CPG

Madras Equities Ltd

249 Madras Street

Damage Report

4 September 2010 Earthquake

Christchurch

6 October 2010

249 Madras Street
Earthquake Damage Report

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249 Madras Street
Earthquake Damage Report

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INTRODUCTION

Following a telephone discussion with John Drew, Building Manager, on 24 September 2010, CPG NZ Ltd was invited to inspect the building at 249 Madras Street and to report on damage sustained during the 4 September Christchurch earthquake and subsequent aftershocks.

INSPECTION

The inspection was carried out between 10:00am and 2:00pm on Wednesday 29 September in the company of John Drew and Leonard Pagan from Rawlinsons. Peter Brown from CTV was also present during the inspection of the ground and first floors occupied by CTV.

During the inspection, external walls were viewed from the ground with the exception of the west wall which is not accessible. Internal surfaces of walls in most rooms were viewed. In a few locations, ceiling tiles were lifted to view underside of floors and wall/column beam connections.

Some structural components are sealed behind fixed linings. These linings were not removed. We did not go inside the two car lift shaft.

BUILDING CONSTRUCTION DETAILS

We have not sighted any structural drawings for the building. I understand that the Building Manager was unable to obtain drawings and Council records are currently unavailable following earthquake damage to their archive systems.

We did obtain a copy of a layout plan for the ground and first floors from CTV.

From these limited drawings and from our inspection we believe that the building consists of the following structural systems. Photo 1 Appendix 1 shows the South elevation of the building.

The building is rectangular in shape measuring overall approximately 30.5m in the east-west direction and 26.0m in the north-south direction. It is five storeys high with a lift machine room and tank room at roof level.

The two car lift shaft, stairwell and bathrooms project from the north side of the building about half way along the north wall. A concrete shear wall extends across the north side of these facilities. Finger walls project at right angles to the north side wall at each end and between the facilities; four finger walls in total. On the south side of the building, opposite the north side shear wall, there is a further concrete shear wall in the plane of the south wall. We believe that these walls form the principal lateral load carrying systems for the building.

The remainder of the structure consists of gravity columns (mainly circular in section), perimeter beams and internal beams running in the east-west direction only at all floors. Beams and columns are all of concrete construction. Floors are of steel tray deck with concrete topping construction. Precast concrete spandrel panels are attached to the perimeter beams and weather proof the building up to window sill level.

We have no information regarding the foundations of the building but assume they consist of a combination of concrete strip and pad type footings.

SEISMIC PERFORMANCE OF THE BUILDING

Initial reports indicate that the 4 September 2010 earthquake produced ground accelerations in Christchurch similar to those required for current design of new buildings. The building at 249 Madras Street was, we understand, designed and constructed in the 1980's. It is likely that the code required design loads at the time were similar to or lower than current requirements.

Accepted design practice requires that buildings remain standing after the 'design earthquake" but it is expected that some damage would be inflicted. The building at 249 Madras Street does exhibit considerable damage with regard to linings and finishings. There is also some minor structural damage, but there are no obvious structural failures. In that respect we believe that the building has performed reasonably well.

We have not attempted for the purpose of this report to investigate or recommend restoration systems. However, diagonal shear cracking and cracking of construction joints has occurred in the shear walls, as reported below. We believe that there has been no yielding of the reinforcement in these walls and that structurally their integrity is still sound. However we would recommend repair of those cracks with a width of more than 0.2mm with epoxy injection. The damaged linings and finishings should also be repaired.

We comment on the various types of damaged observed as follows.

South Elevation Shear Wall

This wall is in fact what is termed a coupled shear wall. It has door holes in the middle of the wall at each storey providing access to the external fire escape. Beams across the door heads couple the walls, each side of the doors, together. The exterior of this wall is coated with a plaster splash coat. The rough texture of the finish on the wall makes it difficult to detect any cracking on the outside face, but there is one diagonal crack visible on the outside ground storey just below the fire escape landing. Photo 2.

At ground storey, the inside of the wall is strapped and lined with plaster board. The plaster board contains some significant cracks. However, the limited portion of the structural wall itself, visible above the ceiling tiles, showed no obvious cracking.

On the first storey, the inside of the structural wall is finished with a thin skim coat of gypsum plaster painted a light colour. Some diagonal cracks can be clearly seen in the gypsum plaster and measure up to approximately 0.2mm in width.

No cracking was observed in the gypsum plaster lining of this wall at levels above the second floor. It seems likely that cracking is present in the ground storey portion of the wall, similar to that of the first storey. We would expect that any cracks present are relatively fine and similar in width to those on the first storey. We recommend that the internal ground storey strapping and plaster board lining be removed to view the structure behind. The lining is damaged and would have to be replaced anyway. Cracks greater than 0.2mm in width should be repaired with epoxy injection. The external surface of the wall should be protected against the ingress of water in any fine cracks with the application of a silicon sealer or similar.

North Side Shear Walls

The north side shear wall and its adjoining finger walls exhibit some minor structural damage. There are some diagonal shear cracks in the walls surrounding the bathrooms and stairwell in the storeys below the second floor level measuring mostly in the order of 0.2mm in width but with three measuring possibly as much as 0.3mm in width. At higher levels there are a few finer cracks.

As visible in the stair well, there are construction joints in the walls immediately below and above each floor level. This is a normal construction practice. At almost all floor levels, cracking has occurred along part of the length of these construction joints and these cracks measure generally in the order of 0.2mm in width but with a few up to possibly 0.35mm in width. Photo 3. Again the cracks larger than 0.2mm in width should be repaired with epoxy injection and the external surface weather proofed.

At the north west corner of the north side shear wall at ground storey, a crack in the concrete is visible. We do not believe that this is earthquake damage. It is our opinion that the concrete cover thickness to the reinforcement has been inadequate here and the reinforcement has corroded. The oxidation of the steel makes it expand and this has fractured the concrete. This is not a major concern but it should be treated and repaired.

Columns, Beams and Spandrel Panels

As stated above, we believe that the columns and beams provide gravity support only and have not been designed to resist lateral loads. However, they do have some stiffness and when the building moves in an earthquake and they do attract some load. Generally we observed very little damage to beams and columns. However there are a few exceptions. The north-east corner column immediately above the third floor spandrel exhibits some minor cracking which is very fine and in our opinion requires no treatment. At the top storey, the first column west of the north-east corner of the building also exhibits some cracking. The appearance of the cracking is accentuated because the paint has chipped off at the cracks (photos 4). One of the south side columns at the top storey also exhibits some fine cracking. We recommend that the cracks in these upper storey columns be injected with epoxy resin.

The first floor beam on the north face of the building in the span between the north-east corner of the building and the adjacent column to the west has some fine diagonal cracking (Photo 5). We recommend that this crack be injected with epoxy resin. We did not see any signs of distress in beam column joints.

The precast concrete spandrel panels appear to have sustained very little damage. However, each side of the south side shear wall, the ends of the spandrels have been plastered. This plaster is spalling off at most levels as a result of differential movement caused by the earthquake. It is a hazard to people below. It should be removed, the concrete surface properly prepared and a strong bonding epoxy plaster re-applied. (Photo 6).

At the fifth floor level, the end of the spandrel panel on the north elevation adjacent to the lift lobby is showing signs of corrosion of the reinforcement. This can be seen out the lift lobby window. This is not a structural problem and has not been caused by the earthquake but it should be treated.

Flooring

As described above, the floor construction consists of a composite concrete topping and steel tray deck system spanning north to south between concrete beams. These floor systems are relatively light weight and flexible and it is common for them to exhibit some deflection. At most of the floors in the building at 249 Madras Street, it is possible to detect high points in the floor over the support beams and sags in between. This is not caused by the earthquake and is a fairly normal and acceptable effect of this type of construction.

In the limited number of locations where we removed ceiling tiles and observed the floor to beam connections we did not see any signs of distress. (Photo 7).

Non-Load Bearing Concrete Block Walls

At the west end of the building in the garage at ground storey there are concrete block infill panels between the structural columns. These block infill panels are separated by a flexible sealant from the columns. They do not appear to have suffered any damage.

At the next level up on the west end wall, the interior is timber framed and plaster board lined. It is not possible to view the exterior cladding because of the close proximity of the adjoining building. However, we assume that there is a similar concrete block wall, also separated from the structural columns. In the north-west corner of the building, the internal lining has been damaged by movement of the building. There is a gap between the internal framing/lining on the west wall and the north-west corner column. It is possible to see daylight through this gap. We assume that the sealant in the outer concrete block wall to concrete column joint has fallen out. This needs further investigation and repair.

At ground storey, there is a concrete block wall parallel to the north side shear wall but on the opposite side of the stair well. This wall has a thin gypsum plaster coating in the stair well. At the top of the wall the plaster coating has been peeled off. It appears that its was touching one of the stair well structural walls and the differential movement has damaged the plaster. There may also be some minor cracking of the top block course which should be repaired. However, this is not a structural component and does not contribute to the integrity of the building. Photo 8.

Internal Framing and Linings

At numerous locations at all levels, there is damage to internal framing and linings. Commonly, internal walls and their linings have been finished hard against structural walls and columns. With movement of the building during the earthquake(s), the structural components have applied in-plane loads to the stiff plaster board lined walls. There are many instances where the plaster board linings have been damaged where they adjoin the structural components. Sometimes, the plaster board has buckled some distance away from the structural wall or column. Photos 9 and 10. There are also numerous instances of plaster board cracking over door heads and under windows and elsewhere. Photos 11 and 12. Ceiling covings and skirting boards have also been damaged. At the south end of one internal north south wall on the second floor, the partition wall has racked sufficient for the double doors contained in the wall to be binding. Photo 13.

Where ceiling linings adjoin concrete columns, the plaster linings have been damaged. In some cases the rails for the suspended tiled ceilings have been buckled. Photo 14.

It would appear that partition walls running north-south have been damaged worse than others. There is some anecdotal evidence that the earthquake accelerations were higher in this direction. It also appears that the damage to partitions is worse on the second and third floors. This may be a result of the response of the building to the magnitude and frequency of the earthquake shaking.

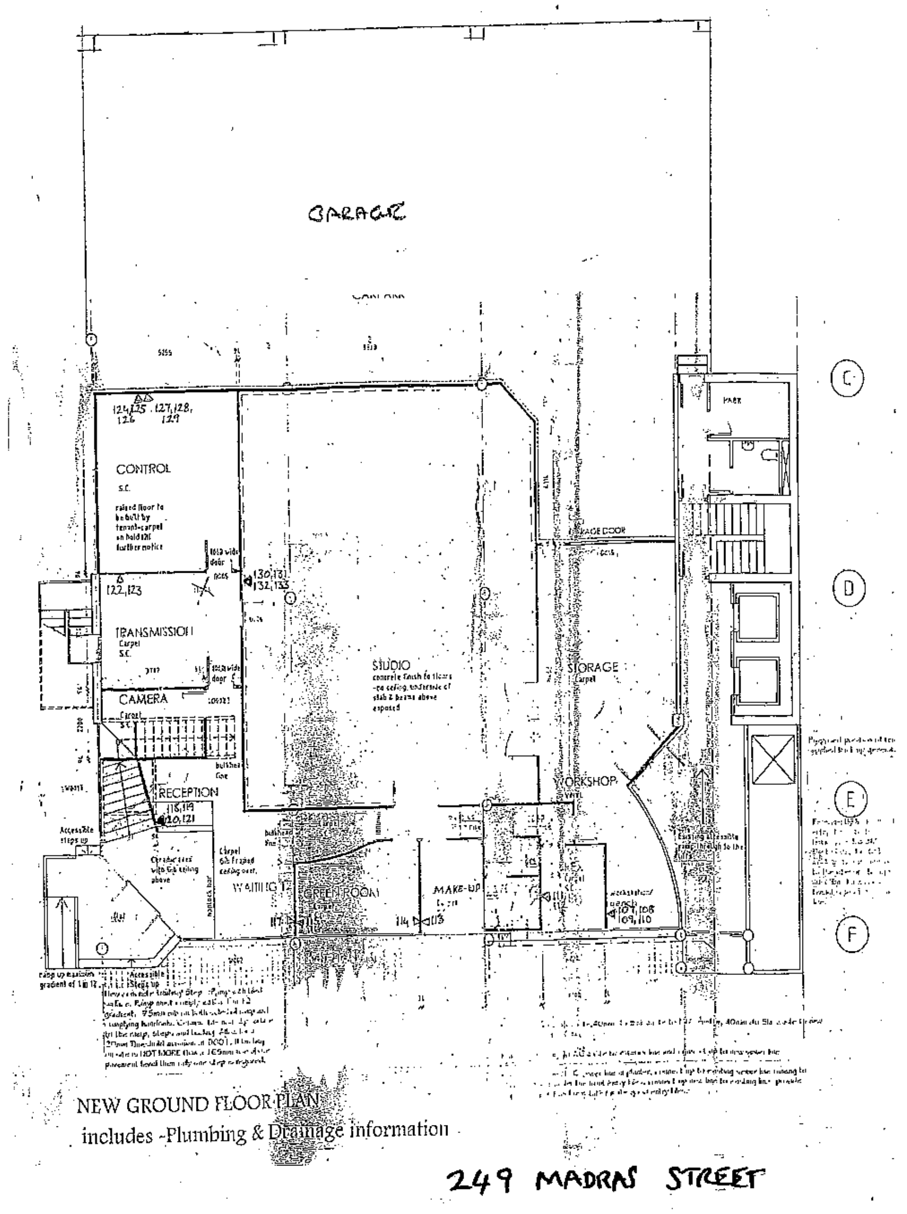
Windows

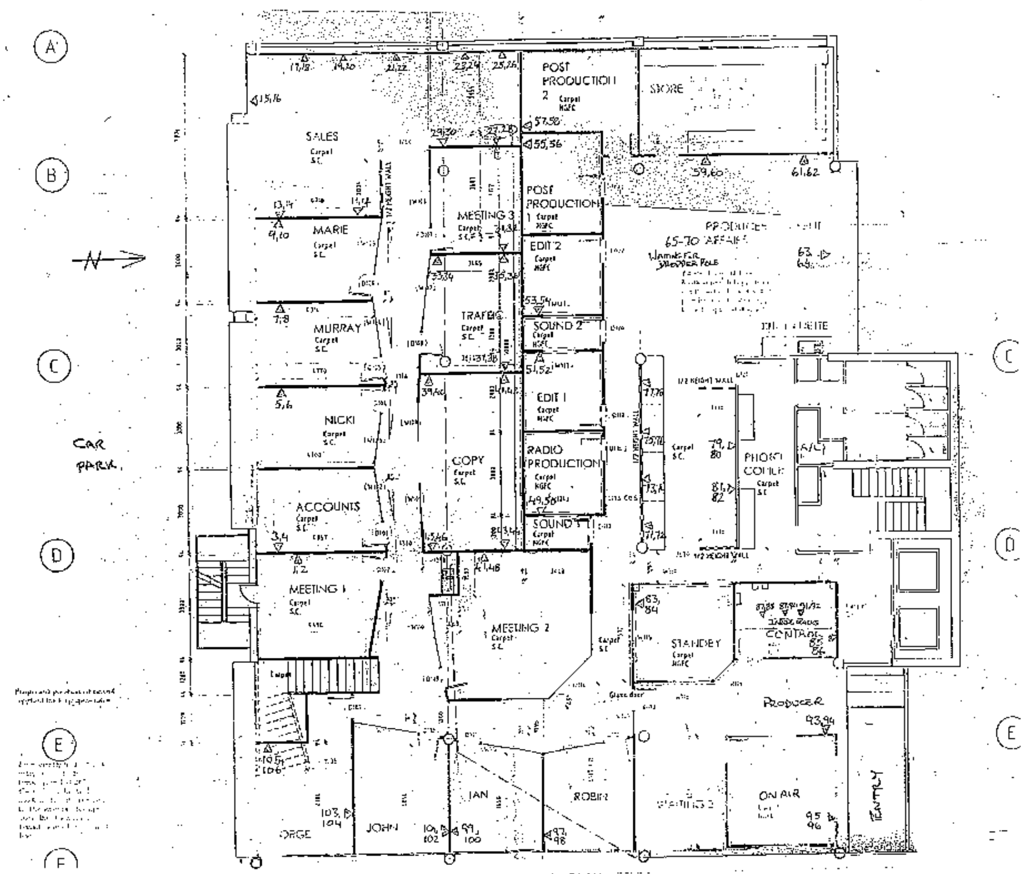
A few windows, particularly in the east elevation have been broken. Photo 15. This may also reflect greater movement of the building in the north-south direction. There are no windows in the opposite west wall but the damage to interior linings on that west wall is significant.

Rubber seals around a first floor window have also fallen out.

APPENDIX I

FLOOR PLANS AT 249 MADRAS STREET


GARAGE
CONTROL
TRANSMISSION
CAMERA
RECEPTION
STUDIO
STORAGE
WORKSHOP
MAKE-UP
GREEN ROOM
WAITING
NEW GROUND FLOOR PLAN
includes -Plumbing & Drainage information
249 MADRAS STREET



249 MADRAS STREET
FIRST FLOOR PLAN

APPENDIX 2

PHOTOS OF DAMAGE AT 249 MADRAS STREET

FOLLOWING 4 SEPTEMBER 2010 EARTHQUAKE AND AFTERSHOCKS

Photo 1 South Elevation of Building


Photo 2 Cracking in south shear wall (not visible in photo) under fire escape landing

Photo 3 Cracking in floor level construction joints in stair well

Photo 4 Cracking in top storey column adjacent to lift lobby.

Photo 5 Cracking in first floor beam north elevation over entry.

Photo 6 Spalling of plaster off ends of spandrel panels.

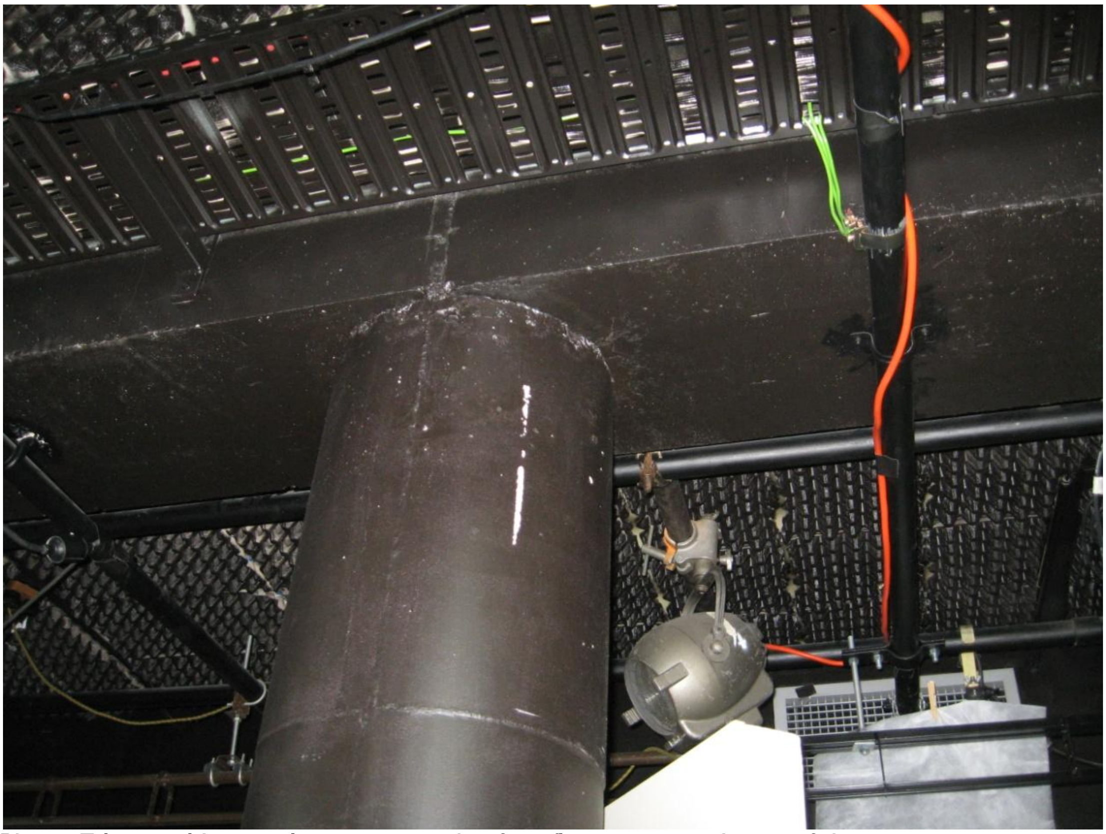


Photo 7 Internal bem column joint under first floor – no evidence of damage.

Photo 8 Spalling gypsum plaster off non-load bearing concrete block wall in stairwell.

Photo 9 Partition lining damaged at junction with concrete column.

Photo 10 Partition lining damaged at junction with concrete beam.

Photo 11 Cracking in linings over door head

Photo 12 Crackling in linings under window.

Photo 13 Racked second floor partition wall and binding double doors.

Photo 14 Cracked wall lining and damaged ceiling coving.


Photo 15 Broken window.

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Job No.

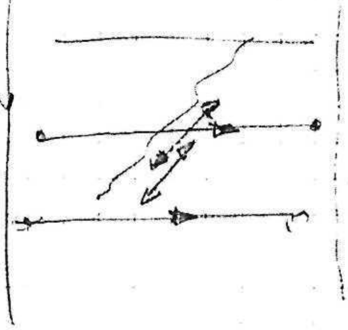
Page No.

Made by: Date:

Des Bull. 0274-388-498
Dean Cook 03 366 3366

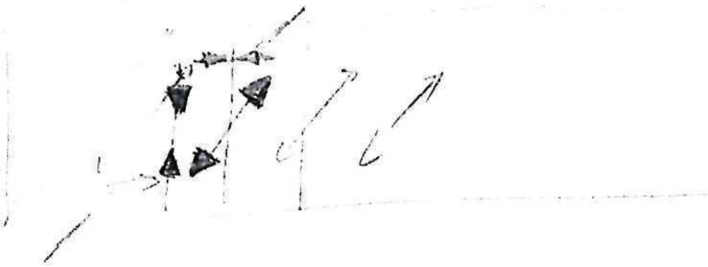
249. MADRAS ST.

1. No evidence of Tensile or compression failure of shear walls
2. Very minor shear cracking (mainly in one direction but a few examples of reverse direction)
3. Shear (diagonal) cracks are very fine. ie less than ½ mm. prob less than 0.25 mm
4. No evidence of instability of edges of walls.
5. P&P pg 323 says ~~cracks will reduce~~
   a) larger the crack width – larger shear displacements
   b) - - - - - - - - - - smaller ultimate strength.
6. Codes req' Vconc = 0 in hinge regions.
7. Cracking strength is probably way below yield strength.



8. Phone John Drew & get him to install safety fencing around sth shear wall where plaster spalling.

openjob
putting it on non-billable job.



Dean. Cook.

0.2mm crack - rested [illegible] yielding
any crack results of tension

3rd pro 1982, 3101, $V_c \ngtr 0.6 \sqrt{P/A_g}$

should be OK for same EQ
stiffness may be a little less stiff
Period will be longer

RECORD OF TELECOM

CPG

File No.

Date: 1Oct10 Time: Ref: 702974 Admin/Design/Report/Const/Dwg/

Between (DWCG) : **David Coatsworth**

☐ DWCG Called
☐ Called DWCG

AND : Dean Cooke of : Firth Concrete ex NZConc & Cement

Address : Ph :

Fax :

SUBJECT: *249 Madras Street*

Described to Dean cracking in the shear walls. He said that at 0.2mm crack width the steel has not yielded. He felt that the walls would be good for the same earthquake again. He agreed that their stiffness might not be as good; ie deflections would be greater in pre-cracked section. Period of vivbration for walls might be a little longer than previously (uncracked)

RECORD OF TELECOM

CPG

File No.

Date: 6 Oct 2010 Time: 2:45 Ref: 702974 Admin/Design/Report/Const/Dwg/

☐ DWCG Called

☐ Called DWCG

Between (DWCG) : **David Coatsworth**

AND : Des Bull of : University of Canterbury

Address : Ph : 0274 388 498, 366 3366

Fax :

SUBJECT: *249 Madras Street*

Spoke to Des about the cracking in the shear walls.

Described diagonal shear cracks in the order of 0.05mm to 0.35mm thick. Des says that any cracking less than 0.4mm still retains aggregate interlock. He says that code designs allow for some cracking. He thinks that these cracks are fine but that for peace of mind he recommends injecting anything larger than 0.2mm wide.

I spoke to him about the horizontal construction joints above and below floor slabs. This section of wall is actually cast with the floor. He said he wasn't surprised that there was cracking there. Again he said inject any crack wider than 0.2mm.

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Made by: Date:

Peter . Higgins 6.10.10
Contech Techniques

Crack injection
Sikadur52 resin 0.5 mm . min
epoxy structural resin 0.1 mm min
nipples @ say 200 mm crs.
need to seal both faces of crack

Jerry Kearney
021 - 023 - 75266.

Adhesion Sealing. Steve Moody. Dunedin.
027 - 278 - 8650.

Dr Thull. University of Canterbury
0.4 mm agg interlock
designed

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6.10.10

Steve Moody. Adhesion Sealing.

MC injecta 1264

Steve is sending details

He will be in Chch next week & will contact us

David Coatsworth

From: David Coatsworth
Sent: Wednesday, 6 October 2010 3:21 p.m.
To: Tony Crang; Jerry Kearney
Subject: Cracked Shear Walls

Hi guys

You will recall the discussions we have had re the 1980's 5 storey building at 249 Madras Street that has some diagonal cracking in the shear walls. I have been back to the site to check on the width of the cracking. Its hard to measure anything that fine but I believe that the widest crack is about 0.35mm. The finest ones are less than 0.05mm.

I have discussed the matter with both Deane Cook who is currently with Firth Industries Certified Concrete (previously with the Cement & Concrete association I think) and to Des Bull lecturer at Canterbury University.

Both of these guys were of the opinion that the width of cracking present is not a problem. Reinforcement has not yielded. They argue that the code design allows for some cracking of the sections being designed. Aggregate interlock is still effective for any crack less than 0.4mm wide. They both agreed that deflections in a pre-cracked section would be higher than prior to cracking.

So in essence they felt that the walls would be satisfactory as they are but for peace of mind and weathering they suggested that we inject any cracks larger than 0.2mm width. I believe in talking with Construction techniques and with Adhesion Sealing (both companies experienced in epoxy injection0 that injecting cracks of width less than 0.2mm becomes a problem. Need special low viscosity resins and many nipples.

Anyway, thanks guys for the input into this issue.

David Coatsworth

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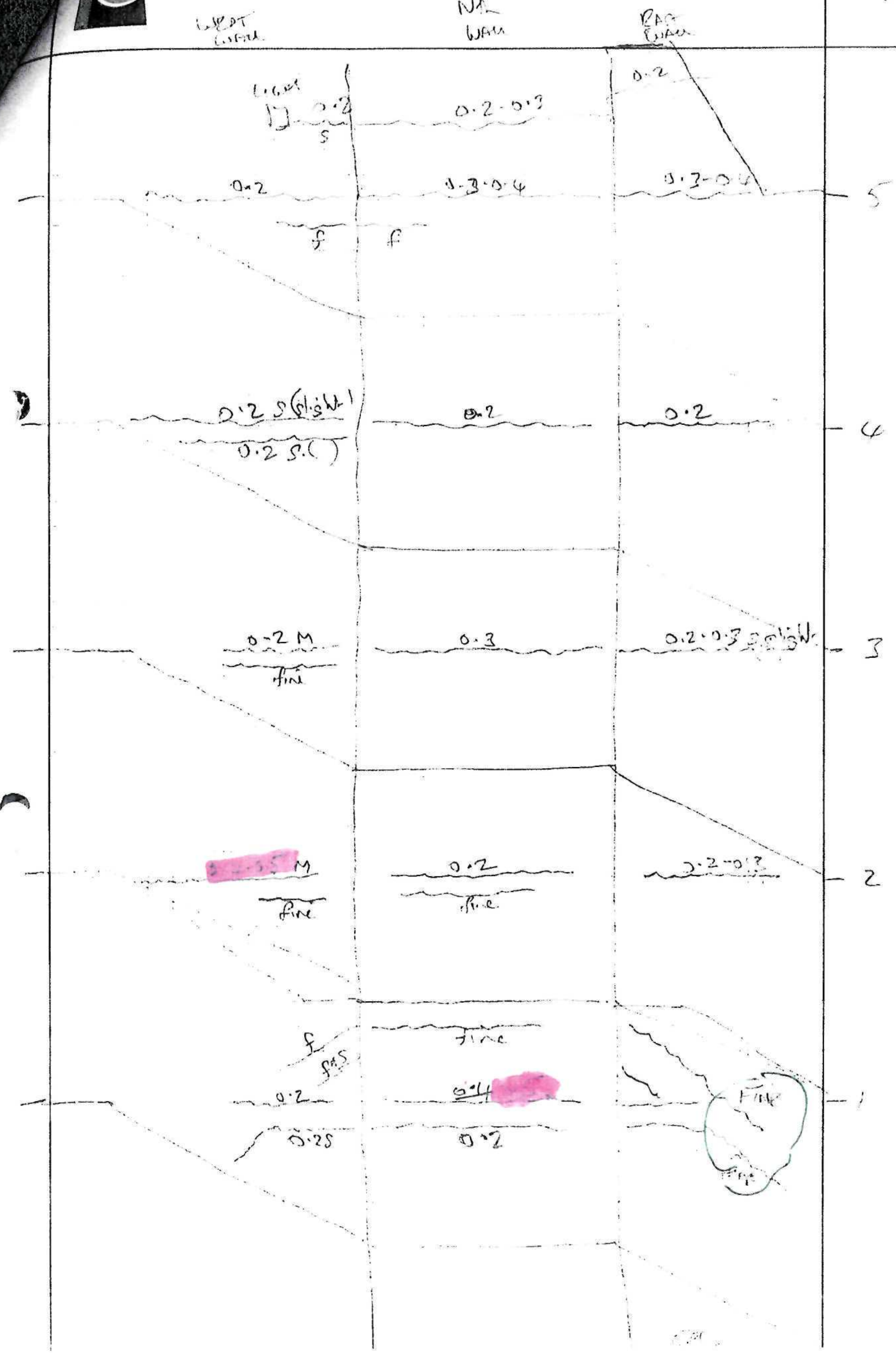
Job No.

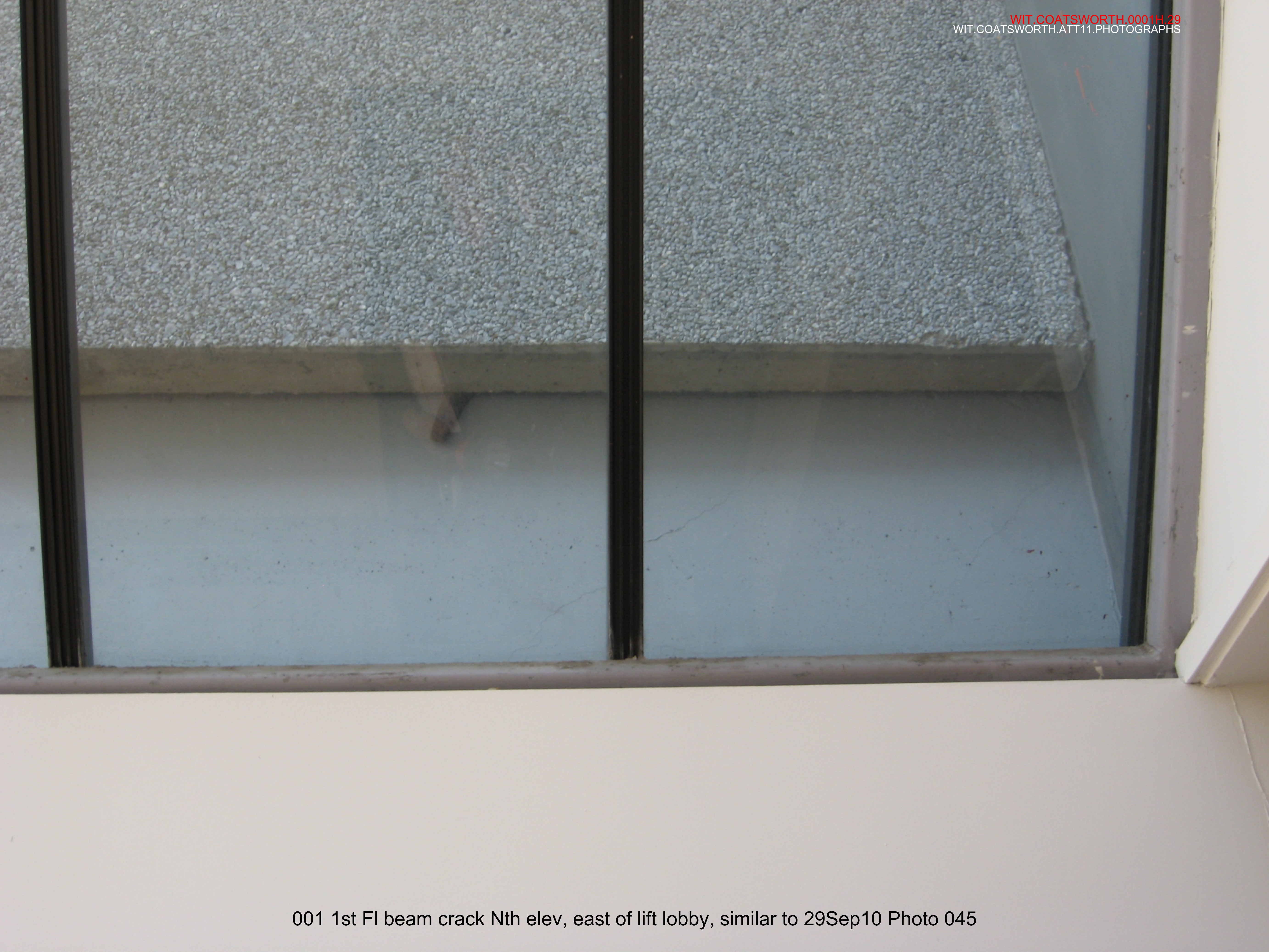
Page No.

Made by: Date:

Second Insp.
9.10.10.

Stairwell





001 1st Fl beam crack Nth elev, east of lift lobby, similar to 29Sep10 Photo 045

002 Gib cracks Grd storey in NE entry by lift lobby

003 Grd Fl cracked tile in NE entry by lift lobby

004 crack in shear wall at side of stair well, floor level ??

005 crack in stair well north wall I think, floor level ??

006 5th floor column in lift lobby, cracks in column similar to 29Sep10 Photo 088

007 5th floor column in lift lobby, minor cracking in beam soffit

008 Grd Fl, stair well block wall from garage, no damage

009 Grd Fl, stair well block wall, plaster

David Coatsworth

From: David Coatsworth
Sent: Tuesday, 19 October 2010 4:24 p.m.
To: 'John Drew'
Subject: 249 Madras Street, Earthquake Damage

Hi John

Further to our report dated 6 October 2010 and further to your request this morning, I took another look at the building at about 2:30pm today following the 5.0 magnitude earthquake we experienced at 11:30am this morning.

I spoke to Peter Brown from CTV and looked around the ground floor of the building with him. He was unable to point to any structural damage that was worse than at the previous inspection. We did see some new plaster droppings on the ground floor in the stairwell where the shear walls have been rubbing against the block wall. This area was damaged in the initial quake but subsequent shakes continue to damage the plaster lining. I also spoke to the ladies on reception on the top 5th floor. They said that the building shook significantly but again they were unable to point to any new damage.

I looked around some of the ground storey columns and couldn't detect any new damage. I went all the way back up the stair well and noted the cracking that we had previously recorded in the shear walls. Generally, I believe that they remain the same with the possible exception of two cracks. It is difficult to measure these cracks but it seems likely that two of them are slightly worse than our previous record.

The building is still structurally sound. However, it is inevitable that where cracks have been opened by the initial earthquake, subsequent shocks will work the joints and open them further. I recommend that we make arrangements as soon as practical to have some repairs of the walls carried out in the form of epoxy injection.

Regards

David Coatsworth

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