NEW ZEALAND POLICE
Ngā Pirihimana o Aotearoa

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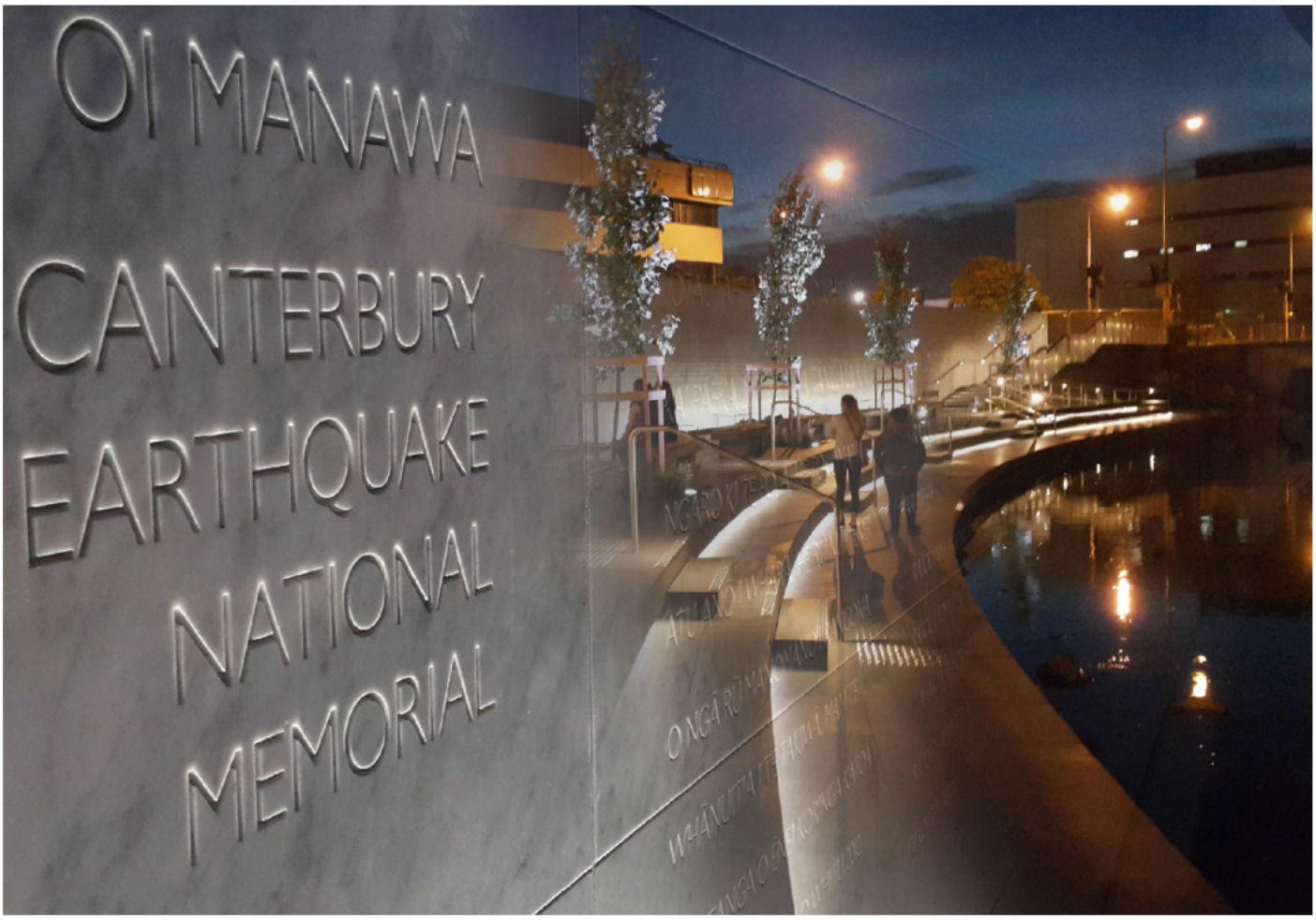
CTV Investigation



Legal Opinion

Crown Solicitor, Christchurch

[redacted]

RAYMOND DONNELLY & CO

BARRISTERS & SOLICITORS CROWN SOLICITOR'S OFFICE

CROWN SOLICITOR AT CHRISTCHURCH

OPINION RE CRIMINAL CHARGES FOLLOWING THE COLLAPSE OF THE CTV BUILDING IN THE FEBRUARY 2011 EARTHQUAKE

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Sections of this document have been redacted to protect the privacy of individuals.

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Contents

Introduction

1. On 10 June 2016 I received a Police "Criminal Investigation Report for the Crown Solicitor" in relation to the collapse of the CTV Building, 249 Madras Street, Christchurch with a request to review the recommendations in that report, namely that manslaughter charges in relation to the 115 deaths caused by the collapse of the CTV building should be laid against Mr David Harding and Dr Alan Reay.

2. This case is somewhat unusual in that the potential culpability requires consideration in the context of the Canterbury Earthquake's Royal Commission (CERC) which heard substantial evidence in relation to the collapse of the CTV building in the February 2011 earthquake. While the terms of reference and the purpose of the CERC are different to the consideration at hand, much of the evidence adduced and the submissions made by counsel for the various parties has relevance to a consideration of culpability.

3. In addition to investigating the matter, the Police have commissioned an expert engineering report from BECA. In the context of a case in which expert opinion will be central, this report naturally assumes prominence in considerations of culpability.

4. The report from BECA has been peer reviewed by [redacted] structural engineer with [redacted]

5. Subsequent to receiving the [redacted] review dated 25 October 2016 there were the following developments:

   - BECA provided written comments on the [redacted] review, dated 19 December 2016
   - I requested a summary of the evidence available from the Police investigation (excluding the evidence given before the CERC). This was received (in draft) on 16 December 2016, 21 December 2016.
   - After discussions with Detective Superintendent Read a decision was made to seek a further peer review of the BECA report by [redacted] structural engineer, of Auckland. A draft review was received on 5 May 2017 and a final report on 17 May 2017.
   - Following the two peer reviews the Police amended their 10 June 2016 report to include references to those peer reviews and any subsequent further information. However the effect of the Police opinion has not materially altered.

6. This opinion should be read in conjunction with the Police report, the BECA report, the [redacted] peer review, BECA's subsequent comments, the summaries of evidence and the [redacted] review.

7. In analysing the law and the facts to arrive at my opinion, I have applied the Solicitor-General's Prosecution Guidelines (as at 2013).

8. I understand that it is intended that this opinion be peer reviewed by the Solicitor-General.

9. It should be noted that there are a number of further inquiries which either I consider necessary or preferable or which the Police have noted the need for the same. I have highlighted these in bold throughout this opinion.

Materials Available and Considered

10. The following materials were provided to me and have been considered by me in preparation of this opinion. The opinion does not attempt to paraphrase or analyse all the materials listed, but rather concentrates in particular on the focused and complex issue of evidential sufficiency:

- Your investigation file
- Police Criminal Investigation Report for Crown Solicitor dated 10 June 2016 and final report dated 26 May 2017
- Engineering opinion from BECA on the collapse of the CTV building dated 15 July 2016
- Peer Review by [redacted] dated 25 October 2016 (and draft peer review dated 3 October 2016 and email from [redacted] dated 18/5/16)
- Comments by BECA on that review, dated 19 December 2016
- Summaries of evidence, received 16 and 21 December 2016
- The further peer review of the BECA report by [redacted] dated 17 May 2017
- CERC Final Report on CTV Building, Volume 6
- Answers to questions raised in the draft version of this opinion, from BECA via a letter from the Police dated 7 July 2017, from [redacted] in a letter dated 3 August 2017 and from [redacted] in undated comments.

Executive Summary

11. The appropriate charge to consider in relation to the actions of Mr Harding and Dr Reay is manslaughter by breach of a duty.

12. The relevant duty would be either s 155 Crimes Act 1961 (duty of persons doing dangerous acts) or possibly s 156 (duty of persons in charge of dangerous things).

13. Section 150A Crimes Act (the requirement to prove a major departure from the standard of a reasonable person) applies to these duties although it is arguable that it does not apply because the acts in question occurred before the passing of s 150A. However, in my view, the safest course would be to assume the requirement of proof of a major departure.

14. There are real issues with proof of causation (and potentially with proof of a major departure) given the large number of challenges that can be raised in relation to the evidence and their cumulative effect.

15. The fact that any trial of manslaughter charges will have to be before a jury means that practically speaking, it will be more difficult to prove the case beyond a reasonable doubt and I consider that the likelihood of success would not be high.

16. However the evidential test in the Prosecution Guidelines is whether the prosecution can adduce evidence which a properly directed jury could reasonably be expected to be satisfied beyond reasonable doubt of the offending. This appears to assume a competent fact-finder.

17. In my view the matter is difficult and is finely balanced but in the end I have concluded that it would be open to you to conclude that the evidential test was met.

18. When the various public interest factors are weighed it would be open to you to conclude that the public interest test is met.

Overview of Background to the Collapse of the CTV Building

19. The CTV building, which had been situated at 249 Madras Street, Christchurch was the only modern (post-1976) building to catastrophically collapse in the 22 February 2011 earthquake. The collapse occurred suddenly and led to all floors essentially pancaking to ground level, causing the deaths of 115 people.

20. In 1986, Williams Construction Limited was asked by a developer, Prime West Corporation Limited, to submit a design/build proposal for an office building at 249 Madras Street, Christchurch.

21. Alun Wilkie of Alun Wilkie Associates was engaged as the Architect to draw up plans. Once this process was underway, Dr Alan Reay, then operating as a sole practitioner under the name Alan M Reay Consulting Engineer (ARCE), was engaged as the structural engineer for the building.

22. David Harding, who had been employed by Dr Reay as a structural engineer in late 1985, was allocated the role of designing the building.

23. A building permit was obtained for the building in September 1986 from the Christchurch City Council with construction work beginning in October of that year. Construction of the building was completed in 1988. Part of Mr Harding's role as the structural engineer was also to supervise structural engineering aspects of the construction.

24. In January 1990, Holmes Consulting Group (HCG), was engaged by the Canterbury Regional Council (CRC), a potential purchaser of the building, to prepare a pre-purchase review as part of CRC's due diligence. It appears that the HCG Engineer engaged in that review, John Hare, quickly identified a non-compliance issue in relation to the connections between the floor slabs and the North Wall Complex (NWC). As a result, it appears that the CRC decided not to proceed with the purchase and instructed HCG to stop any further review of the building.

25. The building was purchased by Madras Equities Ltd in December 1990. This company remained the owner of the building until its collapse in February 2011. (The building had remained unsold and unoccupied from its completion in 1988 until it was sold in December 1990, and occupied by tenants late in 1991).

26. Following HCG's identification of the non-compliance issue in the connections between the floor slabs and the NWC, Mr Hare brought this issue to the attention of Dr Reay (who at that time was a Director of Alan Reay Consultants Ltd (ARCL)) and his then fellow Director, Geoff Banks (Mr Harding had by then left Dr Reay's employment).

27. Mr Banks of ARCL carried out the engineering design of drag bars to address the area of non-compliance identified in the HCG report and these were installed in October 1991.

28. Between 1991 and September 2010, several minor additions and alterations were carried out, mostly as part of tenancy fit-outs. One of these fit-outs was for Christchurch Television in 2000, the predecessor of Canterbury Television, the name by which the building became known.

29. On 4 September 2010, an earthquake of magnitude 7.1, known as the Darfield earthquake, struck the Canterbury region. There followed a series of significant aftershocks in the months that followed, including a significant one on 26 December 2010, which has come to be referred

to as the "Boxing Day Earthquake". Although there was signs of damage observed in post-earthquake inspections after the September and Boxing Day earthquakes, the CTV building endured both of these earthquakes and the many aftershocks without collapse or any apparent significant structural damage.

30. On 22 February 2011, a devastating earthquake of 6.2 magnitude struck with an epicentre very close to the Christchurch CBD. The resultant shaking resulted in the sudden and complete pancaking collapse of the CTV building, claiming 115 lives and injuring others.

31. As a result of the February earthquake, the former Department of Building and Housing conducted a technical investigation into the performance of four buildings that suffered serious structural failures, one of which was the CTV building (also included was the PGC building which partially collapsed killing 18 people). Dr Clark Hyland and Mr Ashley Smith were appointed to investigate the CTV building. Their findings were reviewed by an Expert Panel appointed by the Department of Building and Housing.

32. Subsequently the New Zealand Government established the CERC to conduct an enquiry into matters to do with earthquakes, including why these four buildings failed as they did. The CERC was precluded from considering liabilities of individuals for the failures.

33. The Department of Building and Housing reports were presented at the hearings of the CERC. After completion of the CERC hearings a final report on the collapse of the CTV building was delivered in 2012.

34. Towards the end of the CERC process the Police investigation into the collapse of the CTV building commenced. This has included the commissioning of BECA, an established national structural engineering firm, to provide an engineering opinion to assist the Police in their investigation into the potential criminal culpability of individuals in relation to the collapse. There have also been two subsequent peer reviews of the BECA report.

Potential Charges under Crimes Act 1961

35. In my view, there are only two potential charges under the Crimes Act 1961 which could be considered; manslaughter by way of a breach of a duty (s160 (2)(b) and ss155/156), or criminal nuisance (s145).

Manslaughter (ss 160(2) (b), 155/156 Crimes Act 1961)

36. Section 158 of the Crimes Act provides:

> Homicide is the killing of a human being by another, directly or indirectly, by any means whatsoever.

37. Section 160 of the Crimes Act provides:

> **160 Culpable homicide**
> (1) Homicide may be either culpable or not culpable.
> (2) Homicide is culpable when it consists in the killing of any person—
> (a) by an unlawful act; or
> (b) by an omission without lawful excuse to perform or observe any legal duty; or
> (c) by both combined; or
> ...
> (3) Except as provided in section 178 of this Act, culpable homicide is either murder or manslaughter.
> (4) Homicide that is not culpable is not an offence.

38. Consideration of the culpability for manslaughter in the context of the CTV building collapse accordingly falls under s160(2)(b) – an omission without lawful excuse to perform or observe any legal duty.

Relevant duties under the Crimes Act

39. Sections 151-157 of the Crimes Act promulgate a number of duties tending to the preservation of life, on the part of parents, employers of persons under 16, those in charge of children, those persons doing dangerous acts and those in charge of dangerous (or potentially dangerous) things.

40. In the context of consideration of culpability arising from the collapse of the CTV building, in my view, the most appropriate duties on which reliance could be placed are those set out in either ss 155 or 156. My preference would be for s 155 but charges could be drafted alleging a breach of s 155 or s 156.

41. Section 155 provides:

> **155 Duty of persons doing dangerous acts**
> Everyone who undertakes (except in case of necessity) to administer surgical or medical treatment, or to do any other lawful act, the doing of which is or may be dangerous to life, is under a legal duty to have and to use reasonable knowledge, skill and care in doing any such act, and is criminally responsible for the consequences of omitting without lawful excuse to discharge that duty.

42. Section 156 provides:

> **156 Duty of persons in charge of dangerous things**
> Everyone who has in his or her charge or under his or her control anything whatever, whether animate or inanimate, or who erects, makes, operates, or maintains anything whatever, which, in the absence of precaution or care, may endanger human life is under a legal duty to take reasonable precautions against and to use reasonable care to avoid such danger, and is criminally responsible for the consequences of omitting without lawful excuse to discharge that duty.

43. Although s 155 specifically refers to surgical or medical treatment, it also applies to anyone doing *"any other lawful act, the doing of which is or may be dangerous to life"*.

44. Therefore it is wide enough to include a structural engineer carrying out the structural design of a building, where one of the main considerations is designing it to meet the risk of earthquake.

45. Section 156, by reference to *"anything whatever"*, applies to a very wide range of human activity. The duty applies to things inherently dangerous in their existing condition and to things that are dangerous because of their operation or surrounding circumstances. Examples of cases in which a duty has been found, include the operation of: a motor vehicle, an aircraft, a train, a vehicle trailer, a power boat, a jet ski, a hand glider, a rope swing, telephone poles, a train handrail and an unfenced swimming pool. It has also included an organised cycling event (*R v Andersen*[1]).

46. Having regard to the breadth of the definition of *"anything whatever"* the structural design of the CTV building could be included in that definition. Likewise, having regard to the nature of the work involved and in particular to the importance of ensuring that the building would appropriately withstand earthquakes, the structural design of the CTV building was clearly something which, in the absence of precaution or care, might endanger human life.

47. In my view it is reasonably clear that Mr Harding had charge or control of the structural design of the CTV building. The duty under this section (and s 155) can apply to more than one person, providing that person also has the thing in his charge or under his control. However, in relation to Dr Reay, if it is alleged that he had a supervisory role over Mr Harding, it might be easier to prove a duty under this section in that the structural design of the CTV building was also in Dr Reay's charge or under his control.

48. The legal duty in both sections is essentially the same – under s 155 *"to have and use reasonable knowledge, skill and care"* and under s 156 *"to take reasonable precautions against and to use reasonable care to avoid such danger"*. What is *"reasonable"* must be judged objectively but in light of all the circumstances *"as they appeared to the accused at the time"* (*R v Gedson*[2]).

49. I do not consider that any acts/omissions by Mr Harding or Dr Reay would fit comfortably under s 157. That section provides that: *"everyone who undertakes to do any act* ***the omission to do which is or may be dangerous to life is under a legal duty to do that act***". The distinction between s 155 and s 157 is that under s 155 it is the doing of the act which is or may be dangerous whereas under s 157 it is the omission to do the act which is dangerous.

50. Furthermore, under s 155 the duty is to use reasonable knowledge, skill, and care in doing the act, whereas under s 157 the duty is simply to do the act undertaken. It would be more logical to frame the duty in terms of s 155, that is, the designers undertook the act of designing the

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[1] *R v Anderson* [2005] NZLR 774

[2] T 51/97, High Court Rotorua, 4 December 1997

building and were therefore under a duty to use reasonable knowledge, skill, and care in doing so.

51. Whether a defendant owes the duty on admitted or established facts is a question of law.

Major departure – s150A Crimes Act

52. Section 150A of the Crimes Act provides that a person is only criminally responsible for omitting to perform a legal duty under ss 155 or 156 if, *"in the circumstances, the omission or unlawful act is a major departure from the standard of care expected of a reasonable person to whom that legal duty applies or who performs that unlawful act"*. Here, that would be a reasonable structural engineer who undertook the act or had the thing in his charge or under his control.

53. *"Major departure"* is not defined in the Crimes Act. However, it is said to have a similar effect to the common law requirement in England and Wales of *"gross negligence"*. It has been expressed in New Zealand in terms that a jury could only convict if satisfied that, having regard to the risk of death involved, the conduct of the defendant was so bad as to amount, in the judgment of the jury, to a crime (see *R v McKie*[3]).

54. The jury's function in determining gross negligence is to decide a question of fact, not a point of law. The issue for the jury is not whether negligence was gross and whether additionally, it was a crime, but whether it was grossly negligent and, consequently criminal (*R v Misra*[4]).

55. In the English case of *Prentice*[5] it was held that any of the following states of mind in a defendant could lead to a finding of gross negligence:

(a) Indifference to an obvious risk of injury to health;

(b) Actual foresight of the risk coupled with the determination nevertheless to run it;

(c) An appreciation of the risk coupled with an intention to avoid it but also coupled with such a high degree of negligence in the attempted avoidance as the jury considers justifies conviction;

(d) Inattention or failure to avert to a serious risk which goes beyond *"mere inadvertence"* in respect of an obvious and important matter which the accused's duty demanded he should address.

56. Therefore whilst all the circumstances of a case must be considered and the defendant's state of mind (eg, if he knowingly ran a risk or was indifferent to an obvious risk of death) proof of a major departure does not require proof of recklessness. Ultimately determining what amounts to a *"major departure"* is a question of degree and a value judgment in the circumstances of a particular case.

57. Circumstances of the particular case have been held not to include a defendant's personal characteristics (unless they rendered him incapable of appreciating the consequences of the omission) since the test under s150A is an objective one: *R v Hamer*[6].

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[3] T 13/00, 3 August 2007, Dunedin High Court, William Young J
[4] [2004] EWCA Crim 2374
[5] (1993) 4 All ER 935, 943
[6] [2005] 2 NZLR 81

Does s 150A apply to this case?

58. In advising the Police early in their investigation, in particular, on the elements required to be proved in relation to a charge of manslaughter, I assumed that s 150A (which was enacted in 1997) would apply and that a major departure from the expected standard of care would have to be proved. Accordingly, this was stipulated in the instructions to BECA in seeking their opinion and proof of a major departure has been addressed by BECA in their report.

59. However, I have subsequently noted that when s 150A was passed in 1997 section 2(2) of the enacting amendment, Crimes Amendment Act 1997 (No 88) provided:

> Nothing in this section applies in respect of any act or omission that occurred before the commencement of this Act.

60. On the face of it this sub-section seems clear, namely that whether the section applies depends on when the act or omission occurred. However it is difficult to see any logical reasoning behind the sub-section, particularly when the reason for the law change was to bring New Zealand into line with other Commonwealth countries in which the 'gross negligence' standard was applied in all relevant cases.

61. As well, the change is to the benefit of a potential defendant so the usual precaution against retrospectivity in penal statutes does not apply. By restricting the application of s 150A to acts or omissions occurring after the commencement date of the amending Act, Parliament has allowed for a situation to occur where a person can be held criminally responsible for breaching a standard of care based on a threshold which, at the time the actual offence was completed, it had deemed to be (as a matter of policy) inappropriately low.

62. A further complication is that, prior to 1997, a breach of ss 155 and 156 of the Act required proof of ordinary negligence, whereas in relation to ss 151, 152, 153 and 157 it required proof of a "very high degree of negligence," in effect gross negligence. (Rectifying this anomaly was another reason why Sir Duncan McMullin recommended the 1997 law change).

63. In my view it would be unwise to approach this case on the basis that all the Crown had to prove in relation to a breach of ss 155 or 156 was ordinary negligence as I consider that this could create a potentially successful appeal point. I am mindful of my previous experience in two cases where, on appeal following successful prosecutions, the Court of Appeal effectively amended the law which had previously been applied (*R v Powell*[7] and *R v Andersen*).

64. Ironically, if a prosecution was brought under s 157 the same issue might not arise as the law that had applied prior to the 1997 change still effectively required 'gross negligence.' However, as I have indicated above, I do not consider that s 157 would be the appropriate section.

65. In my view, the safest course in relation to the issue of the applicability of s 150A, would be to indicate, prior to any trial that the Crown elected to proceed on the basis that, although arguably not required, it had to prove a major departure. It would of course be up to the trial Judge to determine the applicable law and if he/she determined that proof of a major departure was not required, I would recommend a pre-trial appeal to the Court of Appeal (or possibly to the Supreme Court).

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[7] [2002] 1 NZLR 666.

Causation

66. To prove culpable homicide under s 160 there must be proof beyond reasonable doubt that the deaths were caused by the omission without lawful excuse to perform the legal duty (under ss 155 or 156).

67. Proof that the omission *"caused"* the deaths requires that the prosecution prove that the omission was a *"substantial and operating"* cause of the deaths. This is sometimes expressed as meaning *"more than minimal"*. It need not be the only cause. There can be other contributing causes, independent of the omission in question, provided that the omission by the defendant was a substantial and operating cause of the deaths.

68. There can also be other contributing causes which can be attributed to the omissions of another or others to perform a similar duty, provided the omission by the defendant in question was still a substantial and operating cause of the deaths.

69. The law recognises that other causes may intervene to *"break the chain of causation"* between a defendant's act/omission and the death. This is the concept of *novus actus interveniens* or *"intervening cause"*, ie that some new event (or events) results in the defendant's actions no longer being a substantial contributing cause of death.

70. An intervening cause can be the actions (or possibly the omissions) of another person but could also be a natural phenomenon (eg, larger than expected earthquake). For the chain of causation to be broken in relation to a defendant's actions, the effect of his actions must be effectively extinguished by the subsequent event.

71. The policy behind the concept of novus actus interveniens is that liability will not exist if it can be shown that the defendant could not have avoided causing death even by exercising reasonable care.

72. In relation to a natural phenomenon, this would mean that legal responsibility would be extinguished upon the occurrence of an event that was unforeseeable and extraordinary such that it could not possibly be anticipated or guarded against. (This issue has relevance in relation to the issue of the magnitude of the February earthquake and whether it was such that it could be considered an intervening cause. It is discussed later).

Section 162 Crimes Act

73. Section 162 Crimes Act 1961 provides:

> **162 Death must be within a year and a day**
>
> (1) No one is criminally responsible for the killing of another unless the death takes place within a year and a day after the cause of death.
> (2) The period of a year and a day shall be reckoned inclusive of the day on which the last unlawful act contributing to the cause of death took place.
> (3) Where the cause of death is an omission to fulfil a legal duty, the period shall be reckoned inclusive of the day on which such omission ceased.
> (4) Where death is in part caused by an unlawful act and in part by an omission, the period shall be reckoned inclusive of the day on which the last unlawful act took place or the omission ceased, whichever happened last.

74. This section most commonly applies in a situation where death by an unlawful act (eg, a stabbing) does not occur until after the expiry of a year and a day (usually due to medical intervention). In that case there could be no prosecution for homicide.

75. The section also applies to a death caused by an omission, s 162(3) providing that the year and a day time limit is calculated from the day when the omission ceased.

76. Therefore it is necessary to determine when an omission ceases.

77. The difficulty is that there appears to be an absence of authority in the criminal law on when an omission ceases.

78. A common sense and purposive interpretation would lead to the conclusion that an omission ceases when the danger the duty seeks to prevent materialises (usually an injury).

79. This would be consistent with civil law principles to the effect that a limitation period runs from the date of discoverability as opposed to the date of an omission.

80. Commentary supporting this view can be found in *Smith and Hogan's Criminal Law, 6th Edition*, p312, however no authority is cited in support.

81. There is therefore the potential for s 162 to be raised by the defence before any trial and obviously if an argument that any omission ceased upon construction of the building was successful it would be fatal to the prosecution.

82. Of more concern, in my view, is an additional argument that could (and no doubt would) be raised, namely whether the 1990 Holmes review of the design and subsequent retrofit resulted in the original omissions (or at least the omission in relation to the North Core-wall connections which was discovered by the Holmes review) ceased when they were brought to Dr Reay's attention and then an attempt made to remedy the defect.

83. I note that in para 6.3 of the Holmes Review it was stated:

> The result would be that in the event of an earthquake the building would essentially separate from the shear walls well before the shear walls reached their design strength.

84. If that argument was successful it would mean that the omission could not be relied on, on its own or potentially as a contributor to the collapse (if that contribution could not clearly be separated from other contributing defects).

85. If the design omission relating to the connection between the North Core and the walls could not be relied on, it would have to be able to be proved beyond reasonable doubt that the building would still have catastrophically collapsed because of the other design defects (irrespective of the North Core-wall design defect).

86. However, this assessment would also have to be made on an assumption that the beam-column joint reinforcement was installed as specified and that the other construction defects were not present.

87. BECA have expressed the view that compliant North Core-wall connections and the installation of the as-specified beam/column reinforcement would not have made any material difference to the manner of the collapse. However in my view it is necessary to have BECA confirm that in their view, even if the North Core-wall connection had been compliant and assuming the beam/column joint reinforcement was installed as specified and the other construction defects were not present the building would still have collapsed in essentially the same manner as it did in the February 2011 earthquake. It is important that in this re-assessment by BECA, they take into account the cautions expressed by [redacted] in relation to the potential

for the margin of error in non-linear time history However in my view it is necessary to have BECA confirm that in their opinion even if the North Core-wall connection had been compliant and assuming the beam/column joint reinforcement was installed as specified and the other construction defects were not present the building analyses to be in the order of +/- 50%.

88. It is also necessary to ensure that there is agreement from the two peer reviewers on this issue and for them (BECA as well) to be able to discount any expert proffering a contrary review as being one that is not reasonably possible.

89. Responses to the matters raised in the two paragraphs above have now been received from BECA and the two peer reviewers.

90. BECA have advised that: *their analysis and testing showed that the correction of the construction defects and code compliant NWC to slab connections would have made an immaterial difference to the performance of the building, compared with the other design errors which included low design loads, low beam/column joint reinforcing in the "gravity" frames and the decision the shear walls would protect the "gravity" frames.*

91. Further, that they essentially consider they can dismiss all other possible explanations or theories of which they are aware.

92. [redacted] has indicated that he agrees with BECA, although he does repeat some of the cautions he has raised previously in relation to the NLTH analysis.

93. [redacted] takes no issue with BECA's view even though he qualifies that somewhat by stating there *"is a very high probability that they have correctly identified the manner of the failure"*.

94. The above responses would appear to mollify the concern I raised over the possible application of s 162 in relation to the retrofit. However I do note the qualifications expressed by the experts.

95. If the charges are framed in the manner that I suggest in this opinion (ie, caused the death of one or more of the 115 persons that died as a result of the collapse) then it might not be necessary to conclude that the building would have had to have pancaked completely in the manner that it did. However it would still be necessary for the experts to be able to conclude that, taking into account the above matters, the building would still have collapsed in a manner that would have resulted in significant fatalities.

96. Without these assurances there is, in my view, a potential for an argument based on s 162 to be successful.

Corporate manslaughter

97. Section 2 of the Crimes Act defines a person as including *"the Crown and any public body or local authority, and any board, society, or company, and any other body of persons, whether incorporated or not, and the inheritants of any district of any local authority, in relation to such acts and things as it or they are capable of doing or owning"*.

98. However, it is recognised that statutory wording or the nature of an offence may mean that a company or corporation cannot incur liability as a principal. In *R v Murray Wright Limited*[8] it was held that a company could not be liable as a principal for manslaughter because homicide is defined by s 160 of the Crimes Act as the *"killing of one human being by another"*. However it is

[8] [1970] NZLR 476 (CA)

possible that a company may be held liable as a party to the offences of an individual. In appropriate cases, there is no reason why a company cannot be liable as a secondary party for offences that it could not commit as a principal offender.

99. There have been, from time to time, calls for a reform in the area of corporate culpability including providing for an offence of *"corporate killing"* however this has not yet met favour in New Zealand. For an example of a discussion in this area see: *"Corporation Manslaughter: Attorney General's Reference (No 2 of 1999) [2000] 3 WLR 195"*, Warren Brookbanks.[9]

100. In the circumstances of this case it is appropriate to focus considerations for manslaughter culpability on individuals who can reasonably be said to come under one of the relevant duties. However, the issue of corporate culpability has some potential relevance in relation to the actions of the Christchurch City Council, discussed below.

Elements of Manslaughter

101. Elements which would need to be proved for manslaughter are:

(a) The defendant owed a duty under either s155 or s156;

(b) The defendant omitted to discharge that duty;

(c) That omission caused the death of one or more of the 115 victims of the CTV collapse;

(d) That omission constituted a *"major departure"* from the standard of care expected of a reasonable structural engineer to whom that duty applied.

Criminal Nuisance (s 145 Crimes Act 1961)

> **145 Criminal nuisance**
> (1) Everyone commits criminal nuisance who does any unlawful act or omits to discharge any legal duty, such act or omission being one which he knew would endanger the lives, safety, or health of the public, or the life, safety, or health of any individual.

102. For a prosecution under s 145, the prosecution has to prove the following elements beyond reasonable doubt:

(a) The defendant was under a legal duty (this would be under either s 155 or s 156 of the Crimes Act));

(b) The defendant omitted to discharge that duty;

(c) The defendant knew that such an omission would endanger the lives, safety or health of the public or any individual.

103. In relation to this latter element, the Court of Appeal in *R v Andersen*[10] held that s 145 should be regarded as creating an offence of recklessness.

104. Therefore, there must be proof that the defendant knew that the omission would endanger life, safety or health. That knowledge must be actual knowledge rather than "deemed knowledge" although knowledge may be readily inferred when the danger is obvious.

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[9] (2000) 6 NZBLQ 228

[10] *R v Andersen* [2005] NZLR 774

105. There must be a causative link between the omission and the endangerment and the knowledge of that risk. This does not require proof that as a result of the breach of duty, danger was actually caused. Rather, it is sufficient that there is proof that the omission materially increased the risk of lives, safety or health being endangered (or put in peril).

106. The fact that the acts or omissions of other parties were also causative of the state of affairs will not negate culpability provided the defendant's omission materially contributed to the endangerment.

107. It is likely that a corporation could be guilty of criminal nuisance.

108. In my opinion it would be difficult to prove recklessness. In any event, the offence of criminal nuisance is unlikely to be viewed as serious enough in the circumstances of this case. I have therefore not considered this charge further.

109. In any event, there is a further problem with criminal nuisance in that under s 25(3)(c) Criminal Procedure Act 2011 it would be time-barred (more than 5 years old) without the approval of the Solicitor-General.

Solicitor-General's Prosecution Guidelines

110. The Prosecution Guidelines as at 2013 are the required framework for consideration of whether prosecutions should be commenced against any individual arising from the collapse of the CTV building.

111. The Guidelines are intended to assist all those persons whose function it is to enforce the criminal law by instituting and conducting a criminal prosecution. The purpose of the Guidelines is to ensure that the principles and practices as to prosecutions in New Zealand are underpinned by unified values. Those values aim to achieve consistency in key decision making and trial practice.

112. The Guidelines are intended to assist in determining whether criminal proceedings should be commenced at all, what charges should be laid, and whether, if commenced, criminal proceedings should be continued or discontinued.

The Test for Prosecution

113. Prosecutions ought to be initiated or continued only where the prosecutor is satisfied that the test for prosecution is met.

114. The test for prosecution is met if:

- The evidence which can be adduced in Court is sufficient to provide a reasonable prospect of conviction – the Evidential Test; and
- Prosecution is required in the public interest – the Public Interest Test.

The Evidential Test

115. A reasonable prospect of conviction exists if, in relation to an identifiable individual, there is credible evidence which the prosecution can adduce before a Court and upon which evidence an impartial jury (or Judge), properly directed in accordance with the law, could reasonably be expected to be satisfied beyond reasonable doubt that the individual who is prosecuted has committed a criminal offence.

116. What is required by the evidential test is that there is an objectively reasonable prospect of a conviction on the evidence. The apparent cogency and creditability of evidence is not a mathematical science, but rather a matter for judgment for the prosecutor. In forming his or her judgment, the prosecutor should endeavour to anticipate and evaluate likely defences.

The Public Interest Test

117. Once a prosecutor is satisfied that there is sufficient evidence to provide a reasonable prospect of conviction, the next consideration is whether the public interest requires prosecution. It is not the rule that all offences for which there are sufficient evidence must be prosecuted. Prosecutors must exercise their discretion as to whether a prosecution is required in the public interest.

118. The Guidelines (at para 5.8) list a number of public interest considerations in favour of prosecution. The predominant consideration is the seriousness of the offence. Where a

conviction is likely to result in a significant penalty including any confiscation order or disqualification, then there is a strong public interest in favour of a prosecution.

119. Whilst not expressly stated, implicit in the above consideration is the outcome of the offending. If causation can be established, the fact that 115 persons died as a result of alleged offending is a material consideration for prosecution.

120. Of the other 15 factors listed of public interest considerations for prosecution at para 5.8, none is particularly relevant in this case.

121. At para 5.9 there is a list of public interest considerations against prosecution. Those relevant to this case include:

5.9.4 Where there has been a long passage of time between an offence taking place and the likely trial date such as to give rise to undue delay or an abuse of process unless:

- The offence is serious;
- delay has been caused in part by the defendant;
- the offence has only recently come to light;
- the complexity of the offence has resulted in a lengthy investigation.

5.9.8 Where the defendant has no previous convictions.

5.9.13 Where any proper alternatives to prosecution are available.

122. The public interest considerations listed in the Guidelines are not comprehensive or exhaustive and will vary from case to case. In each case, where the evidential test has been met, the prosecutor should weigh the relevant public interest factors that are applicable and then determine whether or not the public interest requires prosecution.

Evidential Sufficiency

Evidential Sufficiency for Manslaughter

123. As the 115 deaths were the result of a building collapse, proving the main elements of the offence will, in the main, rely on expert evidence.

124. The Police have obtained an expert opinion from BECA and would intend calling [redacted] (and possibly others) from BECA to give expert evidence in order to prove these elements. In a case such as this it would be unusual to rely solely on one expert opinion. To that end the Police have also obtained a peer review of that expert opinion from a structural engineer, [redacted]

125. Although I believe the original intention was that [redacted] would peer review the final report from BECA and thereby effectively provide an independent expert opinion, I understand that [redacted] has been in contact with BECA throughout the process of the formulation of their opinion, in the same manner as that of a technical peer reviewer. Whilst there is nothing wrong with this, it may be open to future defence criticism that it is not an additional independent expert opinion. In light of these issues and once [redacted] review had been received, the Police obtained a further peer review of the BECA report by [redacted] structural engineer, of Auckland.

126. The BECA opinion provides a reasonably strong opinion in support of proof of the relevant elements and, as well, a reasonably strong rebuttal of the main issues likely to be raised in relation to that proof.

127. [redacted] largely concurs with the BECA opinion although, importantly, he does make a number of qualifications which I discuss individually below.

128. [redacted] in the main, agrees with the BECA opinion, although he appears to consider that the view that the primary reason the building collapsed was because of the deficient beam-column joints is too narrow and that there were a number of serious design errors which in combination caused the collapse.

Evidential Basis for Charges

129. I note that the Police report (pages 134-137) deals with the issue of whether evidence given before the CERC could be used in a criminal prosecution. The conclusion reached is that, although inconsistent statements could be used in cross-examination, it would be preferable to approach a prosecution on the basis that the evidence given before the CERC should not be relied on. I note the Police have advised that this is the course they have adopted in their investigation. In my view, even though this may require extensive briefing of witnesses, that is a wise course. It may of course transpire that some of this evidence could be relied on (likely because the witness waived privilege).

130. However, in my view it is still appropriate, in assessing evidential sufficiency, to consider the evidence given at the CERC hearings, particularly by Dr Reay and Mr Harding, as those explanations are unlikely to change substantially.

131. You have provided me with a summary of the evidence you have gathered to date, independent of the evidence given before the CERC. That summary shows that the actions of Mr Harding can

reasonably be covered by various witnesses. However difficulties may arise in relation to Dr Reay's actions because there appear to be less people who can speak to those.

132. Recently I have been provided with the evidence heard by an investigating committee for IPENZ, the engineer's professional body. This material would not seem to be privileged or the subject of any potential bar in terms of its use in criminal proceedings. It is useful in that Dr Reay and Mr Harding gave similar accounts to those they gave before CERC. This would, in particular, provide evidence of Dr Reay's alleged lack of supervision. Of course it also provides his explanation of the same and it would likely have to be lead in its entirety, potentially avoiding the necessity for him to give evidence.

133. In relation to the IPENZ material I note that in addition to the interviews with Dr Reay and Mr Harding, a number of affidavits were filed by Dr Reay's counsel. In my view the Police should provide this new material to BECA and the peer reviewers for comment, in particular the affidavit from [redacted] and other engineers as to the standards of the day and reliance on the Christchurch City Council's structural review. This is because a potential Crown expert has to be able to reject another expert's contrary view as one that cannot be reasonably held.

134. I note that this material has been provided to BECA and Messrs [redacted] and they have now provided their views.

135. BECA have advised that although they have not been able to comprehensively review the IPENZ material, on a preliminary review they have not found anything which would change their conclusions and consider a comprehensive review would be unlikely to change them either.

136. Messrs [redacted] take no issue with BECA's response.

137. At the time of writing this opinion the documentary and electronic material obtained from the execution of a number of search warrants on Dr Reay's business premises and homes had still not been fully assessed due to protracted argument from Dr Reay's legal counsel over issues of legal professional privilege.

138. **It is important that this issue is resolved as soon as possible.** I accept that it is unlikely to be resolved prior to a decision as to whether or not to prosecute and do not consider that decision would need to await resolution, although it would have been preferable.

139. However once it is resolved (likely by the High Court) and that material is assessed it may be that this affects the evidential sufficiency analysis, although at this stage it would seem unlikely to decrease evidential sufficiency. **If that is the case a further review would be necessary.**

140. I set out below the summary and conclusions from the BECA opinion (pp 1-7) and then address the proof of each element and in particular discuss the likely issues that will be raised in relation to that proof in order that a conclusion on evidential sufficiency can be reached:

"Summary and Conclusions

BECA has been commissioned by the New Zealand Police to provide an opinion on structural engineering matters related to the collapse of the commercial building at 249 Madras Street, commonly known as the CTV building, in which 115 people lost their lives as a result of the 22 February 2011 Christchurch earthquake. Part of the work includes an opinion on what was the "expected standard" of design, construction and consenting of buildings, particularly in Christchurch, during the mid-1980s and early 1990s when the design, construction and subsequent retrofit of the CTV building were carried out.

The information and reports produced by others during the Department of Building and Housing (DBH) and Canterbury Earthquake Royal Commission (CERC) inquiries have been used in the preparation of this report, together with our own analyses and investigations as described.

The collapse of the CTV building was catastrophic and sudden, with the floor slabs pancaking on top of one another leaving little space between. The CTV building was the only modern (post-1976) building to collapse in this manner in the earthquake sequence between September 2010 and February 2011.

The brief requires us to report on the following three questions:

1. *Was there an omission by any individual to discharge their duty? Refer to Section 2 for the definition of "duty" as used in this report. In answering this question, we note that we are expressing our opinion as requested, but the issue of whether any particular individual has breached the assumed duty may ultimately be a matter for the courts to address.*

2. *Was that omission a substantial and operating cause of the deaths?*

3. *If so, was that omission a major departure from the expected standard?*

The individuals whose actions we have been requested to consider were named by the Police in their brief (Refer Appendix A).

In preparing this opinion BECA has:

1. *Reviewed the relevant parts of the evidence given at the CERC hearings and the CERC and DBH reports.*

2. *Carried out analyses of the building, using the codes and practices of the day.*

3. *Reviewed the calculations carried out by David Harding, an employee of Alan M. Reay Consulting Engineer (ARCE), and reviewed the drawings for the building.*

4. *Reviewed the calculations carried out by Geoff Banks, a director of Alan Reay Consultants Limited (ARCL), for the checking and design of the 1990/1991 retrofit works related to the diaphragm connections.*

5. *Undertaken interviews with consulting engineers, both within BECA and with other organisations listed in Appendix E, who were active in the design of multi-storey buildings at the time, to ascertain the relevant design standards, design approach, practices for overviewing and checking designs and expectations regarding council checking as part of the issuing of building permits in the mid-1980s.*

6. *Reviewed the design of other 1980s Christchurch buildings that we could find with similar structural systems and of similar size and scale, and compared the relevant parts of their structure with the CTV building structure.*

7. *Analysed the performance of the CTV building structure under the shaking experienced as recorded at other sites in Christchurch at the time of the earthquakes using the results of nonlinear time-history analyses (NLTHAs) undertaken jointly with* [redacted]

8. *Completed physical testing of full size replica concrete specimens of key parts of the CTV building structure at the University of Auckland.*

9. *Formed an opinion on what caused the collapse of the CTV building to be so severe that all floors pancaked to ground level resulting in heavy loss of life based on all of the information we have gathered.*

In our opinion:

1. *The collapse was initiated by loss of stiffness in one or more beam-column joints resulting in column axial failure, probably in the ground floor of an internal frame, probably on Grid 2. The capacity and stiffness of the beam-column joint regions associated with these columns was significantly reduced by the lack of transverse and shear reinforcement and this was a significant contributor to the collapse. The characteristics of axial failure in these relatively slender columns were such that their ability to support gravity loads would have been completely lost once it occurred. This would be either by progressive crushing/failure of the column concrete and/or sliding of the column to one side once at least one end became effectively detached from the structure. Once collapse of these columns was initiated there was no ability for the gravity loads to be redistributed to adjacent columns with the result the remaining columns were progressively overloaded, leading to the pancaking collapse of one floor on top of another.*

2. *If the building had been designed in accordance with and compliant with the codes of the day it would not have collapsed in the pancaking form it did, notwithstanding the level of shaking and number of earthquakes in the Canterbury sequence up to and including 22 February 2011.*

3. *The sudden pancaking nature of the failure occurred because the primary seismic structure had insufficient strength and stiffness to protect the primary gravity frames as detailed, and as a consequence the primary gravity frames were not sufficiently detailed for flexure or ductility to sustain the deflections imposed on them.*

4. *The primary seismic structure (i.e. the shear walls and their foundations) initially survived the earthquake, damaged but still standing, apart from the South Shear Wall which ultimately failed in its weak direction after the collapse of the floors because it lost north-south support provided by the floor slabs and the North Wall Complex. The intent of the codes of the day was that pancaking collapse would not have occurred in the level of shaking experienced on 22 February 2011, although the building could be heavily damaged. It is our opinion that, had the whole building complied with codes and practices of the day, the building, though damaged, would have had sufficient resilience not to collapse suddenly and in a pancaking fashion. All other buildings in Christchurch of a similar age with similar structural systems that experienced the 22 February 2011 earthquake had shear walls that provided more effective protection of the gravity structures and the gravity structures were detailed with more transverse steel that provided greater ductility.*

5. *There is no evidence that the collapse was triggered by ground subsidence/settlement.*

6. *The original 1986 structural analysis and design of the building was undertaken using appropriate codes and analysis techniques but contained a number of errors in relation to the application of the codes. There was also a significant mathematical error.*

The significant errors included:

a. *An incorrect calculation of the building's natural periods of vibration in both the east-west and the north-south directions leading to an under-calculation of the seismic design load.*

b. *Incorrect reduction in the analysis results for design of the primary seismic elements by including an extra unjustified 0.8 factor, leading to a further lowering of the seismic design load compared with that required by the code. In combination with 6a), the net effect was that the North Wall Complex (in the north-south direction) was 25% weaker and the South Shear Wall (in the east-west direction) 40% weaker than required by the code.*

c. *Failure to calculate correctly the building deflections under code-specified loading, particularly for loading in the east-west direction. This may have resulted in a lack of appreciation by the designer of the deflections required to be sustained by parts of the structure, which, in turn, led to the errors described in d) and e) below.*

d. *Non-compliance with the code requirements for the spacing and amount of specified transverse reinforcement for beam-column joints, resulting in a lack of ductility/resilience.*

e. *An incorrect and not justified decision to regard the beams, columns and their joints in the building as being required to resist only gravity loads. In doing so, the designer concluded incorrectly they were not required to be designed for seismic frame action or for ductility. This caused a lack of resilience in those elements which were then unable to sustain the required seismic deformations while maintaining their primary role of supporting the gravity loads.*

f. *An incorrect units' conversion leading to a gross understatement of the shear to be transferred from the floor slabs to the North Wall Complex for loading in the east-west direction, which led to an under-designed connection that did not comply with codes of the day. This gave rise to the potential for the floors and North Wall Complex to separate with the result that the building would not behave as the codes intended.*

g. *Failure to check the connection of the floor slabs to the North Wall Complex for loading in the north-south direction, leading to a connection that did not comply with the codes of the day. This gave rise to the potential for the floors to detach from the North Wall Complex with the result that that the building would not behave as the codes intended.*

7. *Apart from the lower design loads arising from 6(a) and (b) above, the primary seismic structure, comprising the shear walls and their foundations, was designed and detailed generally in accordance with codes and practices of the day.*

8. *The transverse beam-column joint steel specified on the drawings in the primary gravity frames did not comply with the code requirements. Away from the joints, the transverse column steel was light (i.e. small diameter and large spacing), but compliant with the minimum requirements of the code in the critical areas. Our investigations have shown that the requirements of the 1982 code, albeit light and less than required in later codes,*

would have been sufficient to prevent the building collapsing in the manner it did in this earthquake, if the significant design issues identified (understrength and noncompliant shear walls, and noncompliant beam-column joint transverse reinforcement) had not been present.

9. *Although the transverse column steel in the CTV building complied with the minimum requirements of the concrete code it was very light compared with general practices of the day. We have found no other similar sized buildings of the era in Christchurch with as little transverse steel as was specified in the CTV building columns and beam-column joints.*

10. *The poor and non-compliant retrofitted connections between the North Wall Complex and the primary gravity structure, if present in an otherwise compliant building, would not have led to the collapse of the type that occurred in the 22 February 2011 earthquake.*

11. *The known construction errors (lack of transverse steel through the beam-column joints, changes to some beam reinforcing end anchorages, potentially low strength concrete, un-roughened precast to in situ concrete joints), if present, in an otherwise compliant building, would not have led to the collapse of the type that occurred in the 22 February 2011 earthquake.*

12. *The structural design was carried out by Mr David Harding, an employee of Dr Alan Reay. According to Dr Reay's evidence at the CERC, neither he, nor any other engineer in his practice, or outside it, provided any oversight or checking. Mr Harding was a senior engineer and employee of Dr Reay, but inexperienced in multi-storey design. The stated lack of oversight by Dr Reay, or any form of review or checking by another experienced person, was contrary to accepted practice of the time. Our experience and the conclusion we reached following discussions with other practitioners of the day was that a principal of a design company, partner of a partnership, or sole practitioner with staff, would oversee a design such as this (often completing the concept design themselves), or organise another senior employee or external consulting engineer to review it. In our opinion, relevantly experienced oversight or review at concept stage would have questioned the low lateral seismic displacements and/or the decision not to detail the primary gravity frames with ductility. To appoint a newly employed senior engineer without experience in similarly sized structures and rely on him to ask questions if needed, was not in accordance with generally accepted and expected practice.*

13. *We agree with the CERC report conclusion that the review undertaken by Holmes Consulting Group in 1990 for a prospective purchaser of the building was* "never intended to be a full peer review of the design of the building"**.** *The assessment did not identify that the gravity structure (ie, the primary gravity frames) should have been detailed with ductility. This is not surprising given it would take an analysis of the whole building (both primary seismic and primary gravity structures) to confirm the requirement, and the short time available permitted only a relatively superficial review.*

14. *The Christchurch City Council (CCC) process for confirming the adequacy of the structural engineering aspects of building permits often relied on the designer, and included only spot checks otherwise. The other designers we spoke to who were practicing in Christchurch at the time said they would not rely on the building permit checking process as a review of their design.*

15. *Other factors have been raised, such as the cumulative effects of multiple earthquakes and demolition of the neighbouring building. In our opinion these factors were not of sufficient severity to be substantial contributors to the collapse.*

In response to the questions posed by the Police, we make the following comments in relation to the named individuals they list in the brief:

Alan Reay – practicing as Alan M. Reay Consulting Engineer, ARCE and later a director of ARCL (post 1988): *ARCE agreed to design the building. As Dr Reay was a sole practitioner this agreement was directly with him.*

In agreeing to design the building, and as the only principal of ARCE, Dr Reay was obligated (had a duty) to his client, future building occupiers and the public in general, to deliver a design that met the expected standard of the day by allocating appropriately skilled and experienced staff to ensure this was achieved. The expected standard included meeting the design codes and standards, and the accepted practices of the day.

There were design errors and non-compliances with the design codes and standards of the day in the CTV building. The presence of these errors and non-compliances occurred because appropriately skilled staff were not allocated to the design and checking of the building. This was an omission in the discharge of Dr Reay's obligations to ensure the design of the building met the expected standard.

To meet his obligation (duty) regarding allocation of appropriate resources Dr Reay had a wide range of options including:

a. *Design the building himself. In doing so he could elect the degree of review his design required based on his own assessment of his competence and recognising professional expectations.*

b. *Appoint an engineer experienced in building work of this type to carry out the design. If the engineer was suitably experienced then, from a technical point of view, Dr Reay could have delegated this task and expected the delegated engineer appoint another engineer to, or personally, undertake the level of checking and/or review to satisfy himself the design was sound.*

c. *Allocate the design task to a less experienced engineer. In this case Dr Reay was obligated to do sufficient checking and reviews to confirm that the design met the expected standard. He could have done this himself or delegated this to an engineer experienced in the design of buildings of this type to do on this behalf.*

Accepted practice of the day was, and is, for a principal of a design firm (Dr Reay was the sole principal of ARCE) to determine the option to be followed based on the experience of the resources available and by an appropriate level of personal input to confirm that a design was delivered to the expected standard. It was not the accepted practice to completely delegate, without any supervision or checking process, all engineering for a significant multi-storey building structure to an engineer who had little or no relevant experience. It was also not the accepted practice of the day to rely on the consent checking process to provide any meaningful level of review.

To delegate the above tasks for the CTV building design, Dr Reay was obligated to satisfy himself that the engineer was experienced in the design of significant multi-storey buildings. The use of precast concrete frame members, innovative for the time, also

warranted additional care. It was not sufficient to rely solely on age and years of experience in engineering without also considering the level of experience available that was directly relevant to the type and scope of building being designed.

It was clear from evidence provided to the CERC that Mr Harding did not have prior experience in the design of buildings of the type of the CTV building, nor did he misrepresent this lack of experience to Dr Reay. In his 13 years of experience, Mr Harding had only his first four years doing structural engineering which was limited to minor single storey domestic and industrial structures. Therefore, it was not reasonable for Dr Reay to assume that he could either delegate the design task to him (option 2 above), or to allocate the design task to him (option 3 above) without also carrying out suitable review himself or delegating this to another suitably experienced engineer.

Major departures from the accepted practices and, therefore, the expected standard of the day by Dr Reay were therefore:

- *assuming that the design task could be delegated completely to Mr Harding, and*
- *allocating the job to Mr Harding, an engineer with virtually no experience in structural design of multi-storey buildings, without also providing appropriate checking himself or ensuring adequate review by others, and*
- *relying on the building consent process to identify errors in the design.*

The building collapsed in a pancaking fashion and as a result caused multiple fatalities. Our investigations have shown a collapse of this type was due to errors in the design and would not have occurred if the design had complied with the design codes and design standards of the day. Dr Reay's omission to discharge his obligations in regard to the allocation of appropriate resources to the design were the reason why the design errors were not identified and corrected, and was therefore a substantial and operating cause of the deaths.

It does not appear from the available reports that Dr Reay was the principal of ARCL responsible for the retrofit carried out in 1990/1991. Geoff Banks, a principal of ARCL, appears to have taken this role.

It is our conclusion that:

1. *Dr Reay, as the person who undertook to design the building, omitted to discharge his duty to allocate appropriately experienced personnel to the design, checking and review process of the building structure.*
2. *This omission was a substantial and operating cause of the collapse, and*
3. *The omission was a major departure from the expected standard.*

David Harding – employee of ARCE and designer of the CTV building: *Mr Harding made significant errors which meant the design of the building did not comply with the codes or standards of the day. There was a significant underestimation of the seismic load and reinforcing requirements in critical areas of the building in Mr Harding's design. Mr Harding's erroneous assumption that the beams, columns and their joints (the primary gravity frame) were not required to be designed or detailed for flexural actions, together with the low seismic load were the reasons why the building collapsed suddenly, floor-on-floor, in the pancaking manner. Other*

errors and omissions in the design compounded the effect of this decision by further reducing the strength and resilience available in the building.

Mr Harding also failed to note and instruct corrections to departures from the construction documentation by the contractor during construction of the building which further increased the deformations in the primary gravity structure beyond what they could sustain.

It is our conclusion that:

1. *Mr Harding, as building designer, omitted to discharge his duty in relation to the design of the CTV building as the design did not comply with generally accepted practices and standards of the day.*

2. *The omission was a substantial and operating cause of the deaths, and*

3. *The omission was a major departure from the expected standard.*

Geoff Banks - director of ARCL and designer of the drag bar retrofit in 1990/1991: *Mr Banks made errors in the assessment of the design actions between the North Wall Complex and the floor slabs during the design of the retrofit works in 1990/1991. The strengthening works partially addressed the deficiencies in the north-south earthquake direction but not in the east-west direction. These errors resulted in an underestimation of the retrofit work required to provide a compliant connection between the floor slabs and the North Wall Complex. Mr Banks should have fully resolved the deficiency with the connection between the North Wall Complex and the floor slabs. However, Mr Banks would not have been expected to have initiated a full structural review of the building at that time, or to have identified the beam-column joint issue, especially as Holmes Consulting Group's investigation indicated that the primary gravity structure was code compliant "in all respects".*

Mr Banks' errors meant the slab to North Wall Complex connection, though improved, was still weaker than it should have been. While this was a potential contributing factor to the collapse, the error was not a major cause of the collapse.

It is our conclusion that:

1. *Mr Banks omitted to discharge his duty in relation to the design of the strengthening works, but*

2. *The omission was not a substantial and operating cause of the deaths.*

Graeme Tapper/Bryan Bluck - Assistant Building Engineer Christchurch City Council (CCC)/Chief Building Engineer CCC: *The CERC identified that there had been a policy in the 1970s, which was perhaps still operating in the mid-1980s, for CCC to rely on structural engineering designers in lieu of a review by the council engineers when processing building permits. This is consistent with the fact that the CERC report indicated the building permit was issued three working days after the receipt of the structural drawings. We do not believe the council could have done sufficient work to identify the deficiencies in the structural design in this short period, especially with the limited resources they had available. It would appear they followed the practice for the council staff to rely on the assurances of the building structural engineer regarding compliance with codes. The practitioners operating in Christchurch at the time who we interviewed recognised this, and did not rely on the council checking process to provide sole confirmation of the adequacy of their design.*

[redacted]

It is our conclusion that:

1. *While the CCC may or may not have discharged their responsibilities under the relevant legislation of the time (we have not checked as it is a legal matter and beyond our brief), they did not depart from their usual practice of not doing a thorough structural check.*

   The CCC may or may not have omitted to discharge their duty by not doing a thorough structural check and consequently issuing a building permit for a defective design.

2. *The undetected defective structural design of the CTV building was a substantial and operating cause of the deaths, but*

3. *Issuing a building permit without a thorough structural check prior to issuing a building permit was not a major departure from the expected standard of the day in Christchurch.*

Bill Jones/Gerald Shirtcliff – employees of Williams Construction managing construction of the building: *The contractor failed to carry out the construction in conformance with the construction documentation in relation to the lack of preparation of construction joints at the beam-ends, and, failure to install the beam-column joint ties as detailed on the construction drawings. In our opinion, the degree of departure from the structural drawings represents an omission to discharge their duty. The construction deficiencies reduced the resilience of the primary gravity frames and hence potentially contributed to the collapse. However, it is our opinion that, in the absence of the design deficiencies, the construction omissions alone would not have resulted in the sudden and complete pancaking of the floors.*

It is our conclusion that:

1. *Messrs Jones and Shirtcliff as managing the construction work omitted to discharge their duties in relation to the construction of the CTV building by not constructing it in accordance with the plans and specifications, but*

2. *The omission was not a substantial and operating cause of the deaths."*

Were David Harding and Alan Reay under a legal duty as defined in the Crimes Act 1961?

141. In my view Mr Harding, in undertaking the structural design of the CTV building was under a duty, either under s 155 or possibly s 156 to take reasonable precaution against and use reasonable care to avoid danger to human life (or to have and use reasonable knowledge, skill, and care).

142. In terms of s 155, Mr Harding, in undertaking the structural design of the CTV building, was doing a lawful act, the doing of which might be dangerous to life and was therefore under a duty to have and use reasonable knowledge, skill and care in doing that act.

143. Alternatively, in terms of s 156, the structural design of the CTV was an inanimate thing which Mr Harding had in his charge or under his control and which, in the absence of reasonable precaution and care, might endanger human life (one of the main aims of the structural design being to ensure the building could withstand earthquakes).

144. In relation to Dr Reay, he could come under s 155 in that he, in conjunction with Mr Harding, undertook the structural design of the CTV building, as principal of the firm.

145. Alternatively he could come under s 156 in that he had the structural design of the CTV building in his charge or in his control in addition to Mr Harding, Dr Reay being the principal of the firm and the person who took on the contract and then assigned Mr Harding to carry out the actual design work.

Were there omissions to perform those duties?

Harding

146. The case against Mr Harding in relation to an omission to perform the required duty would be:

(a) That he undertook work that he was not suitably experienced to carry out;

(b) That he was working beyond his competency and should not have agreed to undertake or continue the work on his own without the appropriate level of input from another suitably experienced engineer;

(c) That he made substantial errors in the design of the building (as identified by BECA) which led to the collapse of the building in the February 2011 earthquake;

(d) That some of those design errors meant that the building was non-compliant with the building codes of the day.

147. Whilst there may be issue taken with 137(a) and (b), in my view they are effectively answered by the evidence that could prove 137(c) and (d), namely the number and nature of the design errors made by Mr Harding.

148. I anticipate that issue will be taken with the interpretation of the building codes of the day and argument as to whether or not the design of the building was non-compliant with the codes of the day. This will be particularly in relation to the interpretation of whether Mr Harding was entitled to treat the beam-columns as a gravity only structure and the code requirements that applied as a result (the reinforcing specified in the beam-column joints appears to have been non-compliant in any event).

149. However on the basis of BECA's opinion there appear to have been substantial errors made and as such that Mr Harding omitted to take reasonable care in the structural design of the building.

150. At the CERC hearings Mr Harding initially tried to claim that the design was not defective and tried to refute alleged errors, however in the end (particularly in response to questioning by one of the Commissioners, Professor Fenwick) he accepted that there were errors in his design.

151. In his review dated 25 October 2016, [redacted] concludes (at page 3) that *"the number, nature and magnitude of errors that were made in the design of the CTV building exceeds the normal standard of care and evidences that the design was accomplished without benefit of adequate experience and/or review."* Despite this he still expresses reservations with regard to the duty as it related to Mr Harding. In particular he comments: *"However, in the course of supervising many engineers over the years, the* PR (peer reviewer) has *found that an inexperienced engineer is rarely aware of what he/she doesn't adequately know."*

152. In his earlier draft dated 3 October 2016 [redacted] had added: *"... it is not clear to me that they should be identified as responsible to do so. More typically we would look at work habits and honest effort in assessing performance."*

153. [redacted] is clear that in his view Mr Harding made significant errors as outlined by BECA and as a result omitted to discharge his duty of care.

154. In my view there could be some considerable support for the view that Mr Harding was effectively left to his own devices by his employer, Dr Reay, and that this was unfair on him. However a contrary view is also open, namely that Mr Harding's experience as at 1986 (13 years post qualification and 10 years post registration) was such that he should have known if he was out of his depth and that he was not receiving the appropriate oversight and supervision.

155. Although it would be theoretically possible for Dr Reay to be convicted of manslaughter on the basis that he did not provide adequate supervision without Mr Harding being held responsible (on the basis that he did not breach a legal duty), I do not think that in the circumstances of this case it would be appropriate to proceed against Dr Reay and not Mr Harding.

Reay

156. In my view, the case against Dr Reay could be presented on the basis that, as the principal of the firm, he was directly responsible for Mr Harding's design defects. However, given the evidence before the CERC as to the involvement that Mr Harding and Dr Reay each had in relation to the actual design work, I believe the case against Reay would also have to be more particularly based on:

- A failure to ensure that Mr Harding, given his lack of experience in the design of multi-storey buildings, had the appropriate level of oversight, mentoring and review of his work;
- A failure to ensure that the completed design (calculations and drawings) were reviewed before they were submitted to the Christchurch City Council.

157. The evidence that would be relied on to prove Dr Reay's omissions on the above basis is the expert opinion from BECA, together with the views expressed by various structural engineers who were in practice in the 1980s, supplemented by the further information obtained from structural engineers interviewed by the Police as to standards of the day. I note that both [redacted] are in full agreement with BECA's conclusions in relation to Dr Reay's omissions.

158. In my view, the evidence in relation to Dr Reay on the supervision and review allegations would likely be sufficient to prove an omission to perform the required duty, however I do see the potential for issue to be taken with proof that this was a major departure and therefore deserving of criminal sanction. I address this in the next section of this opinion.

Were the omissions a major departure?

Harding

159. In relation to the design errors listed by BECA in their report, while I envisage there could be issue taken with whether they amounted to gross negligence (as opposed to simple negligence) and therefore a major departure from the required standard, in my view, as things presently stand, there is sufficient evidence to reasonably prove a major departure.

160. However I would add three qualifications to this. Firstly, in relation to the issue of code compliance and the interpretation of what amounts to non-compliance with the code of the day. As indicated, I anticipate this issue would be raised in any trial. If it were to gain any traction it

could undermine proof of a major departure as, if the errors were found to be code compliant (or more particularly could have been interpreted as such), I consider it would be difficult to prove they were a major departure.

161. Secondly, the reservations expressed by [redacted] the peer reviewer. In his earlier email of 19 May 2016, questioned whether the design errors were a contributor, similar to the larger than anticipated size of the earthquake or a primary cause. In his draft peer review dated 3 October 2016, [redacted] maintained this concern. In relation to the issue of the part that the code-compliant, but minimal, transverse steel in the columns played in the collapse, [redacted] expressed the view that *"this presents potential issue with regard to culpability"* particularly in relation to an inexperienced engineer. In his conclusion, he concurred with BECA's findings regarding duty and cause, but expressed *"reservations with regard to the duty as related to Mr Harding."* Similar concerns have been expressed by [redacted] in his final report.

162. Thirdly, Mr Harding could rely on the fact the Council had a legal duty (see below) to check the calculations and drawings before issuing a permit. The fact that the permit was issued by Mr Tapper, an experienced CCC engineer, despite the errors, could be relied on by Mr Harding to argue that if Mr Tapper did not find the error it cannot have been a major departure to make the errors in the first place (it could also potentially be relied on to argue that the chain of causation was broken although in my view this would be unlikely to succeed).

Reay

163. The expert opinion from BECA is that:

- Reay is the person who was commissioned by the client, and therefore was responsible for the structural design and construction observation of the CTV building;
- Reay, as principal of ARCE, omitted to discharge his duty in relation to the design of the CTV building as he neither carried out oversight of, reviewed or checked the design, nor arranged for another suitably experienced engineer to do so. This omission meant that errors in the design were not detected. If they had been detected and corrected, the building would not have collapsed in a pancaking fashion;
- The omission was a substantial and operating cause of the deaths and was a major departure from the expected standard.
- It was not reasonable for Dr Reay to rely on the Council structural reviews to check the design of a structure such as the CTV building;

164. In reaching these opinions, BECA have relied on the evidence given by Dr Reay and Mr Harding at the CERC, the Code of Professional Practice for Consulting Engineers and the Code of Ethics of the Institution at the relevant time, and also on the opinions given by the various practitioners who were interviewed by BECA on the standards of the day, in particular, in relation to oversight and supervision.

165. In BECA's view, both Dr Reay and Mr Harding breached clause 11 of the Code of Professional Practice for Consulting Engineers which required a Consulting Engineer not to engage in any act, activity, or conduct which was contrary to the Code of Ethics of the Institution. In their view, this involved the breach of a number of specific clauses: clause 1 (to exercise professional and technical skill and judgment to the best of his ability and discharge professional and technical responsibilities with integrity), clause 6 (not to misinterpret his competence nor, without

disclosing its limits, undertake work beyond it) and clause 8 (recognise his responsibilities to his employer or client, others associated with his work, the public interest and his profession).

166. In my view, Dr Reay's omission to provide oversight, review and checking of the structural designs clearly amounted to negligence. However, whether it would meet the test of a major departure is more problematic. My reasons for saying this are as follows:

- In evidence at the CERC hearings, Dr Reay said that he had presumed Harding could design the building. Mr Harding gave him no reason to doubt this and appeared confident in the work. Dr Reay considered Mr Harding a senior engineer, based on his age, his years of experience and the fact that he had been involved in structural design (albeit not multi-story buildings);

- Further, Dr Reay could no doubt say that, although in hindsight he should have provided more oversight, at the time Mr Harding never gave any indication he was struggling and that when Dr Reay asked him about the shear walls on the architectural plans Mr Harding was able to confidently explain what he had done. Dr Reay could also rely on the fact that Mr Harding re-ran the required computer (ETABS) testing which Mr Harding said showed that the south wall he had drawn was sufficient;

- Dr Reay could rely on the fact that prior to commencing the design of the CTV building, Mr Harding designed 2-3 level buildings and, importantly, completed the design of the 9 storey Westpark Towers which involved completing the ETABS work commenced by [redacted] Although this work, and in particular the important phase of inputting the correct figures into the computer had already been done by [redacted] it would appear from [redacted] statement to the Police that he was commissioned by Dr Reay as a consultant to return to ARCE to finish a number of jobs, including overseeing Mr Harding on the ETABS work for Westpark Towers. Further, that Mr Harding attended seminars to improve his professional competence, such seminars relevant to the design of the CTV building;

- Dr Reay would no doubt, as he asserted to the CERC, say that, as a sole practitioner, he relied on the City Council structural design checking process;

- Although most of the practitioners who have been interviewed, either by BECA or the Police, are of the view that it was inappropriate to rely on the local Council to check structural drawings and calculations, I would anticipate that Reay could call a sole practitioner who was in practice in the mid-80s to say that this was sometimes relied on;

- [redacted] (para 73 of his Police interview record) noted that *"As far as I can recall in the 1980s it was more often than not the Council provided the external review"* (although this would appear to be in relation to the Upper Hutt Council where [redacted] had worked)

- [redacted] (para 39) noted that *"independent review tends to get more difficult as the practice size decreases"* and (at para 43) that in the mid 1980's there was no formal practice of design reviews and that this was introduced in the 1990's when QA was becoming more formalised and (para 51) that the signing of drawings was usually done but not always;

- [redacted] said that it was *"never commonplace or usual"* to have one engineer assigned to design with no oversight from a senior engineer (para 47) and that *"in the*

1980's the use of an external review would be rare" (para 48). The use of the terms 'commonplace' or 'usual' could imply that, while unusual, it did happen;

- [redacted] has referred to the fact that in Auckland in the 1980's there was checking by an engineer in the Council but that in his view this did not detract from the need for an internal review by a senior engineer in the firm.

- In relation to treating the Council as an external review, Dr Reay could rely on the fact that under Clause 8.2.5 of Part 2 of the Second Schedule of Bylaw 105: "*The designer of any concrete element shall provide calculations which establish that the concrete element had been designed in accordance with the requirements of this Bylaw* ***or*** *alternatively certify in an approved manner that the design method conforms with the requirements of a recognised code of practice.*" It appears that this was the practice of the Christchurch City Council at the time. At present there is nothing to indicate that a design certificate was completed for the CTV building. However, we know that calculations were provided (and more requested by Mr Tapper, the Council Engineer who checked the drawings and calculations and approved them). There was evidence at the CERC to the effect that Mr Tapper was reasonably experienced and meticulous in his checking. This could all be relied on by Dr Reay to show that, even if it was not the usual practice, or even good practice, relying on the Council as an external review was not a major departure in the circumstances at that time.

- At the CERC hearsay evidence was given by Mrs Patricia Tapper and Peter Nicols, the net effect of which was to point to direct contact between Dr Reay and Bryan Bluck, the then Chief Engineer at the Christchurch City Council, after Mr Tapper had raised issues with the building design. It would appear from that evidence that Dr Reay must have convinced Mr Bluck that the concerns raised by Mr Tapper were unfounded. I agree with the Police assessment that, although this evidence, if it was ruled admissible, could be of value, it should not be relied on to prove that Dr Reay knew more about the building design than he professed in his evidence at the CERC;

167. As referred to above, Dr Reay could argue that if Mr Tapper had examined the Drawings and calculations and issued a permit, then it could not be said that Dr Reay's failure to identify the errors was a major departure.

168. **It may be that further work could be done on this issue to improve the evidence supporting a conclusion that Dr Reay's actions were a major departure**. However, at present, whilst that conclusion could be open to a jury, I see it as vulnerable.

Poof of Causation

169. As already noted, in a case such as this proof will in large measure be dependent on expert evidence. This applies to the element of causation – whether the prosecution can prove that the omissions by Mr Harding and/or Dr Reay were a substantial and operating cause of the CTV collapse.

170. The expert opinion from BECA is that, based on their interpretation of the information from the CERC report, BECA's own analysis (including further non-linear time history analyses) and BECA's own physical testing, the collapse was initiated by failure of one or more of the internal columns in the lower levels of the building. Once these columns failed the adjacent columns also failed as they were unable to sustain the additional building gravity loads that were progressively

redistributed to them. The lack of resilience and redundancy in the primary gravity structure resulted in the catastrophic failure that occurred.

171. The beam-column joints had insufficient transverse (binding) spiral reinforcement over the height of the beam-column joint regions and BECA believe this is the prime reason why the columns failed. Although the contractor had failed to provide the steel at all in these regions, in BECA's view, the reinforcing steel that was detailed in the design would not have been sufficient even if it had been placed.

172. The lack of adequate transverse reinforcement in the interior beam-column joint regions in the lower levels meant that the columns could not retain stiffness and higher demands were placed on them leading to axial failure in the interior columns.

173. Whether the building failed in precisely that manner, BECA are clear that the lack of any significant resilience in the primary gravity structure made the building very vulnerable in severe earthquake shaking and susceptible to pancaking of the floor slabs. That lack of resilience was a direct consequence of deficiencies in the structural design.

174. In BECA's view, if the building had been designed in accordance with and compliant with the building codes of the day it would not have collapsed in the pancaking nature in which it did, notwithstanding the level of shaking and the number of earthquakes in the Canterbury sequence up to and including 22 February 2011.

175. BECA are of the view that there were a number of significant design errors by Mr Harding, in particular understrength and non-compliant shear walls and non-compliant beam-column joint transverse reinforcement and that these were a substantial and operating cause of the collapse.

176. In relation to Dr Reay, BECA's opinion (based on the evidence given by Dr Reay and Mr Harding before the CERC) is that, as the person who undertook to design the building, Dr Reay omitted to discharge his duty in allocating the design to Mr Harding when Mr Harding did not have sufficient experience to do so and/or in not ensuring that there was sufficient checking and review of the design by either himself or an engineer experienced in the design of buildings of this type. In BECA's view this omission was the reason Mr Harding's design errors were not identified and corrected and was therefore a substantial and operating cause of the deaths.

177. Proof of causation will effectively depend on the robustness of this expert opinion and whether [redacted] assuming he gives evidence on behalf of BECA) can reject any contrary expert opinion on the issue as being an opinion that cannot can be reasonably held. I understand that this aspect has been explained to BECA and that they are confident in that regard and have in their report attempted to deal with most of the arguments that might be raised by any opposing expert (a good many of which were raised before the CERC by Dr Reay's counsel).

178. I do not intend to detail the BECA opinion in relation to causation any further but rather will deal with the main issues with proof of causation which are likely to be raised in any trial and any potential problems in rebutting them.

179. In relation to proof of causation, I note that the peer reviewer, [redacted] has expressed a number of reservations in his report and emails. I will deal with the issues he raises under their various heads below.

180. [redacted] agrees that the beam-column joint reinforcement specified was inadequate but considers that rather than focus on that error, it is preferable to consider the fatal design errors, namely the significant under-estimation of the load which would be transferred into the shear

walls and the potential deflections. These errors were the reason Mr Harding wrongly assumed he could design the building with a primary gravity only structure (with the resulting inadequate reinforcement in the columns and beam-column joints).

Cause of collapse

181. I note that the CERC also concluded that the transverse reinforcement specified by the designer was deficient and even if it had been installed it would have made little improvement to the performance of the beam-column joints (page 94). However, in relation to the cause of the collapse, the CERC concluded that a basic flaw in the beam-column joints was that there was insufficient overlap where the bottom horizontal beam bars were anchored into the columns (page 260) and that this was a primary cause of the collapse.

182. This is of some significance in that BECA's view is that the primary cause of the collapse was not this but the inadequate transverse reinforcing in the joints. I anticipate that BECA would be challenged on this difference. As I understand it, the main reason BECA are confident that their view is more likely in terms of the cause of the collapse is from the physical testing they carried out. However, as I refer to below, I anticipate this testing would be the subject of considerable challenge as well.

183. A potential issue is whether a jury could be sure that if the contractor had placed the transverse reinforcement specified by Mr Harding in the beam-column joints (even though it would still have been non-compliant) the building would still have collapsed (or would still have collapsed in the pancake manner it did killing 115 people)?

184. Clearly if there could not be certainty on this issue there could not be proof of causation as against the designer(s) of the building, given the importance BECA place on the beam-column joint reinforcing in relation to the collapse.

185. Subsequent to receiving the BECA Opinion, I posed the following questions to [redacted]

1. *Can you be sure that, if the transverse reinforcement in the beam-column joints that was detailed by Harding had been put in by the contractor in all of the beam-column joints, the building would still have collapsed in the pancake manner in which it did? ie, Is there a possibility in that scenario that it might have still collapsed but not necessarily in the pancake manner it did (or even still in a pancake manner but not to the same degree)?*

1a. *If the contractor had not made the errors he did(failure to roughen surfaces, etc) would this in combination with the fact that he had placed the specified reinforcement in the beam-column joints have made any difference to whether you could be sure as to whether the building would have collapsed in a pancake manner, etc? What is the basis for your conclusions in 1 and 1a? Is it on the basis of the physical testing carried out?*

I received the following reply:

> Before answering these questions it is worthwhile to recap on what we believe was the initiation of the collapse and how the collapse progressed. In doing so we reiterate that the initiation and progression for the collapse will never be known with certainty but in our opinion this is the most likely scenario supported by all of our investigations including our analyses and physical testing. This is the same scenario we present in our opinion report.
>
> The building collapsed because one or more of the internal columns near the base (and most likely in the ground floor storey where the axial loads were highest and the differential stiffness

at each end of the column potentially the greatest) was damaged during the earthquake, to the extent that it was unable to carry the gravity loads on it in conjunction with the lateral displacements imposed by the earthquake. Once the support of one column was lost, the adjacent columns had insufficient capacity to resist the additional loads transferred to them from the lost column so that they also failed. The result was the progressive but complete loss of gravity support for the central region of the building with the perimeter structure also unable to prevent the complete failure of each floor slab onto the one below. The one exception was the hanging up of some floor slabs on the NWC.

We have referred to this type of collapse as pancaking in nature.

Softening off of the beam-column joints for the internal columns at the first floor level relative to the stiff connection to the foundation led to an uneven distribution of deformation in the end regions of the ground floor columns, immediately above the ground floor slab and immediately below the soffit of the first floor beam. As a result, the demands at the base of these columns were larger than they might otherwise have been.

We have concluded that without the beam-column joint softening, the column end region deformations at the top and bottom of the column would have been similar and the column would have been able to sustain significantly larger lateral displacements than it did.

In response to question 1: If the contractor had placed the transverse reinforcement detailed by Harding it would have had a negligible effect on preventing the softening of the beam-column joint, due to the small bar diameter and large spacing of the spiral transverse reinforcement compared with the joint depth (only one complete turn of the spiral was possible over the depth of the joint). As noted above, it is the softening of an internal beam/column joint that we believe caused the failure of a connected internal column. Once an internal column failure initiated, a lightly transversely reinforced joint (as opposed to no transverse reinforcement) would have no effect on the collapse scenario outlined above.

In response to question 1a: The construction issues that we believe you are referring to in particular are the lack of roughening to the beam end construction joints and the potential offset of the column vertical reinforcement in the concrete section. We believe that neither of these aspects nor, for that matter, any of the other construction issues, have relevance to the initiation or progression of the collapse. Our reasons follow.

Our calculations indicate that the strength of the internal ground floor column at the interface with the joint is less than the capacity of the beams without roughening so that the column yields and limits the loads that need to be carried across the beam end joint interface. Therefore, the lower strength of the column protects the un-roughened beam end from overload. As a result we would not expect the beam ends to be distressed when the internal frame is deflected laterally even for large deflections. Therefore, whether or not the beam ends were roughened is expected to have no effect on the initiation of the collapse or its progression. The lack of damage to the un-roughened beam end region was confirmed by the physical testing that was completed. There was no evidence of beam distress in any of the tests.

Inspections of the rubble indicated that the column vertical reinforcing cages were displaced in some column sections. We have no way of confirming in which columns this may have occurred.

As discussed in our report, any displacement of the reinforcing cage for a column is likely to have been restricted to the mid column height region. The reason for this is that the vertical column bars have little tolerance for out of placement as they pass through the beam column joint and they would be held in place by the starter bars extending from the foundation pad. The bending stresses in the column under lateral loading are minimum in the central height region and therefore any out of position of the column reinforcing cage in that location is

expected to have had a minimal effect on the capacity of the column to resist lateral loads. This was confirmed by the physical testing where damage in the column was restricted to the column end regions, notwithstanding that some displacement of the reinforcing cage in the formwork over the mid height of the column occurred during construction of the test specimens.

None of the other construction issues are related to the potential performance of the internal columns.

186. One potential difficulty with this view is that on my understanding the contention that the failure to place any transverse steel in the beam-column joints would have made no difference is in large part based on the physical testing commissioned by BECA.

187. A strong criticism that can be made of that testing (and one which I understand has already been raised by Professor [redacted] of Auckland University) is that it only involved the testing of one model of each different beam-column structure (the as-designed, the as-built and the code-compliant model) and that this is an insufficient basis, statistically, on which to draw any safe conclusions.

188. A similar criticism has been made by [redacted] in his draft peer review dated 3 October 2016 in which he states: *"We agree that BECA's analysis, in combination with physical testing, evidence that a tipping point for column failure (ie, collapse initiation) is exceeded when design errors were included and is not when the errors are not present.* ***However, this assumes that the results of limited analysis are reasonably accurate. Many of those who have performed nonlinear time history analyses and physical testing would identify that the variations in results that can occur is quite substantial."*** (emphasis added). This wording is not included in the final peer review dated 25 October 2016 but rather it states: *"Although physical testing on one set of specimens cannot be taken as a precise predictor of behaviour, such testing can inform the nature of failure and be indicative of the general level of displacement at which it might occur."*

189. Whilst [redacted] appears to have modified his view in relation to the testing, his initial view will still be one on which he could be cross-examined.

190. [redacted] appears to agree with BECA's contention that the reinforcement in the beam-column joints was so light that the fact that it was not placed by the contractor would have made little, if any difference. As referred to above, [redacted] is of the view that there needs to be less emphasis on the beam-column joints as the main cause of collapse and a more holistic approach in terms of a number of crucial design errors. If the matter proceeds to a prosecution I would favour that approach as a sensible one in all the circumstances.

191. I note that [redacted] also raises a caution in relation to the non-linear time history modelling carried out by BECA and in fact expresses the view that the margin of error can be as high as +/- 50%. I understand that he too considers that the single testing results are susceptible to criticism, accepting of course that BECA did not carry it out as a research project to prove anything on its own but rather to see if it confirmed their own views and the computer modelling.

192. In relation to the physical testing of one replica beam-column joint in each case, although computer modelling enabled the rest of the building to be replicated, it could also be argued that there is still uncertainty without a full-size model of the building (or something close to that). This was a criticism raised by Dr Reay at the CERC hearings to the effect that there could

not be any certainty as to the collapse scenarios postulated by different experts without a full-sized model of the building being subjected to testing on a shaking table. That was rejected by the CERC as being unnecessary but is an issue that would no doubt be raised again, particularly in a forum where the standard of proof is higher and culpability in issue.

193. If reasonable doubt could be raised as to whether the building would have collapsed in the pancake manner in which it did if the contractor had placed the as-designed transverse steel in all of the beam-column joints then this could affect the prosecution's ability to prove causation as a jury would be unsure that all 115 people (or how many of that number) would have been killed from the collapse.

194. This potential issue (and the issue of proving that some of those who survived the initial collapse and might have been killed by the rescue attempts) could be covered by drafting any charge as one alleging that one or more of the people killed in the CTV collapse were killed as a result of the omission(s).

195. The potential mode of collapse (and proof that all 115 people were killed) is also relevant in relation to other issues with causation, such as the standard of the retrofit in 1991 (addressed later).

196. The fact that the contractor did not place any of the specified transverse reinforcing at all would not be a bar to prosecuting the designer(s) of the building. However, in my view, if there was any uncertainty over whether this failure by the contractor could have affected the type of collapse, this could present a difficulty with proof of causation.

Transverse reinforcing of Columns

197. In an email dated 19 May 2016 from [redacted] to BECA (before he had completed his peer review but at a time when he had had access to BECA'S draft report), [redacted] expressed concern that the transverse reinforcement on the columns, although code-compliant at the time, was very light and could have contributed to the collapse. He based this in part on the results of the physical testing BECA had conducted (which showed damage occurred to the base of the columns). He went as far as saying that if that was the case then it would raise questions with proof of gross negligence (as opposed to simple negligence).

198. This led to BECA reconsidering this issue and amending their draft report to include a new section, 11.2. That section concludes that although the low minimum requirements for transverse reinforcement in the columns in the standard of the day made the primary gravity structure less resilient than it might otherwise have been in the later, 1995 code, BECA's investigations have shown that the requirements of the design codes of the day, albeit less stringent than later codes required, would have been sufficient to prevent the building collapsing in the manner it did during the February earthquake.

199. In his draft peer review dated 3 October 2016 [redacted] notes:

> Although physical testing on one set of specimens cannot be taken as a precise predictor of behaviour, such testing can inform the nature of failure and be indicative of the general level of displacement at which it might occur. The physical testing performed for the CTV building indicated that failure would be sudden and catastrophic, with little indication of imminent failure. The result of testing is consistent with analyses that indicated that softening of beam-to-column joints at the first elevated level, would increase demand on the columns and therefore contribute to the likelihood of failure.

200. After referring to BECA's conclusion that the collapse would not have occurred in the absence of the design errors, [redacted] comments:

> We agree with BECA's analysis, in combination with the physical testing, evidence that a tipping point for column failure (i.e. collapse initiation) is exceeded when the design errors were included and is not exceeded when the errors are not present. However this assumes that the results of limited analysis are reasonably accurate. Many of those who have performed nonlinear time history analyses and physical testing would identify that the variations in results that can occur is quite substantial. In the absence of resilient detailing, many structures that have otherwise been designed for conformance with building codes and standards are at risk of collapse.
>
> Because the expected failure of the CTV building is associated with the failure of gravity columns and not the failure of the lateral seismic force resisting system, it raises the question of whether codes at the time were so severely lacking in requirements for column binding reinforcement that they failed to ensure resiliency against collapse in extreme events, as generally expected.

201. [redacted] also refers to this issue (on the 2nd page of the draft report) where he states:

> Based on our experience, we were shocked by the very low amount of transverse steel provided in the building columns and to learn that it was allowed by building code at the time. The reinforcement is much less than we have seen in practice in seismically active areas.
>
> This item presents potential issue with regard to culpability, as transverse steel has been identified as meeting the minimum requirements of the code in effect at the time. Although an experienced engineer may not have used such a low amount of reinforcement for a column in a multi-story building in a seismic zone, an inexperienced engineer would likely have used the minimum standard prescribed by the code. This raises the question: was the disproportionate damage to the CTV building as compared to other structures in Christchurch primarily the result of adherence to code minimum transverse column reinforcement, as compared to more traditional levels of reinforcement that were present in other buildings?

202. In an email to Detective Superintendent Read on 8 October 2016, [redacted] dealing with the same issue (BECA'S conclusion) expressed his view as follows:

> We agree and disagree with this point. We agree that engineering computations show this to be the case. However we caution that the provisions of the Code that allowed for non-resilient column detailing (i.e. poor transverse binding steel) put some percentage of structures at risk of collapse when subjected to strong earthquakes.

203. Then in his final report dated 25 October 2016 [redacted] (at p5), referred to BECA's conclusion that the design errors (namely, a lack of strength and stiffness in the walls to control drift to acceptable levels and protect building columns and the softening of beam-column joints that resulted from a failure to provide code-proscribed reinforcement which substantially increased demand on columns) contributed to the collapse and that the collapse would not have occurred absent these errors. He then states:

> We agree with BECA's finding regarding the location of collapse initiation, based on the results of analysis, testing and collapse propagation analysis that are fully consistent with this assessment. We also agree that design errors substantially contributed to the collapse. We agree that it is highly probable that failure would not have occurred absent the design errors, based on BECA's analyses and test results that indicate such and the substantial affect that the errors are estimated to have had on building response.

[redacted]

> However, because the experience and response of individual buildings to individual earthquakes cannot be precisely established by analysis and testing, we cannot concur that the collapse would not have occurred in the absence of the identified errors. We base this conclusion on the relatively large dispersion that we see in assessing earthquake response and the lack of resilience in the building columns to accommodate excess demand. The lack of resilience afforded by poorly reinforced columns in combination with other aspects of the gravity force resisting system selection and detailing is in our opinion likely to be a substantial operating cause of why the CTV Building collapsed so completely when strongly shaken.

204. [redacted] (at p6) then reviews BECA's discounting of other possible causes, agreeing with BECA's views. However, in relation to BECA's view that, despite the larger-than-code ground motions, there would not have been initiation of failure if the structure had been properly designed to code requirements, he states:

> However in our opinion, it is possible that collapse could have occurred in the absence of the design errors due to higher than expended (sic) ground motions in combination with the lack of resilience that this structure possessed. It is anticipated by the profession and its standards that some few number of code-compliant buildings, especially those that do not contain resilient detailing, will experience collapse in extreme earthquake events.

205. [redacted] disagreement with BECA's view that the building would not have collapsed "but for' the design errors is not a bar to proof of causation. Although the 'but for' test is often used as a rule of thumb in determining causation issues, in relation to multiple causes it is not necessary that the consequence would not have occurred 'but for' a particular cause, provided that at the time of the consequence the cause was still a substantial and operating cause.

206. However, in my view [redacted] view is a factor to take into account when assessing the evidential sufficiency in relation to causation. It (together with the criticisms of the single test) potentially weakens the strong view expressed by BECA and is not an ideal position to be commencing from.

207. [redacted] view could also cast doubt over BECA's ability to be sure as to the degree to which the minimal transverse steel in fact contributed to the pancake collapse (cf. some other lesser form of collapse or a partial pancake, in which not as many people would have been killed).

208. [redacted] too, recommends caution in relation to BECA's conclusion that the columns with their minimal (yet compliant) ties would have prevented the collapse if the shear walls and beam-column joints had been code-compliant because of the potential for a high margin of error in the computer modelling.

209. This also emphasises the need for a more holistic view of the design errors and their combined effect in terms of the collapse. As the CERC observed, the exact collapse scenario would never be certain. It would be preferable to run a case on the basis that Mr Harding made a number of crucial design errors which, in combination were a substantial and operating cause of the collapse.

210. [redacted] raised the possibility of a Monte Carlo simulation analysis. I understand that the Police, on further advice from BECA, have decided that this type of analysis would not achieve anything of material value because of the large number of variables that have to be applied in such an analysis. I have no doubt that the defence in any prosecution would still raise it and it would have to be dealt with by BECA. If [redacted] is called as a witness this could present a potential conflict on the issue. I am unaware whether [redacted] has been asked for a view on the matter.

The retrofit in 1991

211. In 1990 John Hare, a structural engineer with Holmes Consulting, was instructed by the Canterbury Regional Council, a prospective purchaser of the building, to carry out a pre-inspection check. Mr Hare quickly identified an issue with the floor diaphragm connections to the North Wall Complex and advised Dr Reay and his then fellow director, Geoff Banks, of his findings.

212. In 1991 retrofit works were designed by Mr Banks and installed by a contractor. However, in BECAs view, the result was that the floor diaphragm connections to the North Wall Complex were still non-code compliant in one direction.

213. In BECA's opinion, because Mr Banks designed the work and he was then a director of Alan Reay Consultants Limited (and not an employee), he was responsible for the work and not Dr Reay (even though Mr Banks had said in evidence at the CERC that he believed Dr Reay was overseeing his design).

214. BECA is of the view that Mr Banks' omissions in that regard were a major departure from the standard of care required but that they were not a significant factor in the collapse. This is based on the non-linear time history analyses carried out by BECA which showed that the response of an otherwise compliant building was not greatly affected by whether the ties (between the floors and the North Wall Complex) were modelled as retrofitted or as fully compliant.

215. However [redacted] does not appear as sure of this conclusion, noting that it is "*most probably correct*". He appears to place more importance on the part the connections between the North Wall Complex and the floors may have played in the collapse.

216. The CERC also appear to have taken a different view from that of BECA in relation to the significance of the North Wall Complex connections. In the CERC's report (p261) they described these connections as "*the second basic weakness*" (the first being the beam-column joints – albeit in relation to the overlap in the bottom bars rather than the inadequate transverse reinforcing steel). The CERC was of the view that the drag bars (fitted during the retrofit): "*lacked ductility and, as indicated by the non-linear time history analyses, the drag bar connections could be expected to have failed either in the September earthquake or near the start of the intense ground motion in the February earthquake.*"

217. It is of note that the late Professor Nigel Priestly who gave evidence before the CERC was of the view that the floor diaphragm connections to the North Wall Complex could well have been compromised as a result of the September earthquake and it aftershocks prior to the February earthquake (this could also have some bearing on the issue of the effect of the September earthquake on causation – discussed later).

218. In my view, this has the **potential** to raise issues in relation to causation. It is also **possible** that at any trial it could be argued by the defence that Mr Banks' actions, in completing the retrofit in a grossly negligent manner, contributed to the collapse. However based on the current BECA opinion there would not be a basis to charge Mr Banks.

219. If a jury were to conclude that the North Wall Complex connections did have a more significant role in the collapse this could affect the issue of causation as against the designer(s) of the building.

220. Subsequent to receiving the BECA report I forwarded the following question to [redacted]

1. *Can you be sure that if Banks's retrofit of the north wall to floor connections had been code-compliant (and as a result the possibility that more of the floors remained attached to the north wall) that the building would still have collapsed in the pancake manner in which it did? ie, is there a possibility in that scenario that it might have still collapsed but not necessarily in the pancake manner in which it did(or even still in a pancake manner but not to the same degree)?*

I received the following reply:

> **In response to question 2:** Our analyses indicate that, while compliant connections between the NWC and the floors might have provided better attachment of the floors to the walls, they would also have led to the capacity of the internal columns (as designed) being reached earlier during the earthquake and as a result the likelihood of collapse initiation would have been greater. This is because larger lateral displacements in the internal frames were predicted in our analyses when the floors were well connected to the NWC rather than the connection just being sufficient to transfer the shear forces (vertical and lateral).
>
> Also the degree of connection would have needed to be significantly greater than required for compliance to provide any meaningful restraint to the floor once the internal columns were lost. Arguably greater support of the floor to the NWC might have provided more voids adjacent to the NWC but we do not believe that this would have significantly influenced the characterisation of the collapse as either being pancaking in nature or catastrophic in outcome.

221. This reinforces the need for any charging document to be drafted so as to not require proof that all 115 deceased were killed by the collapse.

222. In my view the issues that relate to the retrofit would be unlikely to provide a break in the chain of causation but I consider the defence at any trial would still use the issue to try and create doubt over proof of causation.

Reliance on Holmes Report

223. During the CERC hearings both Dr Reay and Mr Banks gave evidence that they placed reliance on the Holmes report prepared by Mr Hare, in particular Mr Hare's statement to the effect that *"the layout and design of the building is quite simple and straightforward and generally complies with current design loading and material codes."*

224. [redacted]

225. BECA are of the view that it was accepted practice for the original design firm to have focussed only on remedying the identified non-compliances and not on other aspects, particularly as the report contained the statements referred to above.

226. It could be argued that the Holmes report is a second opinion that could reinforce a claim that the original design was compliant (except for the diaphragm connections). The CERC found that the Holmes report was never intended to be a full peer review and was carried out in a short time frame. BECA agree with that, as does [redacted] In my view, given this and the qualifications Mr Hare made, it could hardly be used to support a claim that the design was compliant.

227. Dr Reay could try and rely on the report to support a claim that if he had looked at the plans in 1986 it would be unreasonable to expect him to have detected faults/non-compliances in the gravity structure(beams and columns) when in 1990 a competent engineer (Mr Hare) had not detected them.

228. However in evidence before the CERC, Dr Reay said he did not look at the design plans at all in 1986. If he had then it would seem likely from his evidence before the CERC that he would have realised that Mr Harding had made a serious error (his evidence was to the effect that as soon as the issue with the North Wall Complex connections was pointed out to him in 1990 he understood it and described it as a basic blunder, or words to that effect). In any event, the review to be expected of someone in Dr Reay's position at the time the building was being designed is very different from that undertaken by Mr Hare in 1990. It may be relied on to support an argument that Dr Reay's actions were not a major departure but I do not consider it would have any real merit.

Size of the February Earthquake

229. In sections 11.2.1 – 11.2.6, BECA consider the issue of whether the shaking experienced in the February earthquake was of sufficient severity to cause the collapse of the building even if the design and construction deficiencies had not been present.

230. This issue is important because if the earthquake was of such severity that was not anticipated in the design codes of the day and could have caused the collapse of the building even without the deficiencies then it could be argued that it was an intervening event which breaks the chain of causation [ie, it was an unforeseeable event (in terms of size) and therefore overwhelmed the original cause (the design deficiencies)].

231. BECA conclude that:

- The duration of strong shaking in the earthquake was short and arguably shorter than the code writers were envisaging when preparing the code provisions.

- The elastic spectral response (a representation of the shaking experienced in an earthquake) determined using the ground motion recorded at the CCCC site (which BECA consider the most representative of the CTV building site based on similar soil conditions) was in excess of the minimum design loads defined by the codes of the day. However, elastic spectral response, even significantly beyond design load levels, is not an indication that collapse is imminent or likely even though the building may be significantly damaged (this is because the general intention in the codes was to protect life in major earthquakes and that the minimum design load levels specified by the code for the Ultimate Limit State were not representative of the maximum shaking which could occur in 'major earthquakes')

- The vertical accelerations were high but these occurred earlier than the strongest horizontal shaking and were therefore unlikely to have significantly influenced the collapse.

- The primary seismic structure (North Wall Complex and South Shear Wall) performed as expected and would have survived if the primary gravity structure (beams, columns and floor slabs) and its attachment to the primary seismic structure had not failed as it did.

- The primary gravity structure did not comply with code requirements of the day and if it had done it would have been expected to have had sufficient resilience to have survived the earthquake without collapse even though severely damaged (based on the non-linear time history analyses and BECA's physical testing).

- The CTV building was the only post-1976 building to collapse in Christchurch and the only building of its structural type to collapse. Other comparative buildings had steel in the beam-column joints which met code.

232. In my view there are issues which could be raised with these conclusions, in particular the part that vertical acceleration played and BECA'S reliance on only the CCCC site.

233. The CERC accepted that vertical seismic forces may have had an influence on the collapse mechanism but did not accept that they were a primary cause of the collapse or that they may have influenced failure of the beam-column joints (section 7.3.1). This was despite strong submissions to the contrary by both Dr Reay and Mr Harding.

234. I envisage that at any trial the issue of the very high vertical accelerations (which were not taken into account in the codes of the day) would be raised and could have an effect on the conclusions able to be drawn in relation to the element of causation.

235. Again, on its own the issue of high vertical accelerations it is unlikely to affect proof of causation but it might have significance when combined with other issues.

236. **The Police report (p94) agrees with this but notes that further investigation will be required and expert evidence to address this should a prosecution take place.** I agree that this will be necessary, although I have some reservations about proceeding to a conclusion on evidential sufficiency without it.

237. I have already referred to the view expressed by [redacted] in his report of 25 October 2016 (at p5) to the effect that it is possible that collapse could have occurred in the absence of the design errors due to the higher than expected ground motions, although of course in combination with the lack of resilience the structure possessed.

238. Another issue which would be raised is the reliance on the CCCC ground motion site. At the CERC there was considerable debate amongst experts as to which of the ground recording sites in Christchurch city were appropriate when considering the level of shaking to which the CTV site would have been subjected.

239. The CERC accepted that a report by Dr Brendan Bradley established that the results of the four Geonet stations (CCCC, CHHC, CBGS and REHS) were appropriate to model the ground motion at the CTV site (section 7.3.1.1).

240. This issue would be raised in any trial and is of some significance as the non-linear time history analyses are based on the ground motion figures (BECA used the CCCC site recordings rather than an average of the four).

241. I note the reference in the Police report (p83/84) to comments made by Dr Reay during execution of the search warrants to the effect that he had tried unsuccessfully to have a motion sensor installed on the CTV site after the February earthquake. This was also raised before the CERC and would clearly be raised at any trial. **I agree with the Police that further investigation and expert evidence will be needed to address this issue.**

242. [redacted] sounds a word of caution over the use of a single motion sensor site when he says in his report of 25 October 2016 (at page 5): *"Although an analysis conducted using a single earthquake record located off site cannot be taken as precise, such analyses can be taken as indicative of general building response."*

243. Again, on its own this issue may not materially affect proof of causation but it needs to be considered in combination with the other issues that could be raised.

Concrete Strength

244. The Hyland/Smith report provided to the Department of Building and Housing concluded that some of the concrete in the columns could have been under-strength. However the CERC concluded, after hearing further evidence on the topic and the results of further testing carried out by experts on behalf of Dr Reay, that the concrete was likely to have been at or above the strength specified and there was no reliable evidence from which to conclude that the concrete was under-strength in any of the columns (p99).

245. BECA agree with those conclusions and with the view that the low results obtained from column C18 should be considered an "outlier" warranting further investigation before it is considered that low concrete strength is an issue (section 9.2.1).

246. The Police investigations have taken this issue further and have identified the supply and placer companies involved. Further inquiries are planned, although the Police expect to have established evidence to show that there were no issues with the strength of the concrete (para 6.8.12).

247. In my view it is important to attempt to establish that there are no issues with the strength of the concrete as, if reasonable doubt could be raised in relation to this, it would likely affect proof of causation. **It would be preferable for the Police inquiries into this issue to be completed before any final decision to charge is made (rather than after charge).**

Christchurch City Council Permit - Approval of Design Plans

248. This issue is relevant because, as already noted above, Dr Reay gave evidence at the CERC that because he was the only principal in his firm at that time he relied on the City Council's approval of the structural design plans.

249. BECA is of the view, based on their own experience but also that of engineers they interviewed, that in 1986 it was not the accepted practice to rely on the Council review process. The Police interviews of engineers has strengthened this view. [redacted] has referred to the practise at that time in the Auckland City Council where an engineer did carry out a reasonably thorough check, although in his view this did not replace the internal checks by a principal or senior engineer in a firm.

250. However if the defence could create a reasonable doubt on this issue and show that an engineer in Dr Reay's position might reasonably have been entitled to rely on the Council review process and approval of the plans this could potentially be used to support an argument that there was a break in the chain of causation or at least be used 'to cloud the issue' generally by suggesting that others involved in the process contributed to the errors not being discovered when they should have been.

251. Dr Reay's argument could be:

- At that time the Council policy, as expounded by Bryan Bluck, was that the Council was entitled to rely on a designer's certificate that the design was compliant in all respects.

- This was consistent with clause 8.2.5 of Bylaw 105 which required that either calculations or a design certificate be provided with the design.

- Mr Tapper, the Council engineer who checked the design, requested calculations. No design certificate was therefore necessary and none has been found to date.

- The signature of Mr Harding in the 'Approved' box on the plans is not a design certificate. (It is notable that a separate design certificate was signed by Dr Reay in relation to the Westpark Towers which were completed just before the commencement of the CTV building).

- Although Mr Tapper did not have a great deal of time to review the drawings (4 working days), the CERC were of the view that he should have picked up any gross omissions in the structural design of the building and that the permit should not have been issued (pages 88 and 308).

- Mr Tapper was described by Mr Henry in his evidence before the CERC as a *"competent senior engineer"* who had developed *"a good sense of the potential weak points"* in a structure (p82).

- While most of the engineers interviewed have expressed the view that they did not rely on the Council review, as the Police report notes (p61) some of them conceded the Council checking did have a part to play in the process (see in particular the view of [redacted] referred to in para 108 above).

252. There is the hearsay evidence accepted by the CERC from which it inferred that Dr Reay played some part in ensuring that the permit was issued by assuring Mr Bluck, Mr Tapper's supervisor, that the building was sound. However I am unsure whether this evidence will be available for any prosecution and am of the view that at this stage it is better to put it to one side in considering whether the Prosecution Guidelines are met.

253. BECA are of the view that the Christchurch City Council may or may not have omitted to discharge their duty by not doing a thorough structural check and consequently issuing a permit for a defective design and that, further, the undetected defective design was a substantial and operating cause of the deaths. However they conclude, based on the practices of the day, that issuing a permit without a prior thorough structural check was not a major departure from the expected standard of the day.

254. As mentioned above, this issue may also be relevant to an issue as to whether other persons potentially contributed to causation. The two men involved from the CCC (Messrs Tapper and Bluck) are deceased. As discussed earlier, a corporation cannot be charged with manslaughter, although it could potentially be charged as a party to manslaughter. However I do not consider that there would be a proper basis on the evidence available to charge the CCC with manslaughter as a party and there could well be issues with proof of that charge.

255. As noted, there is still the potential for an argument to be advanced that there was a break in the causation chain and I therefore consider it is still a factor which needs to be taken into account. As I have noted above, the issue of Mr Tapper's approval of the design could also be

relied on by Dr Reay to show that his failure to detect the errors was not a major departure from the expected standard.

Cumulative Effect of Multiple Earthquakes prior to February Earthquake

256. An issue raised by Dr Reay before the CERC and which would no doubt be raised at any trial is the cumulative effect of the September earthquake and the multiple aftershocks (including the Boxing Day earthquake) which preceded the February earthquake, the suggestion being that these could have contributed to the building's capacity to withstand the February earthquake and therefore could affect the degree to which there can be any certainty in relation to the cause of the collapse.

257. The phenomena of cumulative damage, low-cycle fatigue and strain hardening were raised by Dr Reay before the CERC. All were dismissed as not having any significant causative effect.

258. In the CERC's view, cumulative damage would have made very little difference to the performance of the building in the February earthquake and any damage that may have been sustained in previous earthquakes was not a primary cause of the collapse (p257).

259. In relation to low-cycle fatigue and strain hardening, the CERC concluded that although it is a known phenomenon, they had seen no evidence (evidence of high strain levels in the reinforcement would be associated with wide cracks and spalling in the associated regions) that it had occurred in either the September or Boxing Day earthquakes and therefore it was unlikely to have been an issue in the performance of the building (p259).

260. To eliminate an issue of strain ageing and its effect on reinforcement (not raised by any party at the hearings), the CERC engaged Homes Solutions Limited to carry out tests on the reinforcing bars from the CTV building. The CERC concluded from those tests that strain ageing would not have had a noticeable effect on the seismic performance of the building in the February earthquake (p259).

261. BECA deal with the cumulative effect of the multiple earthquakes by concluding that the ability of the building to survive the February earthquake should not have been significantly impaired by the prior earthquakes if it had been properly designed.

262. The Police report (p82) suggests that further clarification of this statement should be sought from BECA to confirm that their view is that the building (as-built) survived any low cycle fatigue without any significant structural damage. This point was effectively answered by the CERC (above) but I agree it would be prudent to obtain confirmation from BECA, in relation to the multiple earthquakes that preceded the February earthquake.

263. The issue of cumulative damage would no doubt be raised at any trial and is allied to the following issue of the standard of the post-September earthquake inspections. Whilst on their own they are unlikely to affect the ability of the Crown to prove causation, they would be raised together with other issues in an effort to create a reasonable doubt overall.

Post-September Earthquake Inspections

264. Evidence was given by Professor Mander, an engineering expert called by Dr Reay, at the CERC to the effect that if the post-September damage inspections had been more thorough more damage could have been detected and the building red-stickered meaning that no-one would have been in the building in the February earthquake unless it had first been repaired (which presumably would have led to the design defects being discovered).

265. This suggestion would no doubt be raised again, based on criticisms that can be levelled at the post-September CCC inspections, the subsequent inspection by CPeng engineer, David Coatsworth, on behalf of the owner (a damage-based assessment without consideration of the building's capacity), and the inspections and lack of any further engineer's inspection after the Boxing Day earthquake.

266. Issues were raised with the CCC Level 2 Rapid Assessment carried out on 7 September 2010, in particular the fact that an engineer was not part of the inspecting group as required at that time and that they could not gain access to all internal areas to make the degree of inspection required in a Level 2 assessment. The Commission concluded that the inspection should not have been classified as a Level 2 assessment for those reasons and the resulting green placard which was relied on by the occupants was in doubt.

267. However this was in effect superseded by the building manager, John Dew, commissioning an inspection by a structural engineer, Mr Coatsworth, later in September 2010. That inspection was a damage-based inspection, consistent with the approach of most, if not all, engineers in the aftermath of the September earthquake. Mr Coatsworth advised Mr Drew that a structural analysis (with analysis of structural drawings) would only be required if significant structural damage was found.

268. The CERC concluded that in terms of the damage-based inspections being conducted after the September earthquake, the inspection was thorough and competent and, in fact of all the inspections considered by the CERC over the course of the inquiry, Mr Coatsworth's was the most thorough (p138).

269. However the CERC, in dealing with (and rejecting) the suggestion by Professor Mander that the building should have been red stickered following the September earthquake, did observe that while a damage-based assessment is a necessary component of the rapid assessment process, it cannot be the sole basis of assessment of whether a building like this should be occupied in the long term (p142).

270. Mr Coatsworth made two recommendations for further investigation, one being an important one – removal of the interior wall linings on the South Shear Wall for a more detailed inspection. This was not carried out. However Mr Coatsworth said in evidence that he did not expect the damage to be significant and that if he suspected there was serious damage he would have removed the linings himself at the time of his inspection (p141).

271. Mr Coatsworth also advised Mr Drew to erect a security fence at the bottom of the fire escape on the south face of the building to prevent injury from any falling plaster. This was not done. However the CERC concluded, that although a compromised fire escape may have led to the CCC closing the building, any closure would almost certainly have been of short duration and it is very unlikely that the building would have been unoccupied in the February earthquake (p141).

272. Following the Boxing Day earthquake in 2011, there were two Level 1 rapid assessments carried out both of which resulted in the issuing of green placards. Mr Drew rang Mr Coatsworth but found his offices were closed until 9 January 2011. Mr Drew did not follow that up but rather chose to concentrate on the damage repair.

273. A number of the tenants of the building continued to hold serious concerns about the safety of the building following the Boxing Day aftershock, in particular a [redacted] who voiced these to Mr Drew.

274. Mr Drew arranged for inspections by two tradesmen to enable estimates for concrete cracking repair. Both of these tradesmen gave evidence at the CERC. One of them, Graeme Smith, (who was also a qualified civil engineer) inspected the building three times in early 2011, including an inspection of the inside of the lift shaft. He was not concerned with the cracking he observed and did not consider it went beyond that described in the Coatsworth report.

275. The CERC concluded that Mr Drew should have at least had a further conversation with Mr Coatsworth about the increased damage as there was potential for the condition to be worse than he assumed. The best approach would have been to ask Mr Coatsworth to re-inspect the building (p150).

276. In my view there appears to be evidence, from the non-linear time history analyses and also the physical testing carried out by BECA (subject to any criticisms that can be made of these), to show that the building was not significantly structurally compromised prior to the February earthquake. Therefore, even though criticisms can be levelled at the post September inspections or lack of them, this should not affect the prosecution's ability to prove causation. However, again, these matters would be advanced in any trial in an effort to try to 'cloud the issue'.

Foundation Softening

277. In section 11.5 BECA refer to an issue raised by [redacted] of Canterbury University, namely whether softening of soils around the foundations of the South Shear Wall could have been a possible cause of the collapse.

278. In order to rebut this possibility the Police commissioned an investigation by BECA of the foundations and surrounding soils. The final report from BECA shows that, in their view, there was nothing untoward in the foundations or surrounding soil which would have contributed to the collapse.

279. I note that [redacted] refers to clause 3.8.1.2 of the then loadings code ("*Computed deformations shall be calculated neglecting foundation rotations*"). He notes that many engineers take this to be a reference to the supporting soil and not the foundations themselves. [redacted] then makes the point that if the foundations as detailed by the CTV designers had been modelled in the ETABS analysis then the deflections would have been greater and the need to reinforce the gravity structure for ductility would have been more obvious.

280. This is another issue that will no doubt be raised, likely in relation to the issue of whether Mr Harding's actions were a major departure.

Proof that all 115 people killed were killed by the collapse

281. As noted, in my view any charge of manslaughter should be a drafted as a representative charge alleging that one or more of the 115 people who died were killed as a result of the collapse. Proof of a homicide would require proof that the deceased were killed directly or indirectly by the omission(s) to perform the relevant duty.

282. My understanding of the post mortem evidence is that in relation to most of the deceased there is evidence to show that they were killed by crush injuries or as a result of the fire which broke out shortly after the collapse. However, we know that some of the deceased were not killed as a result of the initial collapse or immediately by the fire as a number were in contact with relatives or emergency services by cell phone from under the collapsed rubble.

283. During the Coronial hearing questions were raised about eight victims who appeared to have survived the initial collapse and as a result the focus was directed to the circumstances of their deaths.

284. Coroner Matenga concluded that improvements in resources, communication and structures could have improved the chances of saving more lives. However, he was not satisfied, to the standard required, that such improvements would have resulted in actually locating and saving the lives of those eight victims and accordingly that the search and rescue efforts did not contribute to the cause of their deaths.

285. I anticipate that in any trial there could well be a challenge to proof that all 115 deceased were killed as a result of the collapse. However, I do not believe it would be successful as it should be able to be proved that they were all killed, either directly or indirectly, as a result of the collapse.

286. Even if some were killed as a result of the rescue attempt this would not break the chain of causation as the rescue attempt was clearly a foreseeable consequence of the collapse.

287. The pancake nature of the collapse meant that the rescue operation would be difficult and potentially dangerous. In my view, for the rescue attempt to be considered as an intervening event it would have to be an extraneous event, not predominantly shaped or conditioned by the original cause. It is difficult to conceive how that could be the case. It might be different if it could be shown with some specificity that aspects of the rescue attempt were so inadequate that those deaths could be attributed to it but on the available evidence this does not appear to be the case.

288. The framing of the charge in the way suggested may avoid the necessity for such an argument.

Conclusion on Issues likely to be raised

289. Although none of the issues referred to above on their own are likely to create a reasonable doubt in relation to proof of causation, in my view, the very real and difficult issue is whether in combination they could do so.

Conclusion on the Evidential Sufficiency Test

290. I agree with the Police that the potential complexity of any trial (with the resultant difficulty of a jury understanding the case) is not of itself a basis on which to conclude that there could not be a reasonable prospect of conviction. The challenge, albeit a difficult one, would be for the Crown to present the case in a way that can be understood by the lay-man (and, as noted already, to present the case relying on all of the design errors in combination).

291. However the potential complexity is also a reason why a reasonable doubt could be created, in particular in relation to proof of causation. We know from the array of matters raised by Dr Reay before the CERC that every possible point would be taken. The question therefore is whether the combination of those issues is likely to create a reasonable doubt in a jury's assessment. In my view this is a difficult issue and one without a clear answer.

292. As I have indicated above, I consider there are also potential issues with proof that Dr Reay's omissions to provide oversight, review and checking of the structural design (including reliance on the Council's checking process) were a major departure from the required standard.

[redacted]

293. In my view it is advisable when considering culpability for manslaughter based on negligence, to be reminded of the words of Justice William Young (now a member of the Supreme Court) in *R v McKie* when he observed:

> Prosecution agencies should think long and hard before prosecutions for manslaughter based on negligence are commenced. [45]

294. Had the test under the Guidelines been a prima facie case there would be no issue, however that is not the test. The test is whether a jury properly directed could **reasonably** return guilty verdicts. The Guidelines appear to assume a competent fact-finder.

295. In my view this is a difficult and finely balanced matter but you would be entitled to conclude that the evidential test was met.

[redacted]

Public Interest

296. The predominant consideration is the seriousness of the offence. Clearly manslaughter with a maximum penalty of life imprisonment is one of the most serious offences in the Crimes Act.

297. In terms of the outcome of the offending if it were proved, the fact that 115 persons died as a result of the offending is a material consideration in support of a prosecution.

298. Whilst there would be a very considerable delay before trial (although it should be noted that the Police investigation did not commence until August 2014), the offending is serious and the complexity of the case has resulted in a lengthy investigation which has had to include a lengthy expert analysis (including complex physical testing) and two separate peer reviews.

299. A factor which can be taken into account in favour of a decision not to prosecute is that a defendant has no previous convictions or bad character. I do not understand either Dr Reay or Mr Harding to have anything of the nature. However, this always has to be weighed against the seriousness of the alleged offending. I also note that Dr Reay and Mr Harding are now in their mid and late 70's respectively and that the CTV building was built some 31 years ago.

300. Another factor is the likely penalty that would be imposed. Although it is a serious matter, there might well not be a full-time custodial sentence imposed if there were convictions.

301. A further factor which can weigh against prosecution is whether there are proper alternative avenues for dealing with the offending.

302. There has been a Royal Commission of Inquiry into the collapse of the CTV building. The actions of both Dr Reay and Mr Harding (and others) were examined in considerable detail by the CERC. Although the CERC was specifically constrained from inquiring into issues of liability or culpability, nevertheless, a view could be taken that there would be little merit in effectively re-litigating the same issues, particularly given the time that has now elapsed since the collapse and the fact that the building codes have been significantly improved since 1986.

303. Disciplinary action against Dr Reay and Mr Harding was initiated by IPENZ, the governance body for structural engineers in New Zealand. However, that action was not able to be continued as both men subsequently resigned from the organisation. I am unclear as to the current position but understand that IPENZ is currently seeking a ruling from the Court of Appeal over a judicial review of the matter. If disciplinary action could have been taken against Dr Reay and Mr Harding and their actions appropriately dealt with, this could have been a factor against a prosecution. **Therefore this matter should be clarified.**

304. In my view weighing up the factors for and against prosecution is also a difficult exercise. However in my opinion, weighing up all of these matters, you would be entitled to conclude that the public interest test is met in this case.

[redacted]

Trial Venue

305. I do not agree with the Police view that an application should be made by the prosecution for a change of venue from Christchurch, given the potential for prejudice. If there is a prosecution, I consider that any application by the defence should be considered on its merits but would have thought the prosecution would likely oppose such an application. Having said that, I agree that it is a case which might well end up being transferred to another venue.

[redacted]

SULLIVAN, Paul

From: Mark Zarifeh [redacted]
Sent: Wednesday, 11 October 2017 12:43 p.m.
To: READ, Peter
Cc: Chris Lange
Subject: CTV

Dear Peter,

I thought it might assist if I clarified our telephone conversation yesterday in response to your email below.
You asked if my opinion would be different if I was looking at the matter now. I think the answer has to be yes, because of the opinion from Crown Law. Just as I have said that I think you have to consider that advice very carefully, so too would I have to, given that it is essentially from the Solicitor-General.
Further, as I have said, Crown Law approached the matter from a more conservative viewpoint, but one which I can see is justified when you consider the case development in New Zealand in relation to negligence based cases over the last 10 or so years. Also, their reasoning appears sound and compelling. Crown Law took a more robust approach in assessing public interest factors and took into account cost which I had not done, but would likely have to do so if I was carrying out the exercise again.
Therefore it would not so much be a matter of changing my original opinion but of having to take on board the Solicitor-General's advice in reviewing my original opinion (which came with qualifications in any event).
Assessments under the Solicitor-General's Prosecution Guidelines are an application of judgement taking all relevant matters into account.
Please contact me if you want to discuss these issues further.

Regards,

Mark

From: READ, Peter [redacted]
Sent: Tuesday, 10 October 2017 12:07 PM
To: Mark Zarifeh [redacted]
Subject: Re: CTV

Mark

Thanks for your email

In your draft opinion you concluded that a jury properly instructed could reach a guilty verdict. In your substantive opinion you conclude that "you would be entitled to conclude that the evidential test was met".
Having considered this email have your previous opinions changed?
I am travelling back from nelson at the moment so will call you when I get into better cell phone coverage.

Sent from my iPhone

On 5/10/2017, at 3:46 PM, Mark Zarifeh [redacted] wrote:

Dear Peter,

1. You have asked me whether I can see any difficulties with a potential decision by the Police to prosecute given the Crown Law advice and recommendation not to prosecute in this instance.

2. In my view the Police should think long and hard before deciding to prosecute in the face of that advice. I say that because the Crown Law advice is effectively from the Solicitor-General, even though it is signed by Brendan Horsley and Annabel Markham (my understanding is that the Solicitor-General was involved in the discussions and decision) and, as you are aware, the Solicitor-General has the oversight of all prosecutions in New Zealand.

3. Further, the advice is in strong terms, essentially concluding in relation to both evidential sufficiency and public interest, that there should not be a prosecution.

4. Although I provided an opinion that the Police would be entitled to conclude that the evidential sufficiency and public interest tests were met, I qualified that saying the issues were finely balanced and difficult. As you are aware, it could have gone the other way. As I have previously indicated, having reviewed the Crown Law advice I cannot argue against it and accept their reasoning appears sound and compelling.

5. The decision to prosecute is ultimately one for the Police. However in my view, it would be unwise not to consider the Crown Law opinion very carefully before making a final decision.

6. If a prosecution was commenced but was ultimately unsuccessful it is likely that a costs application would be brought by the defence. The Crown Law opinion may then become discoverable. There is the very real potential that a Police decision to prosecute against Crown Law advice not recommending a prosecution could be used as a basis to apply for indemnity costs which in a case such as the present could be considerable.

7. These are important issues so I am happy to discuss these matters further with you if wish.

Regards,

Mark

MARK ZARIFEH | Partner | Crown Solicitor | Raymond Donnelly & Co
[redacted]

Also note, the views expressed in this message may not necessarily reflect those of [redacted] the New Zealand Police. If you have received this message in error, please email or telephone the sender immediately

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