

BEFORE THE CHRISTCHURCH CITY COUNCIL

IN THE MATTER OF

the Resource Management Act 1991

AND

IN THE MATTER OF

An application for Resource Consent
by Carol and Peter Johns

STATEMENT OF EVIDENCE OF EDWARD HILL

STRUCTURAL ENGINEER

Dated: 04 March 2024

INTRODUCTION

- 1 My full name is Edward George Hill. I am a Senior Principal Engineer and Director at Batchelar McDougall Consulting Limited (BMC) in the Christchurch office.
- 2 BMC is a structural and civil engineering consultancy that provides design and assessment related advice to a wide range of commercial and private clients.
- 3 I hold the qualifications of a master's degree in civil engineering from Cardiff University, attained in 2008. I am a Chartered member of Engineering New Zealand (CPEng 1027892).
- 4 My specific experience relevant to this evidence includes 15 years as a consultant structural engineer with a focus assessment and repair of heritage buildings.

CODE OF CONDUCT

- 5 Although this is a Council hearing, I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2023. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving evidence.
- 6 Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

SCOPE OF EVIDENCE

- 7 My evidence is presented on behalf of Carol and Peter Johns ('**the Johns**'), the Applicant in these proceedings.
- 8 BMC were originally engaged by Pioneer Construction, who were working on behalf of the Johns, to undertake a Residential Structural Assessment Report (RSAR) in 2020.
- 9 The scope of the RSAR report was to "identify structural earthquake related damage and recommend an appropriate reinstatement strategy to the required standard".
- 10 I visited site on the 9th December 2020 and the final RSAR report was issued 4th May 2021.
- 11 BMC have subsequently been engaged by The EQC in February 2024 to assist in preparing this report for this Council hearing.
- 12 My evidence will cover:
 - (a) Earthquake damage to the property sustained in 2011.
 - (b) The repair strategy.
 - (c) The risks associated with undertaking the repair.

EARTHQUAKE DAMAGE

- 13 The BMC RSAR outlines the damage sustained to the property during the Canterbury Earthquake Sequence (CES) of 2010 and 2011.
- 14 The BMC report is taken as read, however, in summary, the key findings are:
 - (a) Strong shaking, primarily as a result of the February 2011 event, caused earthquake damage to the property and nearby retaining walls.
 - (b) The earthquake damage to the dwelling superstructure included damage to the timber roof framing, cracking to the internal and external linings, misalignment of doors and windows and, cracking/destabilisation of the brick chimney on the north elevation.
 - (c) The earthquake damage to the foundations in the eastern half of the dwelling was primarily caused by settlement associated with the movement of the upper crib retaining wall on the east boundary of the site above Dublin Street.
 - (d) Other nearby retaining walls, notably on the northern boundary and Dublin Street to the east, were also damaged.

REPAIR STRATEGY

- 15 The RSAR outlines a potential repair strategy to repair earthquake-related damage in accordance with the EQC Act.
- 16 The EQC Act standard of repair is given as *"replacing or reinstating the building to a condition substantially the same as but not better or more extensive than its condition when new, modified as necessary to comply with any applicable laws"*.
- 17 The BMC report is taken as read, however, in summary, the key repair recommendations are:
 - (a) The original portion of the house foundation and subfloor framing has suffered earthquake damage. This damage needs to be repaired and the eastern area of the original dwelling needs to be relevelled.
 - (b) However, due to the condition of the foundation and subfloor framing, and proximity to adjacent retaining walls, repair is not feasible and replacement with a new foundation system and subfloor framing is recommended.
 - (c) The new foundation system comprises shallow timber piles encased in concrete founded below fill and soft material at a depth of approximately 1m. These foundations need to be inset from the perimeter of the building to avoid undermining the adjacent retaining walls.
 - (d) To create a subfloor void to aid airflow and drainage whilst maintaining the surrounding landscaping, a low masonry wall around the perimeter is proposed.
 - (e) Repair of the superstructure to address the issues raised in the report also needs to be scoped by a builder.
 - (f) Retaining wall repair and site drainage need to be separately assessed and scoped by others.

- 18 Where a repair strategy specifies 'new work' under S17 of the Building Act, this work needs to comply with the Building Code. This triggers the requirement for the new foundations and sub-floor framing to be to current code.
- 19 Where structure is not being altered by repairs or new work, S112 allows these unaffected elements to "*continue to comply at least to the same extent as*" they did before the works, as long as the overall building performance is not reduced.
- 20 More recently, for complex repairs, especially those with significant risks relating to access, temporary works, geotechnical hazards and retaining walls, we have added the statement to our RSAR "This repair strategy should be scoped by an experienced contractor with adequate allowances to cover risks and a cost-comparison made against rebuilding the structure". If I were drafting the report again today, I would include this statement.

RISKS

- 21 As mentioned briefly in the BMC RSAR, there are risks associated with the repair, and I have been asked to explain these in more detail to assist the Council in understanding these from a structural perspective.
- 22 The key structural risks associated with repairing the structure relate to access, retaining walls, condition of the structure, and geotechnical considerations including site drainage (as outlined by RDA Geotechnical Limited).
- 23 I will also outline some of the Health and Safety Risks that, as a designer, it is my duty to consider, eliminate as far as reasonably practicable and communicate residual risks.

ACCESS

- 24 The property is surrounded by retaining walls of varying heights and types. Access to the site is hampered not only by the physical width and steepness of the path up from Dublin Street but also by the capacity of the retaining walls to take the surcharge from construction loads such as excavators and materials deliveries.
- 25 The location of the current dwelling, and notably the proximity of the poor condition crib retaining wall on the eastern boundary, does not allow any room at the front of the site for deliveries or stockpiling of materials, and safe access for any machinery is not well assured therefore all subfloor work will need to be hand excavated.
- 26 In addition to the above, power poles and overhead wires on Dublin Street make the use of cranes and hi-habs to deliver or remove equipment and materials very difficult. If possible at all, it would likely require isolating the power and having traffic control in place.
- 27 The proximity of the stacked-stone retaining wall to the north of the dwelling will make access to temporarily prop the house to excavate the new subfloor and foundations very difficult.
- 28 If the dwelling was demolished, work methodologies for a new build to avoid the zones of influence of these retaining walls would be possible. A clear site would also allow access for a full drainage system to be installed with a significantly reduced risk of undermining the retaining walls and dwelling foundations.

- 29 Limited access along the path to the property would likely mean that demolition materials would need to be removed from site either via a chute over the retaining wall down to Dublin St or small dump truck to be loaded on Coleridge Tc.
- 30 Access for removal of Asbestos-containing materials would need a separate risk management plan prepared by the specialist removal company.

RETAINING WALLS

- 31 The condition and proximity of the retaining walls to the dwelling make the repair considerably more complex and increase the risk of damaging these walls during repairs.
- 32 The proximity of the dwelling to the retaining wall to the north has driven the design of the foundation and the requirement not to undermine this wall has resulted in the piles being offset. There remains a risk that piles need to be extended deeper during construction due to poor ground and these excavations undermine and damage the wall.
- 33 The proximity and condition of this wall also mean any temporary propping or support of the house during the foundation replacement will be challenging.
- 34 The crib retaining wall to the east was (at least partially) rebuilt by the homeowner post-CES due to earthquake-related movement. Again, the condition of this wall means that any construction activities above the wall need to be carefully considered to avoid surcharging the wall.

CONDITION OF THE STRUCTURE

- 35 Inspections on site indicated that bearers are on the ground, and there is very little space or ventilation below the joists in the subfloor. Where visible, the bearers and joists appeared rot and borer affected. Based on this, and the rear of the site having worse subfloor ventilation, it is likely that other areas are in similar or worse condition.
- 36 Based on the area of subfloor I could observe during the site inspection, I do not consider it likely that an attempt to lift or mechanically relevel the dwelling using the existing subfloor would be successful, hence the recommendation to replace this element.
- 37 If preservation of historic fabric was paramount, a relevel could be attempted but the risk of damaging adjacent structure due to local failure of members would be high and a contractor pricing this work would likely allow for full replacement, even if they then saved what they could.
- 38 Given the age of the dwelling, and the condition of structural elements visible, it is likely that additional issues with durability will arise during the repairs that will require attending to.
- 39 For buildings of this age and type, especially with damaged cladding that has been poorly repaired, it would be common for the engineer to be called to site to inspect timber after damaged cladding was removed and to specify repairs or replacement of damaged timber members.
- 40 It is advisable to account for additional consequential damage that may occur after releveling. When cosmetic repairs have masked earthquake-related damage, the 'tells' such as alignment

of doors and windows that relevening contractors use to gauge how far to lift a building are gone, so the risk of going 'too far' with the lift and causing additional consequential damage is increased.

GEOTECHNICAL CONSIDERATIONS INCLUDING SITE DRAINAGE

- 41 I am not a geotechnical expert so my comments here are intended to highlight risks mentioned in the RDA Geotechnical Report; my opinion is given from a structural perspective. If further explanation or expansion of these risks is required, then a Geotechnical Expert should be approached for comment.
- 42 The RDA report does not specifically cover retaining walls, although it does mention the crib wall on the eastern boundary "behaving poorly" and that it appears to have moved as a result of the CES.
- 43 The RDA report highlights that the site's 'low' position relative to neighbouring properties may be contributing to settlement and recommends that stormwater runoff be assessed and "controlled and discharged to appropriate and approved outlets". This assessment should be undertaken by a civil engineer and a drainage system designed to control stormwater and retaining wall sub-surface drains.
- 44 Any excavation to install drainage would need to consider the proximity of the adjacent retaining walls and dwelling. Again, the constrained site and position of the existing dwelling make this challenging.

HEALTH AND SAFETY IN DESIGN

- 45 Health and safety risks considered by BMC during the design phase are presented in the Simplified Risk Matrix in Appendix A. This is a common way for designers to communicate decisions and residual risks to clients and contractors.

CONCLUSION

- 46 The dwelling at 33 Dublin St, Lyttleton has suffered earthquake-related damage and requires a partial foundation replacement to address this.
- 47 Installation of this new foundation is a complex undertaking, with significant risks associated with the adjacent retaining walls and limited site access.
- 48 Whilst repair is possible, this site is complex and retaining wall issues are compounded by the limited access, our recommendation would be that a rebuild option be costed and compared to the repair cost with adequate allowance for contingencies due to the condition of the structure.
- 49 If the dwelling were to be demolished, dealing with site drainage and issues with adjacent retaining walls would be easier and safer. However, the demolition option is not without its risks and challenges that would need to be managed by an experienced contractor.

A handwritten signature in black ink, appearing to read 'Ed Hill'.

Edward Hill

MEng(hons), CPEng, CMEngNZ, IntPE(NZ)

Director | Senior Principal Engineer

07 March 2024

Attachment A: Health and Safety

Health and Safety in Design

Practical interaction with a building or structure throughout its lifecycle, poses risk to worker and user health and safety. It is our duty and legal obligation to identify these hazards early in the design stage and eliminate them as far as reasonably practicable, in accordance with the Health and Safety at Work Act 2015. If we cannot eliminate an identified hazard, we must take steps to minimise it and communicate this residual risk to key parties who will oversee interaction with the design.

It is also our duty to consult, cooperate and confer with other affected parties and this section of our DFR is intended to communicate risks that we can reasonably identify within our area of expertise and influence. We expect this to form part of a larger H&S management plan for the project which will be coordinated by the lead consultant or client.

Systematic Risk Management Process

As part of our internal design process, BMC have undertaken a systematic risk management assessment to identify and eliminate or minimise hazards, as far as they relate to BMC's scope of work for the project.

Key Areas Assessed for Hazards:

- Position/Location of the Building
- Environmental Conditions
- Construction (structure)
- Use
- Abnormal Environmental Events
- Maintenance/Repair (structure)
- Demolition

Risk Matrices

		POTENTIAL CONSEQUENCE SEVERITY OF HAZARD				
		Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
LIKELIHOOD	Rare (1)	1	2	3	4	5
	Unlikely (2)	2	4	6	8	10
	Possible (3)	3	6	9	12	15
	Likely (4)	4	8	12	16	20
	Almost certain (5)	5	10	15	20	25

SCORE KEY	
Score	Risk
≥20	Extreme Risk
10-15	Very High
5-10	High
3-4	Medium
≤ 2	Low

Table Key	
L	Likelihood (1-5)
C	Consequence Severity (1-5)
Sc	Matrix Score (L x C)

Simplified Risk Management Record



Hazard	Initial Risk			Implemented Design Control	Residual Risk			Communicate Residual Risk
	L	C	Sc		L	C	Sc	
Identified Hazard & Potential Harm				Specific Design Actions Taken				Communication and with which party/s
Condition of subfloor timber causes local collapse/failure during lifting and installation of new foundations under existing dwelling.	3	4	12	Remove and replace sub floor timber including flooring to gain access internally to excavate foundation from within the building. This means a high lift is not required to replace the foundation. Temporary propping still required.	2	3	6	Condition of the remaining framing including the bottom plates will need to be checked by the engineer upon opening up prior to floor removal to confirm it is suitable for propping. Contractor to engage specialist lifting company.
Collapse of retaining wall to the north of the dwelling due to undermining whilst excavating new foundations.	2	4	8	Inset piles from the perimeter to move excavation further away from the retaining wall.	1	4	4	Retaining wall should be monitored during construction and excavation depths shown on drawings not exceeded without consultation with engineer.
The crib wall to the east of the dwelling could be damaged by surcharge applied during lift or by material storage.	3	3	6	Recommend the contractor consider partial demolition of this wall early on during construction to create a lower platform for material storage and locate props supporting the house away from the wall. Communicated via Design Features Report.	2	2	4	Assessment and monitoring of neighbouring/adjacent retaining walls will need to be undertaken before partial deconstruction of the crib wall.
Falling from height. The position of the existing dwelling on the site pushes the workers and access to the perimeters of the site, closer to drops and retaining walls.	3	4	12	Highlight removal of the dwelling as an option to improve access and allow the contractor to more easily manage working at height. This introduces other risks around demolition and additional material delivery, hence the unchanged residual risk score.	3	4	12	Discuss safe working methodologies and working at height risk management with contractor at pre-start meeting.
Electrocution from power lines overhead during material delivery.	3	4	12	Size members and provide splice details to make members easier to transport by hand, removing the need to lift large members in to site via crane.	2	4	8	Communicate risk via DFR and ensure contractor is managing this on site. Discuss and agree construction methodologies during pre-start meeting.
Asbestos-containing materials (ACM's) have been identified on-site. If these are damaged and the asbestos becomes airborne, this poses a significant health risk to workers and others nearby.	4	4	16	Full asbestos demolition survey to be completed and specialist contractor engaged to undertake the removal of all ACM's.	3	3	9	Communicate risk via DFR and ensure contractor is managing this on site.
Excavation of drainage trenches causes damage or collapse of dwelling foundations or retaining walls.	3	3	9	Undertake site drainage survey and engage a civil engineer to design suitable drainage system.	2	3	6	Communicate risk via DFR and ensure contractor is managing this on site.