SCHEDULE OF NON-COMPLIANCE

CODE COMPLIANCE			
ITEM	**CODE PROVISION**	**ALLEGED NON-COMPLIANCE**	**EVIDENCE**
Symmetry	Clause 3.1.1 NZS 4203 [0018.38] Main elements of a building that resist seismic forces shall, as far as is practicable, be located symmetrically about centre of mass.	Walls not symmetrical in the east-west direction.	Murray Jacobs [WIT.Jacobs.0001.4 paras 11-14] DBH Panel report, [BUI.MAD249.0192.53]
		Centre of stiffness of the designated primary seismic resisting elements significantly eccentric to the centre of mass.	DBH Panel report, [BUI.MAD249.0192.53] Rob Jury [TRANS 20120710.77 lines 19-20]

Shear reinforcing of columns	Clause 7.3.4.3 NZS 3101 [0016.58] Clause 7.3.5.4 NZS 3101 [0016.58] Minimum requirements for shear reinforcement in columns under NZS 3101: 1982.	Requirements for minimum spacing of the spiral reinforcing and a minimum cross-sectional area. Spiral reinforcing of R6 @ 90mm centres approximately or R10 @ 150 mm centres required. R6 @ 250mm centres used.	Hyland-Smith report [BUI.MAD249.0189.140] Murray Jacobs [WIT.JACOBS.0001.16] paras 47-48
Anchorage of spirals on columns	Clause 5.3.29.3 NZS 3101 [0016.41] Requires anchorage of spirals	No 135 degree stirrup hook on spiral reinforcing.	Ashley Smith: Saw no indication in the drawings of anchorage.
Adequacy of the R6 @ 250 mm spirals in the regions of the cranked splices in the columns.	Clause 5.3.27.1 NZS 3101:1982 [0016.41] Relates to 'Special details for columns and piers.' 'Ties or spirals shall be placed no more than 150mm from the point of bend.'	Spirals of R6 @ 250 mm insufficient to meet this requirement.	Ashley Smith [TRANS 20120808 line 3]

Ductility of columns	Columns should have been designed for ductility	1. Capacity design required columns and beam columns connections to be designed or ductility. 2. Failure of columns was a risk to life. 3. Columns should have been treated as primary seismic force resisting elements and not secondary elements. 4. Even if treated as secondary elements, the drift limits exceeded v delta.	
	Clause 3.5.1.1(a) NZS3101 [0016.24] Clause 3.5.1.3 NZS3101 [0016.24] Clause 3.5.1.5 NZS3101 [0016.24] Clause 3.5.3.2 NZS3101 [0016.24]	1. Capacity design required that columns be designed for ductility.	Smith- Capacity design applicable. [TRANS.20120809 line 4] Professor Mander: requirements of capacity design: [TRANS 201020724.101, line 26 to TRANS 201020724.102 lines 16]

	Clause 3.2 NZS 4203 [0018.38]	2. Failure of columns was a risk to life and columns were therefore required to be designed to possess ductility.	Murray Jacobs: [WIT.JACOBS.0001.6 paras 15-17] Professor Mander gave evidence that failure of columns in CTV presented a risk to life: [TRANS 201020724.86, line 24-27]
	Clause 3.5.14.3 NZS 3101 [0016.28]	3. Columns should not have been classified as secondary elements: a. They formed part of the primary force resisting system: i. Primary force resisting system is that which in fact would have been exposed to seismic forces, even though loads had been assigned to other parts of the system for design purposes.	

		ii. Definition of 'Primary elements' in NZS 4203:1984 included beams and columns. b. The columns were necessary for the survival of the building as a whole under seismically induced lateral loading	Murray Jacobs: [WIT.JACOBS.0001.13 para 36]
	Clause 3.5.14.3 NZS 3101 [0016.28]	4. If columns were secondary elements, drift limits (V delta) were exceeded and columns should have been designed for ductility	Hyland-Smith report [BUI.MAD249.0189.139] Rob Jury [TRANS 20120710.77, lines 10-12]

Beam-Column Connections required to be designed for ductility.	Clause 9.5.1 NZS 3101: 1982 [0016.70] Clause 9.5.6.1 NZS 3101: 1982 [0016.72]	If columns were required to be designed for ductility, beam-column connections should have as well.	Murray Jacobs [WIT.JACOBS.0001.17 paras 49-52]
Minimum (non-seismic) transverse reinforcement requirements for beam-column connections not met.	Clause 9.4.2 NZS 3101 [0016.69] Clause 9.4.5 NZS 3101 [0016.69] Clause 9.4.6 NZS 3101 [0016.70]	These clauses provide: 1. Design forces acting on a beam-column joint shall be evaluated from the maximum stresses generated by all members meeting at a joint, subjected to the most adverse combination of loads, with the joint in equilibrium. 2. Joint shear shall be assumed to be resisted by a concrete mechanism plus a truss mechanism comprising horizontal and vertical stirrups or bars... 3. Equations applicable to horizontal joint shear reinforcement. Transverse reinforcement of R6 @ 250 mm insufficient to meet these requirements.	Ashley Smith [TRANS 20120809 line 25-32]

	Clause 9.4.8 NZS 3101 [0016.70]	Spiral reinforcing required to be no more than 200 mm. Transverse reinforcement of R6 @ 250 mm insufficient to meet these requirements.	
Diaphragm	Clause 10.5.6.2 NZS 3101: 1982 [0016.75] Clause 5.3.32 NZS 3101: 1982 [0016.41-2] Clauses require the diaphragm to be reinforced in both directions with not less than minimum reinforcement required for two-way slabs.	664 mesh did not meet these requirements.	Murray Jacobs: [WIT.JACOBS.0001.14 paras 38-40]
	Clause 3.4.6.3 NZS 4203:1984 [0018.53] Diaphragms to be designed using the forces set out in parts and portions section of NZS 4203: 1984	Forces set out in parts and portion section (3.4.9) not used.	

	Capacity design applied. [[0016.24]	Designers did not follow requirements of capacity design.	David Harding: TRANS 20120731.90 lines 4-20
Diaphragm connection to North Core	Clause 3.4.6.3 NZS 4203: 1984 [0018.53] Floor acting as diaphragm to be designed in accordance with clause 3.4.9 Clause 3.4.9 NZS 4203:1984:- Parts and portions [0018.54] Table on [0018.58]	Did not comply with code at the time of the building permit. Reasons: 1. Capacity design requirements not met. 2. Non compliant with NZS 4203: 1984: a. David Harding used forces derived from equivalent static method. b. Code requires forces prescribed in parts and portions.	David Harding: TRANS 20120731.90 lines 4-20 Arthur O'Leary: para 80 first brief.

	Did not comply with code following drag bars	Reasons: 1. Non-compliant with NZS 4203 in the East-West direction. 2. Drag bars should have extended to the slab back to line 3.	Arthur O'Leary: para 81 first brief. Murray Jacobs: WIT.JACOBS.0002.7 para 22
Spandrel Panel Separation	Clause 3.5.14.2 NZS3101:1982 [0016.28]	No seismic gap specified	

"BEST PRACTICE"			
ITEM	**BEST PRACTICE**	**ALLEGED NON-COMPLIANCE**	**EVIDENCE**
Diaphragm connection	Should achieve a sufficient connection between the floor slab and a wall.	Lack of adequate connection between floor slabs and North Core.	Nigel Priestley- 'Clearly inadequate to achieve a sufficient connection.' [WIT.PRIESTLEY.0001.17 para 53] 'Lack of design connection between floor slabs and wall at lines D and D/E remarkable. [[WIT.PRIESTLEY.0001.17 para 54] Nigel Priestley [TRANS.20120711.68 line 2, TRANS 20120711.53, 54 lines 20-21]]
Eccentricity			Nigel Priestley [TRANS20120711.55 lines 7-11]

Robustness	Robustness means the ability of the structure to sustain damage without causing progressive damage to the building as a whole: Hyland/Smith [BUI.MAD249.0189.143]	Building should have been robust. The secondary beam and column frames lacked the level of robustness expected of frames designed to cope with the cyclic drift of earthquakes. Seismic design provisions of NZS 3101 would have improved robustness: Hyland Smith [BUI.MAD249.0189.144]	Rob Jury [TRANS 20120710.79 line 18]
Redundancy	Building should have had redundancy- that is, if one part (such as columns or beam column connections failed) it should not have resulted in collapse.	Building lacked redundancy: 1. If columns or beam column connections failed, whole or partial collapse would result.	
Columns	Ductile detailing of columns recommended especially where there are high axial load levels- Park and Paulay.	Lack of ductile detailing	Nigel Priestley: [WIT.PRIESTLEY.0001.23 para 78; ENG.PAU.0001.2 last para refers to brittle failure of unconfined columns at even moderate levels of axial compressive load.] Nigel Priestley [TRANS.20120711.65 line 22]

		Excessive spacing of transverse reinforcement. Even if the minimum transverse reinforcement was code compliant, it was still inadequate to achieve ductility.	Nigel Priestley [WIT.PRIESTLEY.0001.23 para 77] Nigel Priestley [TRANS.20120711.68 line 2]
Excessive cover to reinforcement of columns		Excessive cover to reinforcement of columns resulting in inadequate compression strength of the concrete core in the event of spalling of the cover concrete.	Nigel Priestley [WIT.PRIESTLEY.0001.23 para 77]
Beam column connection		Lack of transverse reinforcement in the beam column joints.	Nigel Priestley [TRANS.20120711.68]
Connectivity between pre-cast beams and columns		Poor connectivity between pre-cast beams and columns.	Nigel Priestley [TRANS.20120711.68]

Disparity between strength of north core and south wall	Disparity in structural type factors used. Centre of stiffness closer to north core.	These could lead to disparities in performance between north core and south wall. South wall could yield before the north core, meaning that south wall performing plastically while north core elastic, which affects inter-storey drift levels.	Ashley Smith