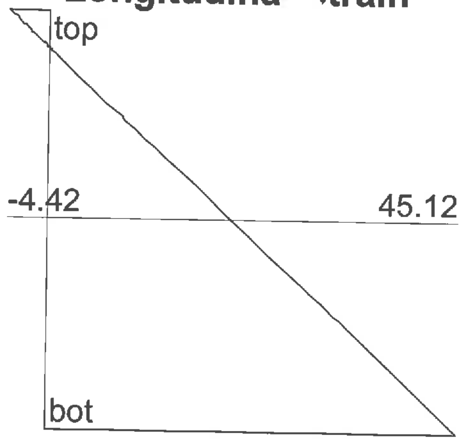
γ_{xy}(avg) = 0.00 mm/m

Axial Load = -0.0 kN
Moment:= 23.9 kNm
Shear = 0.0 kN

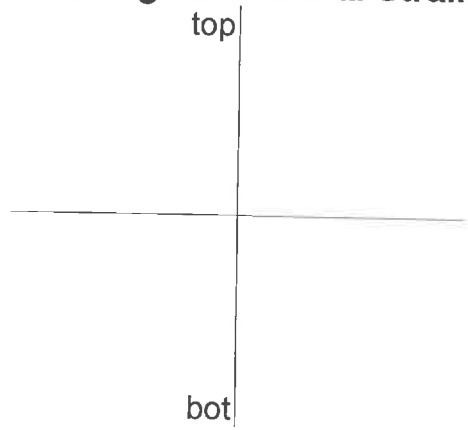
Cross Section



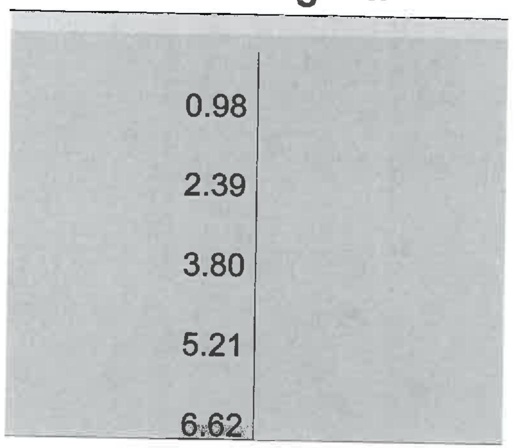
Longitudinal Strain



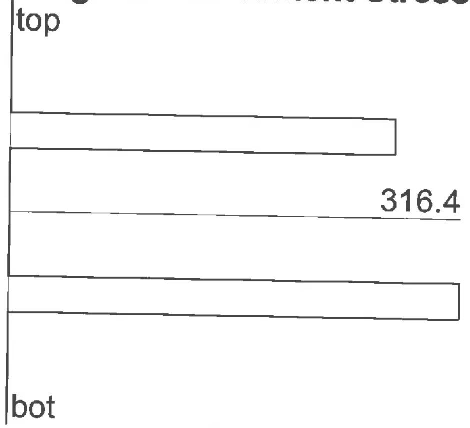
Shrinkage & Thermal Strain



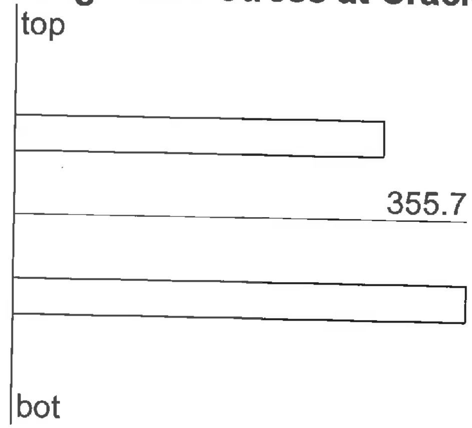
Crack Diagram



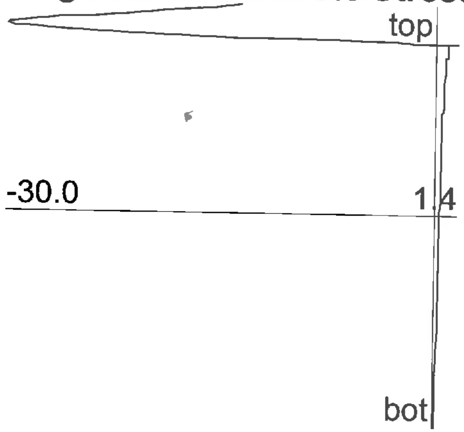
Long. Reinforcement Stress



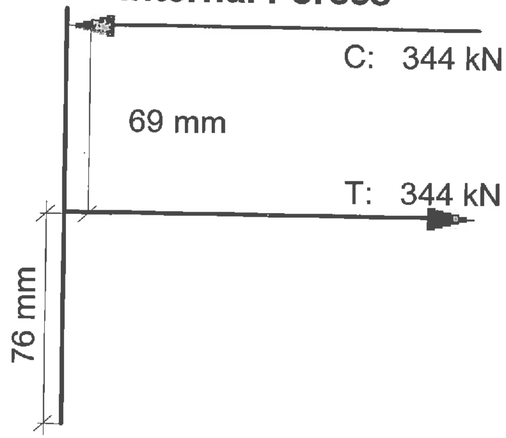
Long. Reinf Stress at Crack



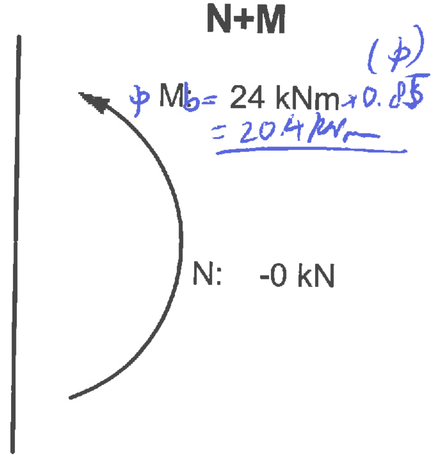
Longitudinal Concrete Stress



Internal Forces



N+M



SW11

J40249

F14-06/02

Date	Eng.	Job No.	Sheet No.
10 FEB 2016	GV	4024A	SW12

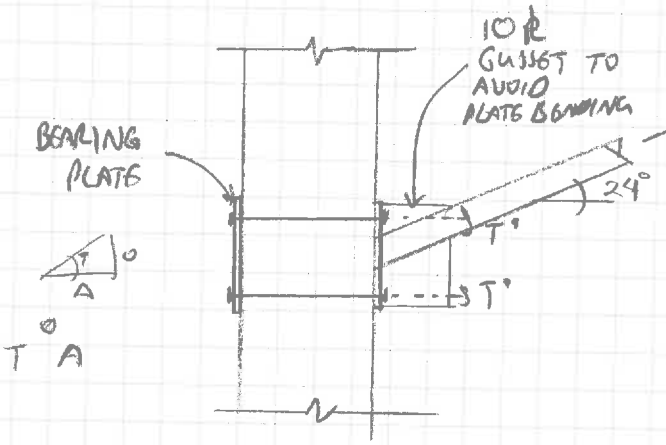
Project

SACRED HEART - BLOCK A

CALCULATIONS

STEEL TO CONCRETE CONNECTIONS:

1.) DIAGONAL STRUT TO COLUMN: (μ=1.25 LOADS)



$N^*_T = \frac{168kN}{4 \times 75} = 0.56kN/mm$ ≡ 6FWAR

$N^*_C = 225kN$

$T^* = \frac{168}{\tan 23°} = 377kN$ ≡ 4-M16 8.8 BOLTS (ϕN_{tf} = 104kN × 4 = 416kN)

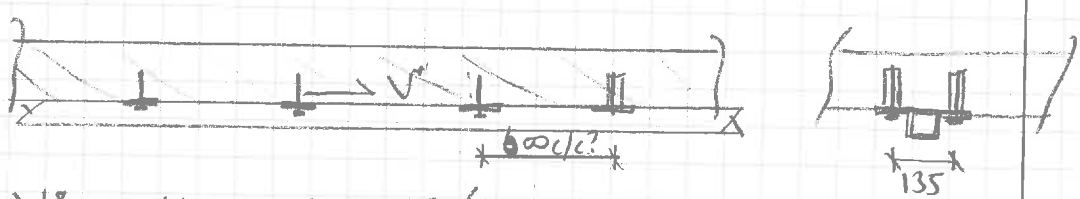
→ CHECK BEARING PLATE:

TRY 300x200 PLATE: (COMPRESSION LOAD GOVERNS)

$\frac{(225/\tan 24°)}{300 \times 200}$ = 8.42MPa < 30MPa - OK

300x200x10 PL

2) FRAME TO SLAB:



$V^* = \frac{191kN}{3.23m}$ = 59.06kN/m (LOAD INTO FRAME)

ϕV_{urc} (2-M12 CHEMSETS, 90 EMBEDMENT) = 21.0kN×2 = 42.0kN

→ 2/M12 - 600c/c CHEMSETS 90 EMBEDMENT, EPCON C6 (ϕN_{urc} = 60.0 kN/m)

WELD FOR CLEATS: V*/CLEAT = 15.9kN

USING 6FW (0.978kN/mm) SP REQUIRE $\frac{15.9}{0.978}$ = 17mm → 60x60x6 CLEAT 6FW TO SHS

F14-06/02

Date 21 DEC 2015	Eng. GW	Job No. 40249	Sheet No. SBW1

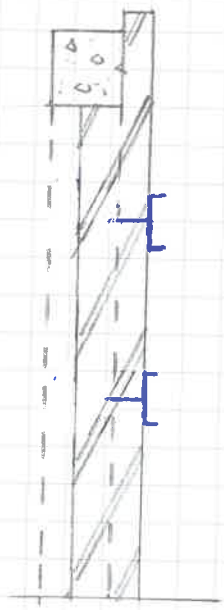
Project

SACRED HEART - BLOCK A

CALCULATIONS

SOUTH BOUNDARY WALL

- FROM SHEET SBW2, INTRODUCE 2 LINES OF NEW SUPPORT AT 1/3 POINTS.



→ W on NEW BEAMS = 1.15kPa (0.65m) = 0.81kN/m

→ M* = 0.81 (4.7)² / 8 = 2.24 kNm < φMy (150PFC, Le = 4.5m, αm = 1.13) = 11kNm - OK

150 PFC BEAMS

CONNECTION OF BRICKWORK TO PFC:

→ USING SIMPSON STRONG TIE SET-XP, Nro = 11.9kN (TENSION)
Vro = 16.8kN (SHEAR)

SINGLE EDGE DISTANCE (CRACKED CONCRETE TO APPROXIMATE BRICK)
↳ USING 80mm MIN EDGE DISTANCE GET 18.4kN (200mm CTS) FOR 4 ANCHORS

= 4.6kN/ANCHOR > 0.81kN/m → **M12 - 800 CTS SIMPSON SET-XP 110 EMBEDMENT**

Date:	21/12/2015	Engineer:	GV	Job No:	40249	Page:	SBW2

Unreinforced Masonry Wall and Parapet Seismic Strength

Project: Block A, Sacred Heart College, Lower Hutt

Southern Boundary Brick Wall

Location: Lower Hutt — Z = 0.40

Soil Cat: Deep or soft soil D — $C_h(T=0)$ = 1.12

Nearest Major Fault Distance D = 30 kM

Note: C_{ph} factor is not calculated as it's been replaced by the mass participation factor γ

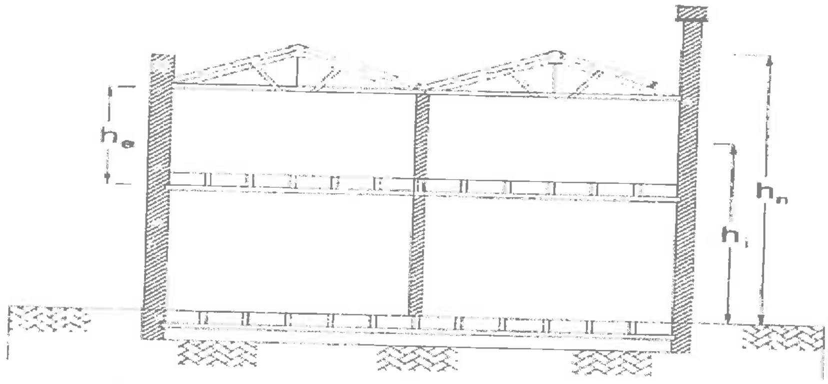


Figure C6-2: Definition of heights

Design Parameters [Note: Out-of-plan Parapet and Wall capacity checked for 1.0 meter width]

	Parapet	GND Storey Wall	1st Storey Wall	2nd Storey Wall	
h_e =	0	0.65	0.65	0.65	m
t_p or b_w =	0	230	230	230	mm
ρ =	0	17.0	17.0	17.0	kN/m³
h_i =	0	0.325	0.975	1.625	m
h_n =	1.95	1.95	1.95	1.95	m
N_t/L_w=	0	5.08	2.54	0	kN per meter
W_w =	0.0	2.5	2.5	2.5	kN per meter
W_t =	0.0	1.3	1.3	1.3	kN per meter
W_b =	N/A	1.27	1.27	1.27	kN per meter
T_1 =	#DIV/0!	0.30	0.38	0.66	Seconds
γ =	#DIV/0!	0.15	0.24	0.50	
R =	1	1.3	1.3	1.3	
$N_{(T,D)}$ =	#DIV/0!	1.00	1.00	1.00	
$C_{(0)}$ =	#DIV/0!	0.45	0.45	0.45	
C_{Hi} =	1.00	1.05	1.16	1.27	
$C_i(T_P)$ =	#DIV/0!	2.00	2.00	2.00	
$C_{d\ Parts}$ =	#DIV/0!	0.19	0.32	0.74	
$P^*_{Pressure}$ =	#DIV/0!	0.74	1.25	1.89	kPa
M^*_{base} =	**#DIV/0!**	**0.04**	**0.07**	**0.10**	**kN-m per meter**
V^*_{base} =	**#DIV/0!**	**0.48**	**0.81**	**1.23**	**kN per meter**
V^*_{con} =	**#DIV/0!**	**0.48**	**0.81**	**1.23**	**kN-m per meter**
Moment Capacity of Parapet and Walls					
Φ=	1	1	1	1	
d=	0	115	115	115	
a =	0.00	0.75	0.45	0.15	mm
Expected Interstorey drift demands:					
	1.0%	1.0%	1.0%	1.0%	
RF	1	1	1	1	
$ΦM_n$ =	**0.00**	**0.73**	**0.44**	**0.15**	kN-m per meter
%NBS	**#DIV/0!**	**1865.8%**	**664.3%**	**146.6%**	

Note: *Above assessment are based on assumption that the interstorey drift demand on building are limit to a maximum value of 1.0%. however for the a maximum allowed drift demand of 2.5%, parapet and wall capacity are reduced by a reduction factor RF upto 31% of its original strength developed under drift demand less than 1.0%.*

F14-06/02

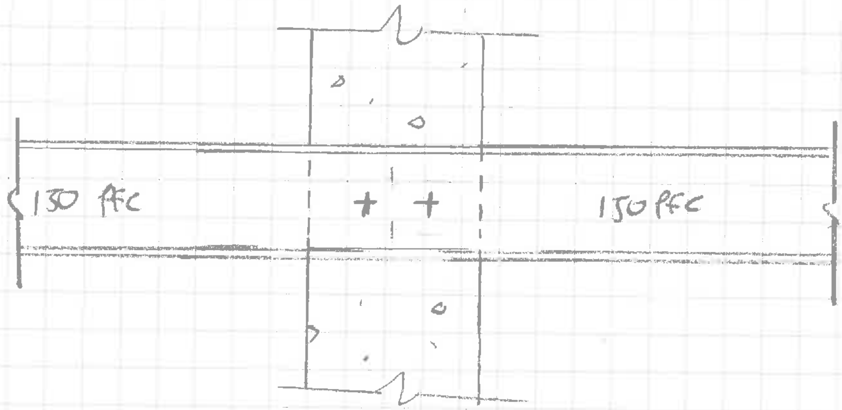
Date 21 DEC 2015	Eng. GW	Job No. 40249	Sheet No. SBW3

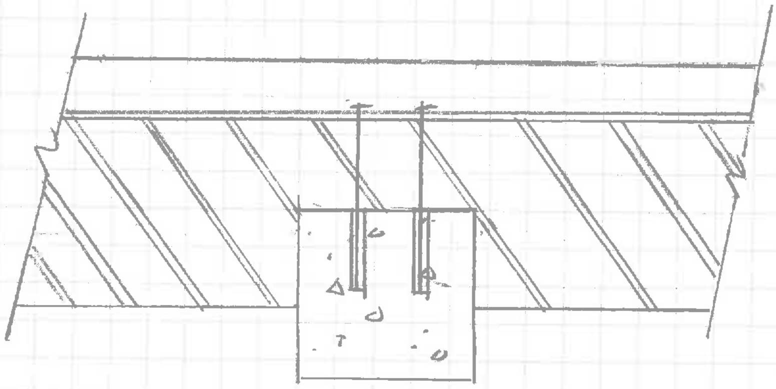
Project

SACRED HEART - BLOCK A

CALCULATIONS

NOW, CONNECTION TO COLUMN:





$V_{GR} = 0.81 kN/m \times 4.7m = 3.8 kN/COLUMN$

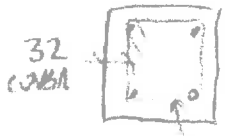
ϕN_{urc} (2-M12 SIMPSON SGT-XP) $\simeq 2 \times 7.1 = 14 kN > V_{GR}$ - OK

2-M12
SIMPSON SGT-XP
110mm EMBEDMENT

M^*_{column} = ~~[struck]~~ 3.86×4.7m × 1.76 + 1.01(23.5)(0.23)^2(1.76)^2/2 = ~~45.2~~ 33.9 kNm

V^*_{column} = ~~[struck]~~ 3.86×4.7 + 1.01(23.5)(0.23)^2(1.76) = ~~16.8~~ 20.4 kN

COLUMN REO:



2-5/8" φ (2-15.9φ)

2-5/8" φ (2-15.9φ)

1/4" φ STPS - 15" CRS (6.35φ - 381 CRS)

ϕM_b = 23 kNm → base < M_{cu} = ~~51% NBS~~ 68% NBS

V_p = 0.72 (V_c + V_s + V_p)

$= 0.72\left[k\sqrt{f'_c}\,0.8A_g + \frac{A_v f_{yt} d''}{s}\cot 30^\circ\right]$; $k = 0.19\alpha\beta$

$= 0.19(1.0)(1.0)$

$= 0.72\left[0.19\sqrt{30}(0.8)(230)^2 + \frac{63(260)(117)}{381}\cot 30^\circ\right]$

V_p = 54.7 kN > V_{cu} (100% NBS)

Job Number	40249		Certa Engineering Ltd
Date	28-Jan-16	Signed	Scala Penetrometer Results Sheet
Location	Sacred Heart College, 65 Laings Rd Lower Hutt		14 Laings Road Lower Hutt
Client	Mission Colleges Lower Hutt Trust Board		Tel (04) 566 8004 Fax (04) 566 8037

Notes

Depth	Probe Number 1 No.	Probe Number 2 No.	Probe Number 3 No.
50	2	1	0
100	1	1	0
150	1	1	0
200	2	0	0
250	2	0	0
300	3	0	0
350	2	0	0
400	0	1	0
450	1	0	0
500	0	1	0
550	1	0	0
600	0	1	0
650	0	0	0
700	1	1	0
750	0	0	0
800	0	1	0
850	1	1	0
900	0	1	0
950	1	2	0
1000	1	1	0
1050	1	1	0
1100	1	1	0
1150	0	1	0
1200	1	0	0
1250	1	1	0
1300	0	1	0
1350	1	1	0
1400	0	1	0
1450	0	1	0
1500	1	1	0
1550	0	1	0
1600	1	1	0
1650	0	1	0
1700	1	1	0
1750	2	8	0
1800	4	10	0
1850	2	10	0
1900	2	0	0
1950	2	0	0
2000	3	0	0
2050	3	0	0
2100	6	0	0
2150	8	0	0
2200	8	0	0
2250	8	0	0
2300	10	0	0
2350	0	0	0
2400	0	0	0
2450	0	0	0
2500	0	0	0
2550	0	0	0
2600	0	0	0
2650	0	0	0
2700	0	0	0
2750	0	0	0
2800	0	0	0
2850	0	0	0
2900	0	0	0
2950	0	0	0
3000	0	0	0
3050	0	0	0
3100	0	0	0
3150	0	0	0
3200	0	0	0
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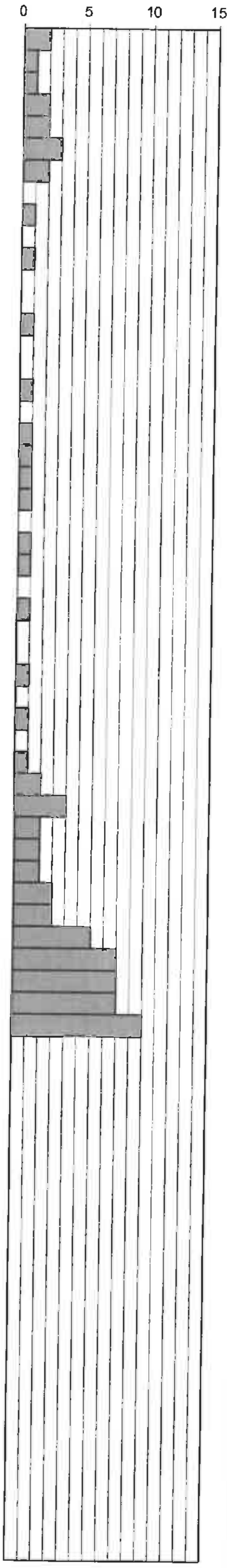
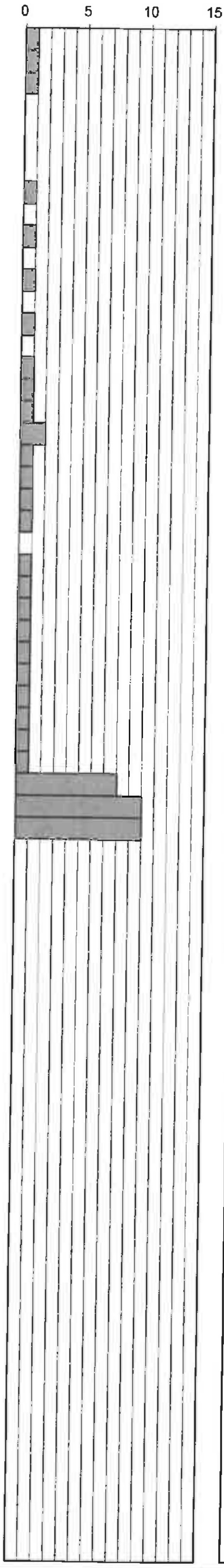
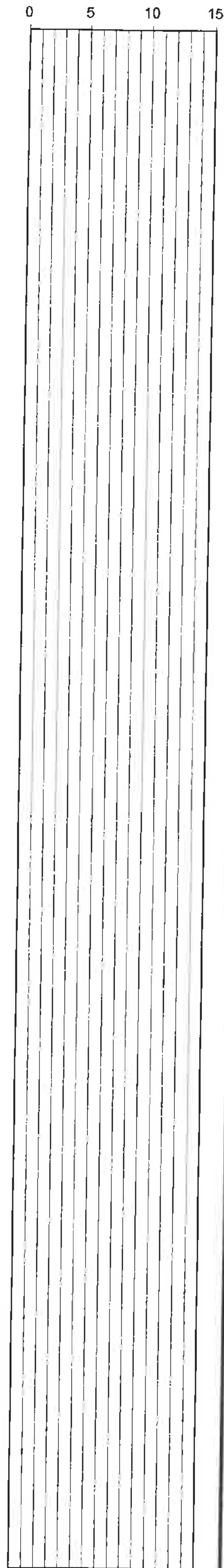
3500	0	0	0







SCALA PENETROMETER TEST LOCATION PLAN

CERTA ENGINEERING

Lower Hutt Office
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Lower Hutt 5040
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CLIENT	Mission Colleges Lower Hutt Trust Board
PROJECT	Seismic Strengthening - Block A Sacred Heart College, 65 Laings Road Lower Hutt

DATE:	28-01-2016	DESIGNED:	
DRAWN:	GV	APPROVED:	
JOB No:	40249	SHEET No:	REV: