In the matter of the Commissions of Inquiry Act 1908

And

In the matter of the Canterbury Earthquakes Royal Commission

Supplementary Brief of evidence of Henry John Hare

Relating to the Forsyth Barr Building
For Hearing on 23 and 24 February 2012

Date: 20 February 2012

DLA PHILLIPS FOX

209 Queen Street, Auckland 1010
PO Box 160, Auckland 1140
DX CP24027 Auckland
Tel +64 9 303 2019
Fax +64 9 303 2311

Solicitor on the record Grant Macdonald grant.macdonald@dlapf.com Tel +64 9 300 3896
Contact solicitor **John Hannan** **john.hannan@dlapf.com** **Tel +64 9 300 3843**

Supplementary brief of evidence

1 My full name is Henry John Hare.

Scope of Evidence

2 I, on behalf of Holmes Consulting Group Limited, provide this Supplementary Brief of evidence pursuant to the Canterbury Earthquakes Royal Commission's letter dated 10 February 2012 in relation to the Forsyth Barr Building ('**the Building**').

Design Engineers

3 Holmes Consulting Group Limited is asked whether it was the consulting engineer in the design of the Building.

Response

4 Documentation including design drawings, construction plans, specifications, design certificates, newspaper clippings, a design feature report, geotechnical and soil reports, calculation sheets, photographs, site reports and sketches have been copied to disk and supplied to Counsel assisting Canterbury Earthquakes Royal Commission.

5 The Building appears to have been designed by Holmes Wood, Poole and Johnstone Limited (**HWPJ**). HWPJ produced initial design drawings in or around October 1987. As from approximately mid to late November 1987, HWPJ appear to have traded under the name of Holmes Consulting Group.

6 The current business known as Holmes Consulting Group Limited (Company Number 441556) was incorporated on 6 September 1989. Accordingly, Holmes Consulting Group Limited was not the entity which carried out the initial design of the Building. This was carried out by a predecessor company.

Identification of the seismic gap

7 Holmes Consulting Group Limited is asked to comment on where, in the plans and/or specifications, the seismic gap in the stairs was identified.

Response

8 The seismic gap in the stairs was identified in the design drawings. A sample design drawing is attached. The sliding detail of the stair is illustrated at detail numbered 1. This clearly shows the seismic gap requirement detail as 30mm.

Plans and/or specifications

9 Holmes Consulting Group Limited is asked whether the importance of the seismic gap was identified in the plans and/or specifications.

Response

10 The seismic gap is specifically detailed in the design drawings. No particular emphasis was given to the seismic joint as all design details are regarded to be important.

11 I would expect any construction company capable of constructing a building of such magnitude to be fully aware of the importance of seismic gaps and the importance of adhering to the design drawings.

Other documentation and/or instruction

12 Holmes Consulting Group Limited is asked whether the importance of the seismic gap was highlighted in any other document and/or instruction to any person involved in the construction of the Building.

Response

Design Drawings

13 The seismic gap was detailed in the design drawings only, and repeated on sketches issued from time to time as construction proceeded.

Site Inspections

14 Numerous site inspections during the construction of the Building were carried out. Site inspections would usually include an inspection of the works in progress and inspection of any remedial works instructed to have been carried out by the construction contractor. The inspection would also usually include discussions with the construction contractor. The site inspections carried out were typically inspections of representative work from time to time, rather than continuous monitoring of work, in accordance with contract at the time and industry standard practice.

15 A site report would be produced after an inspection. The site reports were copied to Fletcher Development and Construction Limited (the Construction Contractor), Paynter Developments Limited (the Owner), Warren & Mahoney Architects Limited (the Architects) and Russell Drysdale & Thomas (the Quantity Surveyors).

16 I attach copy site reports dated 22 June 1988, 27 June 1988, 29 June 1988, 8 July 1988, 8 August 1988, 11 August 1988, 25 January 1989, 3 May 1989 and 3 May 1989 which all make reference to the stairs or seismic joints.

Site Report dated 8 July 1988

17 In the site report dated 8 July 1988, the inspecting engineer gives specific instruction in relation to the widening of the seismic joint. Most importantly the report instructs the removal of concrete on the supporting precast beam where the 30mm specified in the plans has not been achieved rather than removal of concrete from the end of the stair. This instruction was given due to the engineer recognising the presence of the steel angle on the stair. This instruction was issued so as to ensure the 30 mm seismic gap as specified in the design drawings was achieved.

Site report dated 25 January 1989

18 The site report dated 25 January 1989 instructs the Construction Contractor that 'the correction of the seismic gap on the stairs has not been carried out yet. This should be addressed as soon as possible'. The report does not specify which floor this relates to but, given the date of the report, I assume it was fairly high up the building.

19 The site reports demonstrate that the design engineer was reviewing the seismic gap to the stairs. She recorded issues requiring remediation of the seismic gap on at least two occasions. She would, no doubt, have inspected the seismic gaps on numerous occasions but only recorded an inspection specifically if the gap was an issue. The lack of seismic gap in some cases was noted and an appropriate instruction for correction was issued. On one occasion the Construction Contractor was chased up to carry out remedial/correction work.

20 **Other documentation**

Specification

21 I attach a copy of the relevant pages of the Specification issued to the structural trades. Section 6 relates to the concrete contractor.

22 At section 6.2.15, the specification obligates the concrete contractor to co-operate with the main contractor and all other affected subcontractors, in every way, to ensure the correct finished relationship, both as to dimensions, details, and such finishes, between his work and all other surrounding work.

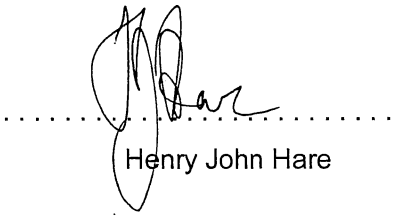
Letter dated 11 December 1997

23 Although not relating to the construction of the Building, I attach a copy of a letter from R G Wilkinson of Holmes Consulting Group to Trans Tasman Properties dated 11 December 1997 (dated some years after the completion of the Building). In this letter, Mr Wilkinson confirms that he had been asked to look at a void that exists below the vinyl flooring at the stair landing adjacent to the ladies toilets at level 10 of the Building.

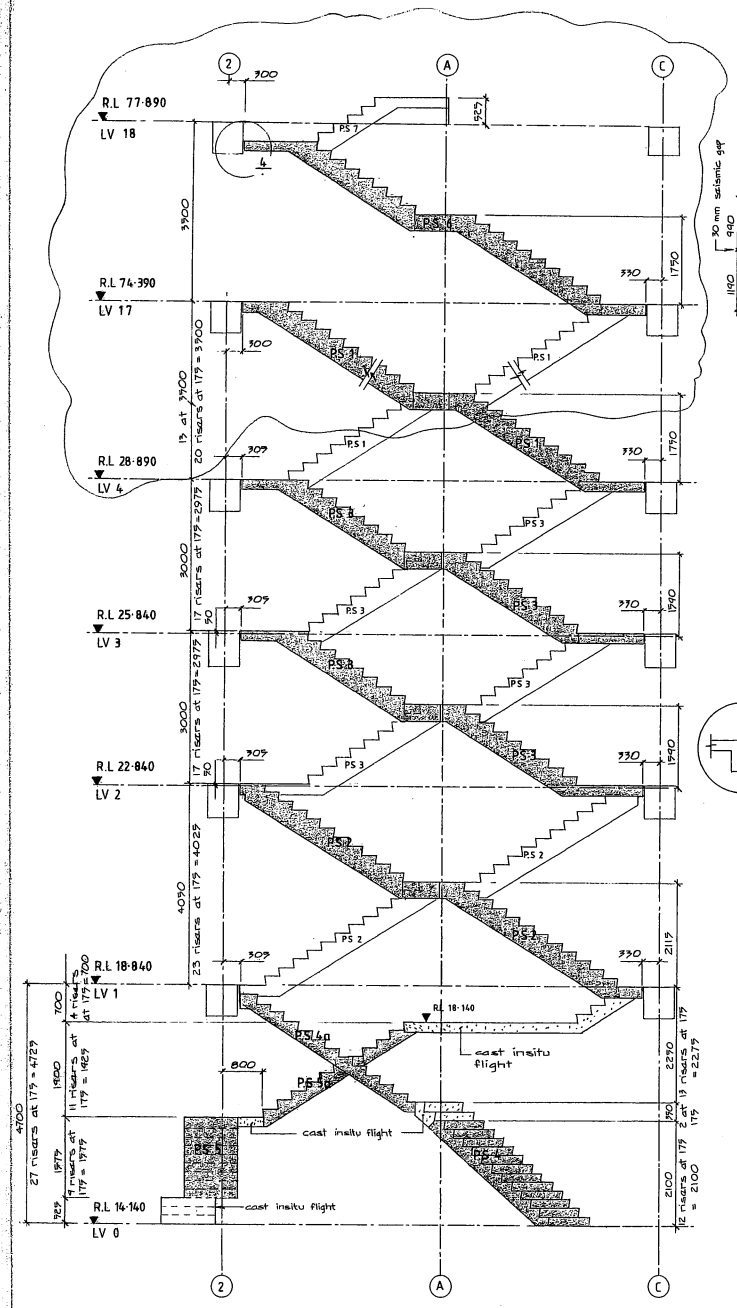
24 In his letter, Mr Wilkinson confirms that the void is intentional and a very important requirement of the safety of the stair flights. He also appears to

have supplied copy drawings demonstrating that the void is a 30mm seismic joint. He instructs Trans Tasman Properties to ensure the joint (and all others elsewhere in the building) is kept clear of incompressible material stating it is essential that the joint can freely open and close in a moderate or severe earthquake.

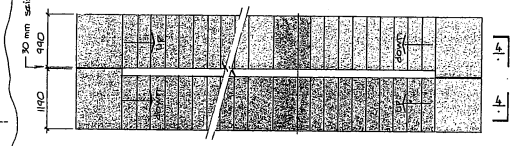
Date: 20th February 2012



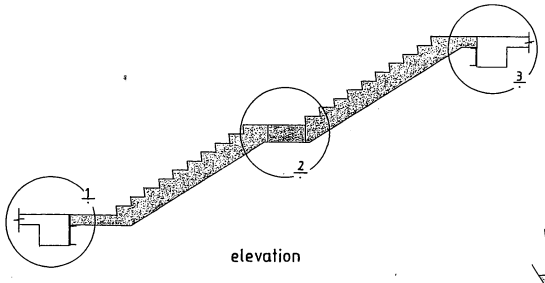
Henry John Hare



stair elevation

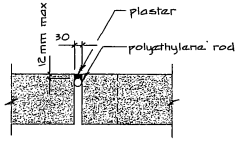


plan

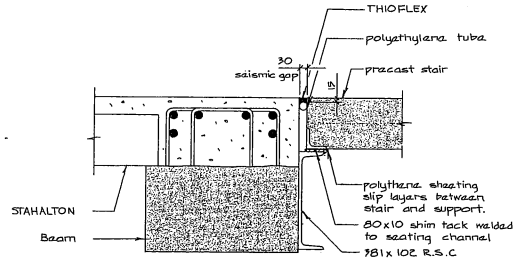


elevation

(typical stair flight connection)



4

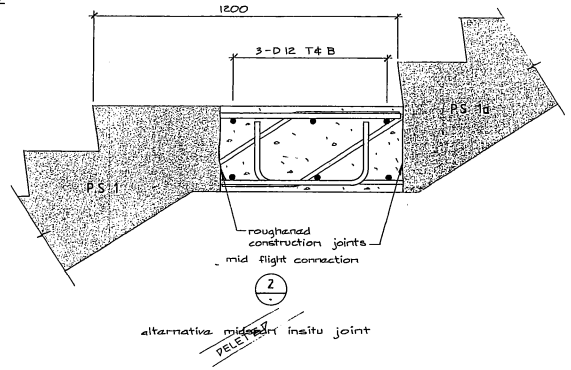


bottom connection

1

sliding detail

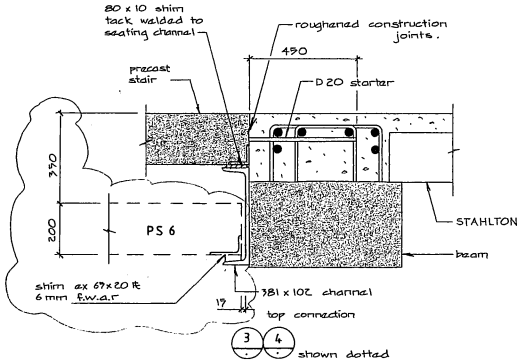
required at bottom of each flight



2

alternative mid-flight insitu joint

DELETED



fixed detail

required at top of each flight

ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE MAKING ANY SHOP DRAWINGS OR COMMENCING ANY WORK

For package number

4	6	7	8	9	10	11	12	13	14	15	17	18	19
					2								

Rev	Date	Amendment
1	4-3-88	Permit
A	7-7-88	Construction
B	6-5-88	P.S 5 & P.S 5a lowered

15-8-88
(2) added & shear P.S6 connection

Warren & Mahoney Architects Ltd
Christchurch Wellington & Auckland

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Christchurch, Wellington, New Plymouth, Auckland

ROBERT JONES HOUSE

CHRISTCHURCH

DRAWN: J.W SCALE: 1:50 1:10
APPROVED: R.A.P.

SHEET TITLE:
PRECAST STAIR CONNECTIONS AND LAYOUT

JOB NO:	SHEET NO:	REV:
2281	S 217	B

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Offices in Christchurch Wellington New Plymouth Auckland

SITE REPORT

JOB NAME ROBERT JONES HOUSE
JOB No 2281
SR No 25
DATE 22.06.88

WORK REVIEWED

PAGE 2

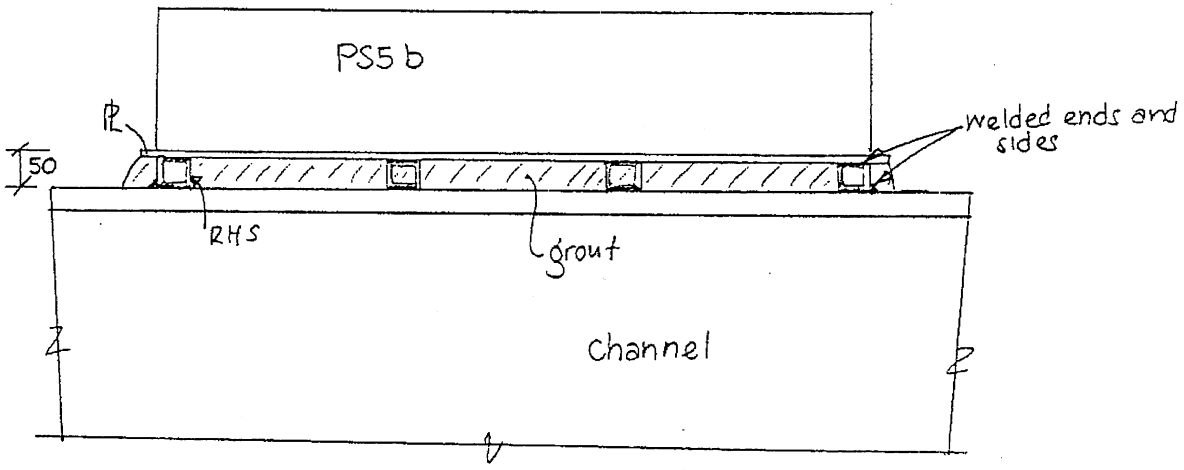
INSTRUCTIONS & COMMENTS

3. (Cont.)

Ducts on PS4a do not line up with the blockwall BW2. Drill holes through precast stair in the correct position to line up with the block wall. Epoxy in 2 D16 starters bars.

4. 50 mm Packer for Stair PS5b (Extension to PS5)

50 mm packer is required between 381 channel and the stair PS5b. Provide a plate supported by sections of RHS, welded to both the channel and the plate at the ends and at the sides. Section is then grouted up.
i.e.



Alternative systems can be submitted to the Engineer for approval.

J.M. Fisher

COPIES TO FLETCHER DEVELOPMENT AND CONSTRUCTION X2, PAYNTER DEVELOPMENTS, W+M, R.D.T.

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Offices in Christchurch Wellington New Plymouth Auckland

SITE REPORT

JOB NAME ROBERT JONES HOUSE
JOB No 2281

S R No 29
DATE 27/6/88

WORK REVIEWED

PAGE 2

INSTRUCTIONS & COMMENTS

Stairs PS5 and PS4 are incorrectly placed. The measurement in S.R. No. 25 from the edge of the 460 UB 74 to the edge of the stair should have read 175mm not 75mm. Therefore the 175mm to cut off the blockwall shown on sketch no.11 should be reduced to 50mm.

Requirements for H.S.F.G. bolting

The specification for high strength friction grip bolting is attached. H.S.F.G. bolts are used to attach the bathroom unit.

Slab Pour Level 2

Work to be completed before slab pour :

- precast beam ends to be scabbled
- 4 H20's to extend out of out-of-line columns as specified on S.R. No.15
- extra bars to be cut as not removed as requested this morning i.e. diagonal bars and extra D24 in end bays
- steel is to be lifted off the deck so correct cover will be achieved when concrete is poured.

Other notes :

- column B/9 is missing 1 stirrup at the bottom
- starters for F/1 and B/5 do not extend into column as drawn. Lap required is 600mm, therefore should be pushed back into the column junction.

J.M. FISHER

COPIES TO

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Offices in Christchurch. Wellington. New Plymouth. Auckland.

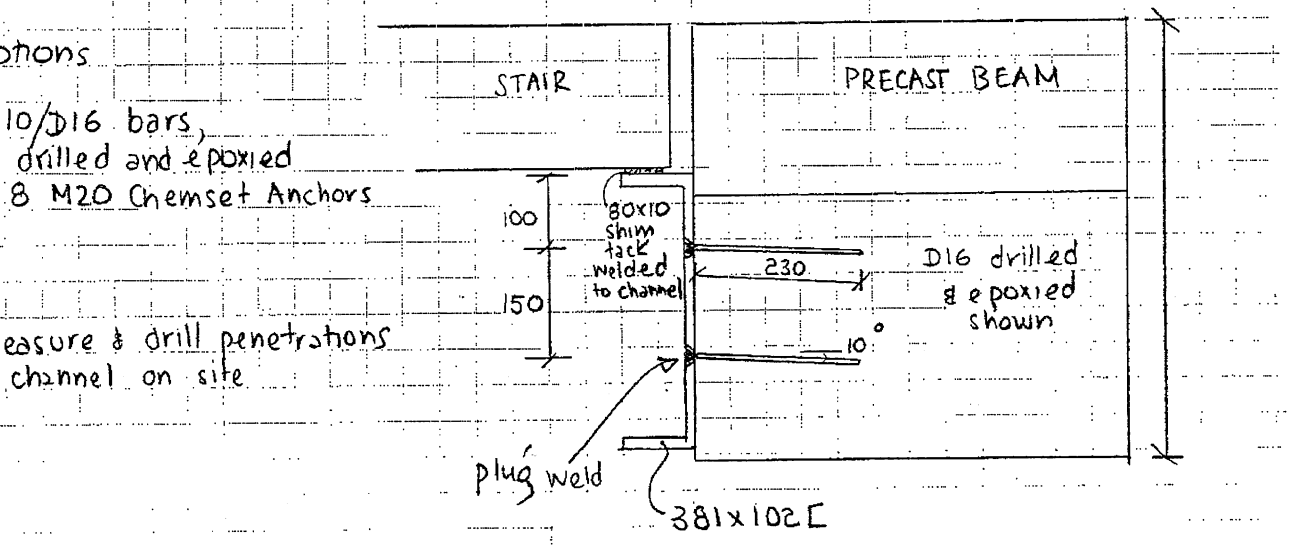
JOB TITLE ROBERT JONES HOUSE
JOB No 2281
SKETCH No 12
DATE 29/6/88

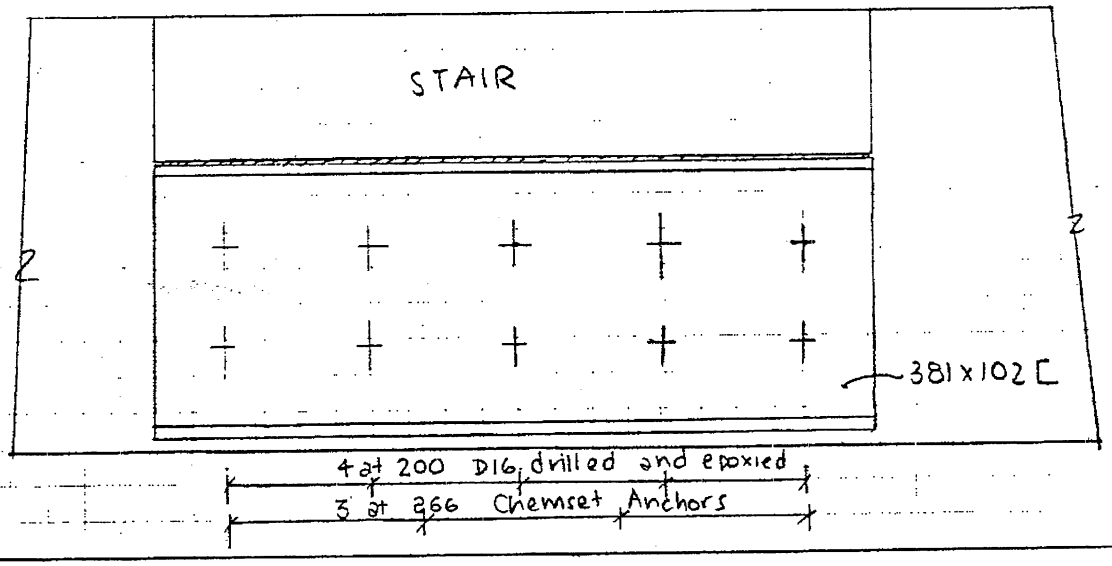
CHANNEL SUPPORT FOR STAIR PS2 ON LEVEL 1

NOTE Check all dimensions on site

Options
1 10/D16 bars, drilled and epoxied
2 8 M20 Chemset Anchors

Measure & drill penetrations in channel on site





G

[redacted]

[redacted]

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Offices in Christchurch Wellington New Plymouth. Auckland

SITE REPORT

JOB NAME ROBERT JONES HOUSE
JOB No 2281

S R No 34
DATE 08.07.88

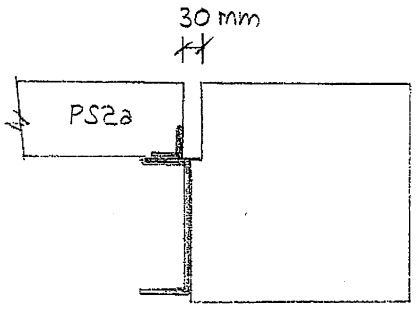
WORK REVIEWED

PAGE 2

INSTRUCTIONS & COMMENTS

STAIR SEISMIC GAP

The seismic gap at the bottom of stairs PS4a is 30 mm. The stairs going up from north to south from levels 1 to 2 and 2 to 3 have less than 30 mm. The level 2 to 3 stair is to be moved before level 3 is poured to acheive the 30 mmm seismic gap. Level two stair is cast in place. The 30 mm gap is to be acheived by cutting the required amount off the precast beam i.e.



J.M. Fisher

COPIES TO FLETCHER DEVELOPMENT AND CONSTRUCTION X2, PAYNTER DEVELOPMENTS, W+M, R.D.T.

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Offices in Christchurch Wellington New Plymouth. Auckland

SITE REPORT

JOB NAME ROBERT JONES HOUSE
JOB No 2281
S.R No 47
DATE 04.08.88

WORK REVIEWED

Precast beams 2b, 2c, 2, 2a.
Stair to blockwall connection PS4, PS5
Inspection of beam steel at Fletcher Reinforcing for pour 5B and 6A
Floor slab and beams for pour level 5B

INSTRUCTIONS & COMMENTS

PRECAST BEAMS 2b, 2c, 2, 2a

S.R. No. 44 should have read 'beams 2b, 2c, 2, 2a' instead of 'beams 2d, 2e, 2, 2a.' Recess is required for levels 10 to 17.

STAIR TO BLOCKWALL CONNECTION - PS4, PS5

New holes drilled through precast stairs to line up with the top of the blockwalls have been drilled with a diamond drill. Consequently the sides of the holes are too smooth to get a good bond between the grout and the concrete. The sides of the holes must be roughened and the holes cleaned out.

INSPECTION OF BEAM STEEL AT FLECTHER REINFORCING FOR POUR 5B AND 6A

Beam steel for pour 5B and 6A were inspected 1.8.88 and 4.8.88 respectively. All beam steel was O.K.

FLOOR SLAB AND BEAMS FOR POUR LEVEL 5B

There are a few points to note from this inspection:

1. The corbel steel in the beams had been displaced, during the placement of the unistrut fixings. The steel must be repositioned.
2. Beam to floor slab and column to floor slab ties had insufficient cover to the timber infills.
3. The construction joints around the internal columns and at the external columns have a smooth interface. Surfaces must be scabbled, and polystyrene around the bars removed.
4. All beams and beam/column joints must be cleaned out and tags removed from steel cages. Timber boxing in the construction joint at the internal column must be removed. This point was raised at the previous pour.
5. The cover to the column stirrups is zero in some places. No less than 20 mm is required in all locations as noted in site report No. 45.
6. Weldplates along lift pit opening: Weldplate at the internal column had one of the three lugs cut off and a lug gauged to allow placement.

1/2 ...

COPIES TO FLETCHER DEVELOPMENT AND CONSTRUCTION X2, PAYNTER DEVELOPMENTS, W+M,RDT

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Offices in Christchurch. Wellington New Plymouth Auckland

SITE REPORT

JOB NAME ROBERT JONES HOUSE
JOB No 2281
SR No 50
DATE 11.08.88

WORK REVIEWED

Inspection of stair PS1 at Devcon.
Inspection of precast beams 3b and 4b.
Sketches 13 and 14.

INSTRUCTIONS & COMMENTS

INSPECTION OF STAIR PS1 AT DEVCON

All reinforcing and steelwork O.K. except cover to top reinforcing was only 10 mm. cover to reinforcing is to be 25 mm.

INSPECTION OF PRECAST BEAMS 3B AND 4B

All formwork and reinforcing O.K.

SKETCHES 13 AND 14

Please find attached sketches 13 and 14 relating to amendments to drawings S200 and S133 respectively.

J.M. Fisher

COPIES TO FLETCHER DEVELOPMENT AND CONSTRUCTION X2, PAYNTER DEVELOPMENTS, W+M, RDI

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Offices in Auckland Christchurch New Plymouth Sydney Wellington

SITE REPORT

JOB NAME ROBERT JONES HOUSE
JOB No 2281

S R. No 106
DATE 25.01.89

WORK REVIEWED

- Inspection of remedial work - level 17
- Seismic stair gaps
- Ramp 1-2 - top portion

INSTRUCTIONS & COMMENTS

INSPECTION OF REMEDIAL WORK - LEVEL 17

- Sawdust was excavated out of column joint on M/4 and M/6. Excavation depth was greater than 50 mm. Repair with a mixture of SIKA TOP 212 as described in site report no. 74.
- Excavation into column joint on M/10 showed that the sawdust had only penetrated 10 - 20 mm - no repair required.
- Excavation of the P/C beam joint at B/5 had not been done.

SEISMIC STAIR GAPS

The correction of the seismic gap on the stairs has not been carried out yet. This should be addressed as soon as possible.

RAMP 1 - 2 - TOP PORTION

At the time of inspection some of the steel had yet to be placed i.e. : D16 tie-in out of column in blockwall, line 14, curb steel, remainder of mesh.

- Starters off beam on grid 1 should be D12 at 300 (see SR 81)
- Starters out of blockwall, grid 14 should be D12 at 400, not at 600 and 800 as present. Blockwall starters missing for portion at top of ramp.
- Concrete to be cleaned off top steel, beam grid 1.
- Starters out of tower to be straightened.

J.M. FISHER

COPIES TO FLETCHER DEVT. AND CONST.; PAYNTER DEVT.; W + M; R.D.T.

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Offices in Auckland Christchurch New Plymouth Sydney Wellington

SITE REPORT

JOB NAME Robert Jones House
JOB No 2281

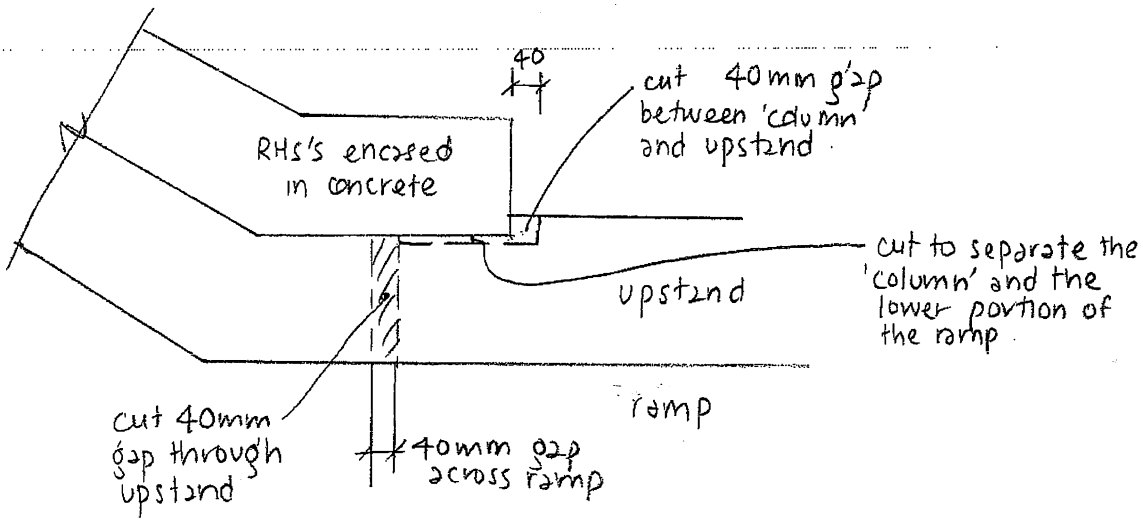
S.R. No 116
DATE 03.05.89

WORK REVIEWED

Page 2.

INSTRUCTIONS & COMMENTS

Grid 13.5



Floor Construction Joints

The construction joints on the tower floors, where they are uneven, are to be ground flush or leveled with a levelling compound.

J.M. McMillan

COPIES TO Fletcher D&C; Paynter Dev; W&M; RDT.

HOLMES CONSULTING GROUP
STRUCTURAL AND CIVIL ENGINEERS
Offices in Auckland Christchurch New Plymouth Sydney Wellington

SITE REPORT

JOB NAME Robert Jones House
JOB No 2281

S.R. No 116
DATE 03.05.89

WORK REVIEWED

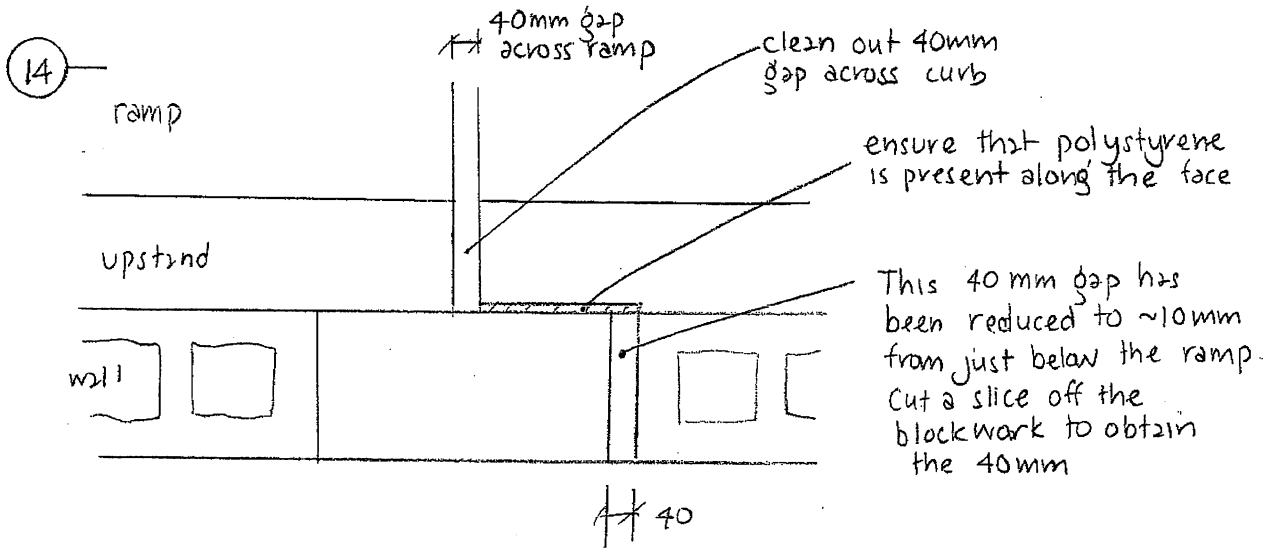
Ramp 2-3 seismic gap.
Floor construction joints.

INSTRUCTIONS & COMMENTS

Ramp 2-3 Seismic Gap.

The 40mm seismic gap at Grid K is not continuous across the width of the gap. It has been sealed at either side. Rectify as shown:

Grid 14



Part Plan

COPIES TO Fletcher D&C; Paynter Dev; W&M; RDT.

LANDMARK DEVELOPMENT,

CHRISTCHURCH

SPECIFICATION

STRUCTURAL TRADES ONLY

JOB NO. 2281 MARCH 1988

6.0 CONCRETOR ISSUE C

This section of the specification applies to the following packages :

Package No.	Package Name	Issue	Date of Issue
6	Substructure Work	A	5.2.88
7	Tower superstructure	C	4.3.88
8	Podium structure	C	4.3.88
9	Precast concrete beams	C	4.3.88
10	Precast concrete stairs	C	4.3.88
12	Precast floors	C	4.3.88
13	Precast Spandrel Panels	C	4.3.88
31	Toilet blocks	C	4.3.88

Issue	Date	Clause Added or Altered
A	5.2.88	First issue
B	17.2.88	Cl. 6.5, 6.6
C	4.3.88	6.2.2, 6.2.3, 6.2.4, 6.2.5, 6.2.6, 6.2.7, 6.2.8, 6.5, 6.6.2, 6.17, 6.18, 6.19, 6.20, 6.21, 6.22, 6.23

CONCRETOR

6.1 PRELIMINARY

Refer to the Preliminary and General Clauses of this specification and to the General Conditions of Contract, which are equally binding on all trades. This section of the specification shall be read in conjunction with all other trades.

6.2.1 EXTENT OF WORK - PACKAGE NO.6 - SUBSTRUCTURE WORK

This section of the Contract consists of the supply, forming and casting of all cast in place plain and reinforced concrete in the tower foundation raft slab, crane base corbels, crane base pad and crane base plinths. The concrete plinths at the base of the two corner columns is included in this section of the contract.

6.2.2 EXTENT OF WORK - PACKAGE NO.7 - TOWER SUPERSTRUCTURE

This section of the contract consists of the supply, forming and casting of all cast in place plain and reinforced concrete including all items necessary to complete the concrete work indicated on the contract drawings as being part of the tower superstructure but not specifically described elsewhere in this specification.

The supply on truck to the site of precast beams, precast stairs, precast Stahlton floors, precast lobby slabs and prefinished toilets is specified under other sections of this specification. The CONCRETOR is to erect all of the aforementioned precast elements.

CONCRETOR is to trim and place all Stahlton timber infills for the Tower floor areas.

The supply and placing of grout for filling blockwork is by CONCRETE BLOCKLAYER.

6.2.3 EXTENT OF WORK - PACKAGE NO.8 - PODIUM STRUCTURE

This section of the contract consists of the supply, forming and casting of all cast in place plain and reinforced concrete including all items necessary to complete the concrete work indicated on the contract drawings as being part of the podium structure but not specifically described elsewhere in this specification.

The supply on truck to the site of precast beams, precast Stahlton floors, and precast spandrel panels is specified under other sections of this specification. The CONCRETOR is to erect all of the aforementioned precast elements.

6.2.3 EXTENT OF WORK - PACKAGE NO.8 - PODIUM STRUCTURE cont.

CONCRETOR is to trim and place all Stahlton timber infills for the podium floor areas.

The supply and placing of grout for filling blockwork is by CONCRETE BLOCKLAYER.

6.2.4 EXTENT OF WORK - PACKAGE NO.9 - PRECAST BEAMS

This section of the contract consists of the supply, casting and finishing of all concrete for the precast beams as detailed on the drawings.

6.2.5 EXTENT OF WORK - PACKAGE NO.10 - PRECAST STAIRS

This section of the contract consists of the supply, casting and finishing of all concrete for the precast stairs as detailed on the drawings.

6.2.6 EXTENT OF WORK - PACKAGE NO.12 - PRECAST LOBBY SLABS

This section of the contract consists of the supply, casting and finishing of all concrete for the precast lobby slabs as detailed on the drawings.

6.2.7 EXTENT OF WORK - PACKAGE NO.13- PRECAST SPANDREL PANELS

This section of the contract consists of the supply, casting and finishing of all concrete for the precast spandrel panels as detailed on the drawings.

6.2.8 EXTENT OF WORK - PACKAGE NO.31 - TOILET BLOCKS

This section of the contract consists of the supply, casting and finishing of all concrete for the precast toilet blocks as detailed on the drawings.

6.3 MATERIALS AND WORKMANSHIP

The CONCRETOR shall adhere to all requirements of NZS 3109: 1980, except where specified otherwise herein or instructed otherwise by the Architect of Engineer. A copy of this standard shall be kept on the site and relevant parts read with the following clauses of this specification.

6.4 INSPECTION

The Engineer will inspect construction in accordance with NZS 3109: 1980, clause 1.3.The CONCRETOR shall supply evidence to the Engineer in advance of the construction in accordance with NZS 3109: 1980, clause 6.10.

6.5 CONCRETE

Site concrete and concrete required to make good excavations shall be 7 MPa at 28 days or better.

All other concrete shall be SPECIAL GRADE as defined in NZS 3109, Clause 6.2 from an approved ready mix plant.

Site concrete	7 MPa
Tower foundation raft slab,	30 MPa
Crane base corbels, pads and plinths	30 MPa
Lift pit base slab and transformer room floor and walls (to have a minimum cement content of 370 kg per cu. metre of concrete, and have approved additives to minimise water content and shrinkage)	35 MPa
Tower external columns and beams	40 MPa
Internal columns, beam column joints and infills between precast beams	30 MPa
Podium foundation beams and pads	30 MPa
Floor toppings over Stahlton planks and timber infills	30 MPa
All other concrete	30 MPa

Notwithstanding the above, all concrete poured as part of the "floor" pour for level 1 and level 2 shall be 40 MPa. For the "floor" pours above level 2 the CONCRETOR shall discuss with the Engineer the management process required to ensure that concrete of differing strengths can be properly accounted for during the subsequent "floor" pours.

Maximum aggregate generally shall be 19mm except that in 75mm thick floor toppings maximum size shall be 15mm.

6.6 QUALITY ASSURANCE

6.6.1 Concrete Testing by Supplier

The ready mix supplier shall make control tests in accordance with NZS 3104, and shall pay the cost of such tests. Tests shall be made either at the ready mix plant, or at the site, except that if the Engineer specifically calls for tests at the site as a result of any dissatisfaction with the plant testing procedure, these shall be done by the ready mix supplier.

6.6.2 Independant Concrete Testing (Packages 4,7 and 8)

A programme of independant concrete testing will be carried out on concrete supplied for package nos 4,7 and 8.

6.6.2 Independant Concrete Testing (Packages 4,7 and 8) cont.

The test results from these independant tests shall be recognised by the concrete supplier and the engineer as accurately determining the 28 day strength of the concrete being supplied to the site. They shall not be challenged.

The tests shall be carried out under the direction of a Registered Engineer or his nominated representative. All sampling and testing shall be done to NZS 3112 : Part 2 : 1986 by personnel approved by the Registered Engineer and all laboratory work must be done in a Telarc approved laboratory.

The concrete supplier must submit with his tender the name of a Registered Engineer (New Zealand) experienced in the field of concrete testing who will undertake to do this independant testing.

The concrete supplier's tender must state the Registered Engineer's fee on a per test set basis.

The Engineer will determine the number, timing and frequency of the independant tests required during the course of this contract.

The test results must be made available to the concrete supplier, engineer and the main contractor within 29 days of taking the concrete samples.

6.6.3 Rejection Limits for Concrete

If a plant test result or an independant test result shows that the 28 day crushing strength of the test cylinders is less than the rejection limit specified in Table 9 of NZS 3104 : 1983 then all concrete from that batch will be rejected.

If concrete is rejected, the concrete supplier may have his contract to supply concrete to the project terminated immediately by the Engineer or the Main Contractor. Furthermore, the concrete supplier will be required to pay the full costs associated with removing the rejected concrete and completely reinstating the structure to the condition it was in at the time of notification of rejection.

If the independant test results show more than one test result lower than the specified concrete strength then the concrete supplier may have his contract to supply concrete to the project terminated immediately by the Engineer or the Main Contractor.

6.7 REINFORCEMENT

Reinforcement, including all necessary distance pieces required to maintain cover, shall be supplied and fixed by REINFORCING STEELWORKER. Provide and fix concrete inserts for threaded starters where detailed.

The foreman, or a competent workman, is to be responsible for checking that reinforcement is not displaced during concreting. Any reinforcement so displaced is to be corrected by the REINFORCING STEELWORKER, who is to be continuously on call during all concrete pours. Any reinforcing displaced or damaged through the CONCRETOR's neglect is to be remedied by the REINFORCING STEELWORKER and the cost borne by the CONCRETOR.

6.8 VIBRATORS

Vibrators shall be used for the placing of all concrete. They shall be high frequency type of approved pattern.

Vibrators shall be moved to new positions as frequently as necessary to ensure uniform vibration of the whole mass and fully compacted concrete. On no account shall vibrators come within 12mm of the face of the formwork. Vibrators shall not be used to transfer concrete from one position to another.

6.9 FORMWORK AND CONCRETING

Formwork and concreting shall conform to NZS 3109, Sections 5 and 7. Formwork shall be so designed and constructed that concrete can be placed and thoroughly compacted without loss of grout. All joints shall be tight and close fitting to prevent leakage. To avoid stepping or ridges at construction joints, formwork shall be tightly secured against previously cast or hardened concrete. Fairface finishes are specified later.

Construction joints shall conform with NZS 3109, clause 5.6.2. type B, unless agreed otherwise with the Engineer and their position shall be as detailed on the drawings.

Before pouring commences, the Engineer or his representative shall be notified and a reasonable opportunity given him to inspect formwork, reinforcement and construction joints. Pouring shall be between properly positioned stops.

Kickers at the base of columns and walls shall not be used unless the concrete in the kicker is placed and fully vibrated with the main pour to the Engineer's satisfaction, or unless as a separate pour a special high strength mix is used and fully vibrated. Details of this mix shall be to the Engineer's approval.

6.9 FORMWORK AND CONCRETING continued

Stripping times shall be as in NZS 3109, Clause 5.4, unless otherwise agreed by the Engineer.

Repair all defects in the concrete to the satisfaction of the Engineer immediately after stripping.

6.10 CURING AND PROTECTION

All concrete shall be cured as defined in NZS 3109, clause 7.7. The use of plastic curing compound shall be as agreed with the Engineer specifically for each occasion before it is used.

Fairface concrete and slab surfaces shall be protected from damage at all times. Concrete surfaces damaged shall be repaired or remade to the satisfaction of the Architect at not extra cost.

6.11 PROTECTION OF BLOCKWORK

Protect blockwork from damage and extraneous loading during construction operations. Formwork shall be carefully fitted and sealed against blockwork as necessary and grout spills shall be removed before they set.

6.12 REPAIRS AND CLEANING

After all the concrete work of the building has been completed and the majority of other trades finished (except for PAINTER and FLOOR COVERINGS) all finished exposed concrete surfaces throughout, including precast concrete, shall be closely inspected for faults in surface finish, damage to corners and edges, dirty marks, splashes or dribbles, and visible imperfections of every kind.

All such imperfections shall be removed by the Contractor to the Architects's complete satisfaction and under his direction.

Patching or filling of fairface concrete and making good broken edges and corners shall be done with coloured sands and cement where necessary, to match precisely the colour of the surrounding concrete when dry. Epoxy or similar adhesives shall be used when required.

The removal of surface markings shall be most carefully done by appropriate methods such as wire brushing, pumice stoning, carborundum stone, or washing and scrubbing; such as will remove the marks without scratching, discolouring or otherwise affecting the surrounding or underlying concrete.

6.13 CONCRETE FINISHES

6.13.1 General

All concrete finishes shall be in accordance with NZS 3114:1987.

All slab finishes shall be in accordance with Part 3 NZS 3114:1987.

All other finishes shall be in accordance with Part 1 NZS 3114:1987.

Finishes not specified elsewhere in this section or on the drawings shall be in accordance with Table 1 of NZS 3116.

6.13.2 Slab Finishes

Slabs to take plaster or tiles and the foundation raft slab shall be finished to U2 i.e. floated finish.

All other slabs shall be finished to U3, i.e. power floated.

Floating and any subsequent finishing shall be at the correct time and intervals to obtain the quality of compaction and finish required. No trowelling in of fines and dry cement will be permitted.

The CONCRETOR shall arrange the pouring to allow adequate time for floating and finishing. Calcium chloride shall be incorporated in the concrete only with the specific approval of the Engineer.

All trowelling ridges shall be removed while green or by subsequent light grinding. Slabs not fulfilling the standard of finish required shall be round smooth or otherwise treated to the satisfaction of the Engineer. Care shall be taken to avoid ridges where newly poured slabs meet existing edges.

6.13.3 Formed Surfaces

Tolerances shall conform with NZS 3114:1987.

Classes of formed finishes are defined in Table 1 NZS 3114:1987.

Refer to the following clause for schedule of finishes required.

In general, form fairface finish surfaces with standard sheets of plywood placed in a regular pattern and tightly butted together to avoid grout loss. The joints shall be sealed with plastic sealant strips or cover battens to prevent grout loss. Formwork shall be sealed with not less than two coats of polyurethane varnish on the concrete face.

6.13.3 Formed Surfaces continued

Fairface formwork shall be so constructed as to provide straight and true angles and so as to produce cast surfaces within a tolerance of plus or minus 3mm on the given dimensions and without visible offsets, bulges, or misalignment of the concrete. Form clean, neat arrises, except where chamfers are shown on the drawings, in which case the fillets shall form part of the mould side and not be loosely added.

The formwork surface in contact with the concrete shall be clean and shall be treated with a suitable form release oil to ensure separation from the concrete. Care shall be taken that oil is kept out of contact with the reinforcement. All rubbish, clippings, shavings and sawdust shall be removed from the formwork immediately before concrete is placed. Formwork shall be checked for dimensional accuracy and alignment, before, during and after concreting and damaged formwork shall be replaced.

All ties and spreaders shall be of an approved type and placed so as to leave a regular and neat pattern on the surface when withdrawn and filled. Wire ties will not be permitted.

All formwork shall be removed without shock or vibration which might damage the concrete.

CONCRETOR shall be responsible for repairing any defects immediately after stripping the formwork. Fill honeycombing with 1:2 cement:sand mortar. Major defects shall be referred to the Engineer.

Filling honeycombing and repair defects immediately after stripping the formwork.

6.13.5 Schedule of Surface Finishes

Item	Class of Finish
Foundation raft slab	U2
Slabs to take plaster or tiles	U2
Ramps, lightly broom after finishing	U3
All other slabs and toppings	U3
Formed concrete to take plaster and tiles	F2
Concrete not exposed in finished building, including surfaces hidden behind ceilings, wall linings and the like	F3
Concrete exposed in the finished building, and concrete surfaces to receive enduit plaster; these surfaces to be rubbed down to remove ridges provided this shall only be done after being referred to and decided by the Architect	F5

6.14 SITE CONCRETE

Place a nominal 50mm thick layer of site concrete under the foundation raft slab and lift pit slab. Screed off site concrete to a level surface to suit the underside of these slabs.

Place or spray a nominal 50mm thick layer of site concrete on all of the batters to the sides of the lift pit excavation and associated foundation beam trenches.

6.15 LIFT PIT FLOOR SLAB

Cast the lift pit floor slab in one continuous operation including the construction of the wall plinth upstands and casting in of the PVC waterstop.

The slab is to act as a waterproof membrane in its finished condition, and it is most important that cracking is avoided. Concrete mix design, placing, finishing and curing shall all be controlled to achieve this.

Build in all falls, sumps and the integral upstand wall plinths as detailed on the drawings.

Supply and build in Expandite PVC waterstops at the construction joint location at the base of the lift pit walls.

The internal waterstop shall be 140mm standard profile PVC waterstop with fully welded joints installed in accordance with the manufacturers recommendations.

Protect all waterstops from damage. Take great care to ensure that concrete is fully vibrated around waterstops to ensure a watertight joint. Any joints which later leak shall be injected with an approved epoxy filler, as necessary injecting several times, to prevent all water from entering at joints.

The lift pit floor slab shall be water-cured for at least five days after casting. Particular care shall be taken at all times in maintaining slabs damp at all times to ensure as much as possible that no cracks are formed and that concrete is of minimum porosity.

6.16 FOUNDATION RAFT SLAB

The foundation raft slab is to be cast in one continuous pour including lift pit walls and concrete plinths at the base of the two corner columns.

Concrete shall be poured by advancing a continuous fresh concrete sloping front from one side of the raft to the other side.

6.16 FOUNDATION RAFT SLAB continued

CONCRETOR must ensure that concrete is placed in the raft slab within 30 minutes of batching.

CONCRETOR must ensure that no more than 60 minutes elapses before fresh concrete is placed over previously placed concrete and fully vibrated to ensure complete integration of the concrete layers. This requirement also applies to the plinths under the corner columns.

CONCRETOR must allow to batch, supply and place at least 100 cu. metres per hour. Concrete supplier will need to supply concrete from at least two independant batching plants and have standby batching capacity available. The full responsibility for the supply of the specified concrete must be with one nominated concrete supply company.

Significant thermal effects can result from large pours of this nature. To minimise these effects the CONCRETOR shall allow to precool the aggregates by water spraying or another approved method for at least 12 hours prior to the commencement of the pour. Cooling of the aggregates must be continued until the pour has been completed.

The CONCRETOR shall further minimise thermal effects by progressively beginning water curing the top of the raft slab as soon as an area of concrete has sufficiently set. The top of the raft slab is to be kept completely wet for at least five days after completion of the pour.

At the time of tendering the CONCRETOR shall submit with his tender full details of the equipment proposed to be used, numbers and designation of personnel to be involved with the pour, capacity of all items of plant and equipment along with full details of backup and standby equipment.

If the pour has to be abandoned part way through, the CONCRETOR will be required to break back and fully prepare a vertical construction joint at a location to be agreed by the Engineer.

6.17 COLUMNS

Construct columns to the dimensions shown on the drawings.

External and internal tower columns are to have a construction joint at the beam soffit level.

Podium columns on grid line N from Grid 4 to 14 are to have a construction joint 20mm below the precast beam soffit level.

All columns will have construction joints at floor levels.

6.17 COLUMNS continued

Care must be taken to maintain reinforcement in the correct locations during placement of concrete in order to ensure that precast beams and prefabricated reinforcement cages will subsequently fit in position.

6.18 PRECAST BEAMS

Take delivery of precast beams and erect between columns within the tower or onto columns on grid line N.

Internal tower beams are to sit on loadbearing formwork adjacent to external columns and on prepositioned props adjacent to internal column faces. Midspan props are to be snug tightened before casting beam column joints or laying Stahlton flooring. Note that the notional seating of the precast beams at the internal columns will not safely support the weight of the precast beams without the assistance of the prepropping adjacent to these columns.

Podium beams are to sit on prelevelled steel packers on grid line N columns. On top of insitu columns set prelevelled steel packers to required height and surround with 1:4 cement:sand mortar neatly trowelled off at edges. Take care to ensure that packers are at least 50mm in from the edges of the column. Podium beams are to sit on loadbearing formwork at the junction point between grids M and N and be supported at the tip of the cantilever on grid line O.

The joint between the underside of the podium beams and the insitu columns shall be sealed with Expandite EVA pre-formed strip or an equivalent strip with the approval of the Engineer.

Fill the joints and the ducts with Healings Conbextra GP or Sika 212 high strength grout. The top of the column and underside of the precast beam is to be moistened before grouting. Mix the grout to the manufacturers recommendations to achieve a uniform fluid consistency. Fill the ducts and joint by pouring the grout in through one corner duct to ensure that all parts of the ducts are joint are totally filled. This can be checked by observing the grout rising up in the other ducts. If grout does not rise up to within 150mm of the top surface of the precast beam then a blockage must be assumed, all grout flushed out, all ducts checked for obstructions and the joint regrouted. Top up the other ducts to the level of the top of the precast beams.

Allow at least 12 hours before placing flooring units to allow the grout to set and cure.

6.19 PRECAST STAHLTON FLOORS AND TOPPINGS

Take delivery of all precast Stahlton floor planks and flat slabs and erect onto beams, walls and backpropping.

In general, all Stahlton floors will be propped to the manufacturers recommendations. Backpropping of floors shall be to the manufacturers recommendations.

The size of the props shall be designed to carry all dead loads and construction live loads.

Take delivery of timber infills, cut and place infills between Stahlton planks. Ensure that timber infills are placed and levelled as necessary to achieve the concrete topping thicknesses shown on the drawings. Clean down tops of precast planks and cast topping slabs as detailed. Note that some areas of topping are thicker and some toppings are varied in thickness.

Levels shall be taken on the tops of the precast planks to ensure the correct precamber is provided and to ensure that after depropping the slab shall be within the level tolerances specified and that the slab has the correct minimum slab thickness.

Use 12mm aggregate concrete in toppings. No crack control sawcuts are required, but the CONCRETOR shall allow to discuss the position of construction joints with the Engineer in advance of casting, to ensure that shrinkage cracking of the toppings can be minimised where possible.

Cast in place slabs as detailed, using either 12 or 20mm aggregate concrete. Slabs shall be left propped for a minimum of 10 days after casting.

Cure all slabs with water or an approved curing compound for a minimum of three days after casting. All curing compounds will need to be approved by the Engineer before being used.

6.20 PRECAST STAIRS, PRECAST LOBBY SLABS, PRECAST TOILET SLABS

Take delivery of all precast prefinished elements and erect onto steel beams. Co-operate with STRUCTURAL STEELWORKER to ensure that all bolted and welded connections are made. Discuss with the Engineer in advance of erection the proposed procedures and erection techniques to be used.

6.21 PRECAST SPANDREL PANELS

Take delivery of all precast spandrel panels and erect onto precast beams and RHS mullions before the floor topping is cast.

6.22 INSITU BEAMS

Form and cast the insitu beams as detailed on the drawings. The formwork shall be designed as loadbearing formwork to support the weight of the Stahlton planks.

6.23 EPOXY GROUTING IN STARTER BARS

The drawings show some reinforcement bars that are to be epoxied into position.

The engineer will instruct the contractor to epoxy other bars into position by way of his Site Reports. In cases where starter bars have not been placed in the appropriate pour, the contractor shall notify the engineer who may instruct the contractor to epoxy these bars in.

a) Holes must be drilled with hammer drills. Diamond core drilling is not acceptable. The hole diameter must be at least 6mm greater than the bars to be epoxied in for bars up th 20mm diameter and at least 10mm greater than for bars 24mm diameter and greater.

b) The depth of hole and embedment of the reinforcing bars shall be to the minimum depths set out in the table below unless the engineer instructs a different depth of hole on the drawings or in the site instructions.

Bar	Depth	Bar	Depth
D10	150mm	H10	150mm
D12	170	H12	190
D16	230	H16	270
D20	340	H20	380
D24	470	H24	500
D28	630		

c) Holes for vertical bars shall always be vertical and holes for horizontal starters shall slope downward at 15 degrees.

d) Holes shall be cleaned out using a modified nozzle to fit a compressed air source so that all dust and debris is blown out from the base of the hole.

e) All holes must be dry prior to filling with epoxy unless the epoxy used is suitable for wet hole or underwater application.

6.23 EPOXY GROUTING IN STARTER BARS continued

f) The holes shall be filled with epoxy prior to inserting the reinforcing bar. Vertical holes can be filled from above with a pourable grade epoxy. Horizontal holes must be filled from the bottom of the hole with a "plastic" epoxy using purpose made and filled cartridges in a "sealant" gun. Standard cartridges shall be modified by placing some plastic hosing over the cartridge nozzle of sufficient length to reach the base of the drilled hole.

g) Bars shall be placed in the holes, shall be fully supported if necessary and left undisturbed for at least 24 hours. After 24 hours horizontal bars installed at 15 degree slope can be bent horizontal.

h) After the bars have been placed in position ensure that the epoxy fills the hole right to the original surface of the concrete. Top up holes if necessary.

i) A large range of construction epoxies are available. The contractor shall use Expocrete S (or similar with prior approval of the Engineer) for all vertical holes. The contractor shall use Expocrete UA (or similar with prior approval of the Engineer) for all horizontal holes.

j) Mixing and handling instructions vary from manufacturer to manufacturer. The contractor shall firmly adhere (pun) to the instructions for the epoxy being used.

k) Notify the engineer of the names of the site staff responsible for ensuring that this section of the specification is being followed.

6.2 PRECAST STAIRS ISSUE A

This section of the specification applies to the following packages;

Package No.	Package Name	Issue	Date of Issue
10	Precast Stairs	A	04.03.88

Issue	Date	Clause Added or Altered
A	04.03.88	First Issue

PRECAST STAIRS

6.2.1 PRELIMINARY

Refer to the Preliminary and General Clauses of this Specification and to the General Conditions of Contract, which are equally binding on all Trades. This section of the specification shall be read in conjunction with all other sections.

6.2.2 EXTENT OF WORK - PACKAGE NO. 10 PRECAST STAIRS

This section of the Contract consists of the manufacture and delivery on truck at site of all precast concrete stairs, complete with all reinforcement, weldplates, boltplates, bolts, inserts and any other fixings or lifting eyes required by the main contractor to erect the stairs.

6.2.3 MATERIALS AND WORKMANSHIP

All formwork, concrete and concreting and finishing shall be in accordance with the relevant clauses of CONCRETOR except where noted otherwise in this section.

All reinforcement shall be supplied, bent and placed in accordance with the relevant clause of REINFORCING STEELWORKER.

All Metalwork shall be supplied, fabricated and placed in accordance with the relevant clauses of STRUCTURAL STEELWORKER.

6.2.4 INSPECTION

The Engineer will inspect construction in accordance with NZS 3109:1980, Clause 1.3.

The Contractor shall supply evidence to the Engineer in advance of the construction in accordance with NZS 3109:1980 Clause 6.10.

The Engineer or his representative may inspect the precast stair units at all stages of manufacture to ensure conformity with this Specification. Units which do not conform to the required tolerances, which show grout leakage, which have been damaged or which are otherwise defective shall be liable to rejection and may be used in the structure only at the Engineer's discretion. No repair work shall be done without specific instructions from the Engineer.

6.2.5 CONCRETE

All concrete shall be SPECIAL GRADE complying with NZS 3109: 1980 Clause 6.2, and from an approved ready mix plant.

Concrete shall have a minimum 28 days strength of 35 MPa and sufficient cement concrete to ensure satisfactory surface finish and durability.

Aggregates shall satisfy the requirements of Clause 6.4 of NZS 3109 and shall be 18mm maximum size.

6.2.6 REINFORCING

Supply, bend and place all reinforcing as detailed on the drawings and in accordance with the relevant clauses of the REINFORCING STEELWORKER section of this specification.

6.2.7 TOLERANCES

All precast stair units shall be manufactured to the following tolerances, unless otherwise stated on the drawings.

Length	+/- 6mm
Cross section	+/- 3mm
Squareness (of cross sections and ends)	+/- 3mm
Twist (dimension from plane containing other 3 corners)	+/- 5mm
Built in items, typically:	+/- 5mm

The above tolerances are given as a guide. Their application in any particular case shall be subject to interpretation by the Engineer.

6.2.8 FINISHES

6.2.8.1 General

All concrete finishes shall be in accordance with NZS 3114:1980.

6.2.8.2 Formed Surfaces

Classes of formed finishes are defined in Table 1 NZS 3114:1980.

Refer to the following clause for schedule of finishes required.

In general, form fairface finish surfaces with standard sheets of plywood or steel placed in a regular pattern and tightly butted together to avoid grout loss. The joints shall be sealed with plastic sealant strips or cover battens to prevent grout loss. Formwork shall be sealed with not less than two coats of polyurethane varnish on the concrete face.

Fairface formwork shall be so constructed as to provide straight and true angles and so as to produce cast surfaces within a tolerance of plus or minus 3mm on the given dimensions and without visible offsets, bulges, or misalignment of the concrete.

6.2.8 FINISHES continued

6.2.8.2 Formed Surfaces

Form clean, neat arrises to all exposed corners, except where chamfers are shown on the drawings, in which case the fillets shall form part of the mould side and not be loosely added.

The formwork surface in contact with the concrete shall be clean and shall be treated with a suitable form release oil to ensure a clean separation from the concrete. Care shall be taken that oil is kept out of contact with the reinforcement. All rubbish, clippings, shavings and sawdust shall be removed from the formwork immediately before concrete is placed. Formwork shall be checked for dimensional accuracy and alignment before, during and after concreting, and damaged formwork shall be replaced.

All ties and spreaders shall be of an approved type and placed so as to leave a regular and neat pattern on the surface when withdrawn and filled. Wire ties will not be permitted.

All formwork shall be removed without shock or vibration which might damage the concrete.

CONCRETOR shall be responsible for repairing any defects immediately after stripping the formwork. Fill honeycombing with 1:2 cement:sand mortar. Major defects shall be referred to the Engineer.

Fill honeycombing and repair defects immediately after stripping the formwork.

Item	Class of Finish
All stair units exposed in the finished work	F5
Faces to act later as construction joints	F3, retarded to leave a 3mm roughening.

6.2.9 CURING AND PROTECTION

All concrete shall be cured as defined in NZS 3109, Clause 7.7. The use of plastic curing compound shall be as agreed with the Engineer specifically for each occasion before it is used.

Fairface concrete and slab surfaces shall be protected from damage at all times.

6.2.10 DELIVERY PROGRAMME

The subcontractor shall allow to cast units so that they are ready for inspection by the Engineer at least two weeks before the main contractor requires delivery. The Precast Stair manufacturer shall be responsible for notifying the Engineer when units are ready for inspection. Stair units shall be stored at the subcontractor's factory or other suitable location so as to facilitate a thorough check of the units by the Engineer and Architect.

6.2.11 HANDLING

Handling shall be such as to prevent any damage to units.

The safe handling of the stair units is the responsibility of the Precast Stair Manufacturer.

The safe design and placement of lifting hooks on devices is the responsibility of the Precast Stair Manufacturer.

The Labour Department may require a design certificate for the lifting eyes or devices. If a design certificate is called for then this shall be provided by the Precast Stair Manufacturer or an engineer engaged by the Precast Stair Manufacturer.

Lifting hooks and devices set permanently in the units shall have a safety factor of at least 4 and for repetitive use shall have a safety factor of at least 6.

Details of lifting hooks and devices, and their positions, shall be submitted to the Engineer for his information and to the main contractor for his approval before manufacture commences. Care shall be exercised at all times that hooks or devices suffer no bending or other damage.

Precast units shall be loaded and transported so that no forces are applied in excess of those occurring during normal lifting. Twisting forces shall not be permitted to occur. Units shall be strapped and secured to prevent movement or damage during transportation.

6.2.12 STACKING

Precast stair units shall be stacked on timber dunnage and suitable soft packing, but not pinex,placed under the lifting points. Stacking shall at all times be such as to minimise the effects of creep and to avoid undue distortion of stair units.

Stacking of stair units shall be carried out on an area capable of withstanding the bearing pressures involved and in such a way that damage to stair units, lifting hooks, and to other embedded fixtures and to other units shall not occur.

6.2.13 MARKING

Mark all stair units with mark number and orientation in the finished job and date of casting. The marking shall not be permitted to affect the fairface finish.

6.2.14 METALWORK BRACKETS, FIXING AND WELDING

Supply and fabricate all weldplates and brackets as detailed on the drawings, in accordance with the relevant clauses of STRUCTURAL STEELWORKER.

Welding of reinforcing bars to metalwork plates and brackets shall be accordance with the relevant clauses of STRUCTURAL STEELWORKER.

6.2.15 CO-OPERATION

This subcontractor shall co-operate with the main contractor and all other affected subcontractors, in every way, to ensure the correct finished relationship, both as to dimensions, details, and such finishes, between his work and all other surrounding work.

He shall carry out his part of the contract with all due diligence and efficiency, at such times and in such order as the main contractor or may require, and so as to finish the parts and the whole of his work when required, to fit in with the overall programme of work laid down by the main contractor who is bound to a final completion date.

6.2.16 QUALITY ASSURANCE

It is the Precast Stair Manufacturers responsibility to ensure that the construction of the precast stairs complies in all respects with the drawings and the specification.

The Precast Stair Manufacturer must advise the engineer and the main contractor in writing the name of the precaster responsible for checking all dimensions, reinforcing, cast in fixings, cover and lifting devices before any precast stair is cast.

The nominated precaster will be required to complete and sign a written check list for each precast stair flight. A copy of each completed check list is to be forwarded to the main contractor and the engineer no more than 30 days after casting the stair flight.

The format and detail of the check list will be agreed to in advance of construction by the engineer and the precast stair manufacturer.

11 December 1997

Patrick O'Reilly
Trans Tasman Properties
Level 1
Shades Atrium
105 City Mall
CHRISTCHURCH

Dear Patrick

FORSYTH BARR HOUSE - STAIR LANDINGS

You asked me to have a look at the void that exists below the vinyl flooring at the stair landing adjacent to the womans' toilets at level 10.

The void is intentional and a very important requirement for the safety of the stair flights. It is part of a seismic joint that allows that end of the stair to move in the event of an earthquake.

Please see attached drawings S9 and S217 that show this 30mm seismic joint. Please ensure that the joint (and all others elsewhere in the building) is kept clear of incompressible material because it is essential that the joint can freely open and close in a moderate or severe earthquake.

Please contact the undersigned if you require further information or advice.

Yours sincerely

R Grant Wilkinson
DIRECTOR

FILE: LE971211.001

Project No: 2281