**From:** Clark Hyland [mailto:clark@fatigueandfracture.com]
**Sent:** Friday, 14 October 2011 11:50 a.m.
**To:** Rob Jury; 'Nigel Priestley'
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**Subject:** RE: CTV Analyses and Collapse Scenarios

Dear Rob,
I am still stunned by your comment yesterday that you would prefer a collapse scenario based on your instincts regardless of what the collapse evidence showed …

However with respect to the shrinkage issue the mesh placed in the slab was according to the manufacturer's recommendations at the time ie 664 mesh for 150 to 200 mm Hi-Bond slabs. This also correlates fairly closely to recommendations for topping shrinkage mesh in NZS 3101:1982 when account is taken for the 0.2% proof stress of hard drawn wire mesh. Less than half this amount of reinforcing would have been placed in the topping if for example a 200 mm Hollowcore unit with 65 mm topping had been used as the flooring. This is because the concrete design standard uses topping thickness as a prime determinant of diaphragm reinforcing requirements. Ie CTV building with similar seismic mass and actions could have had less than half the mesh placed in the floor slabs if the designer had chosen 200 mm Hollowcore.

Even at an instinctive level you would have to agree that would have been a worse situation than what was actually there with the 200 mm Hi-Bond diaphragm.

It is important to recognise that the mesh did not fail in a brittle manner on CTV ie in cleavage (sadly the SESOC and Royal Commission has got terminology mixed up on that). It in fact had a uniform elongation at maximum load of on average 4.2%. This is greater than the requirements for L class hard drawn wire mesh in NZS 4671 today of 1.5%. At the time there was no elongation limit for this material. However a bend test was required which is in fact a defacto way of testing elongation.

As the mesh on CTV was undeformed a strain of 4.2% is applied over a 150 mm grid of wire (ie the unrestrained length if debonding between cross wires is instinctively considered to have occurred) , then crack widths totalling 7.4 mm over 150 mm would occur before maximum load was achieved. This is a very large amount of cracking and indicates the ability of the slab diaphragm to accommodate tensile loads and redistribute actions above its 0.2% proof stress (ie 0.3 mm crack width over 150 mm ) .

In summary some simple calculations, knowledge of material performance and a consideration of the collapse evidence indicates that an instinctive view of slab diaphragm brittleness in response to shrinkage and overload conditions in earthquake may not be reliable.

Regards