Post Earthquake Performance of Passive Fire Protection Systems

Author Peter Collier, Senior Fire Engineer, BRANZ Ltd

A recent research project at BRANZ studied the effect of simulated earthquake racking on the fire resistance of plasterboard lined fire resistant walls.

Introduction

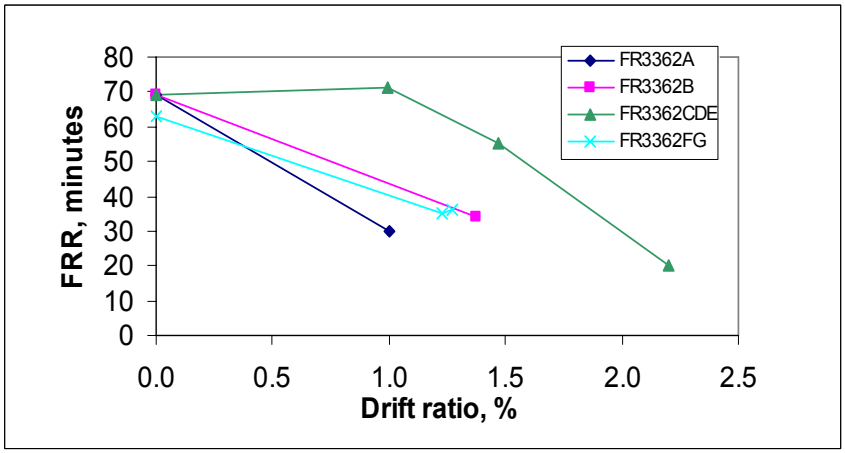
The role of passive fire protection (PFP) systems in accordance with NZBC Fire Safety Acceptable Solution C/AS1 includes protecting the means of escape from a building in the event of fire, and the control of internal and external fire and smoke spread.

Although PFP systems may perform their specified function under ideal test conditions there are concerns that an earthquake may weaken the fixing of linings to framing and hence the level of protection may be degraded post-earthquake. The integrity of the PFP systems post earthquake is important in protecting safe paths for the egress of building occupants and delaying internal fire spread between firecells, particularly when it is also considered that egress may be slowed due to earthquake damage obstructing escape routes in buildings.

The objective of the project was to get a clear understanding of how earthquakes affect the functionality of PFP systems with a view to being able to provide the regulator with technical guidance on the issue.

Experimental trials

- A selection of light timber framed and steel framed wall systems, that had previously been rated in fire resistance tests, were subjected to various levels of simulated earthquake racking in the laboratory
- The "simulated earthquake damaged" walls were then subjected to standard fire resistance tests
- The fire resistances of the walls damaged by the simulated "earthquake racking" were compared with the fire resistance of the original.



The Integrity component of fire resistance of the walls, where a failure is considered to be the appearance of flaming or hot gases on the ambient side, is compared with the drift ratio* in the above graph. A drift ratio of 1.5% corresponds with the design earthquake from the Loadings Code. The family of curves in the graph represent different edge details of the plasterboard and that had a major influence on the fixity of the plasterboard linings where detachment of the lining led to opening of gaps and flaming that ultimately resulted in Integrity failures.

Conclusion

The amount of reduction in fire resistance of a 60 minute plasterboard lined wall can exceed 50%. This is important given that active fire protection systems such as sprinklers may have also been rendered inoperable in the earthquake event. This is a dual problem in that a reduction in the fire resistance requirements of up to 50% may have been permitted because sprinklers were included as part of the fire design. The problem may be further compounded by the increased likelihood of fire outbreak due to disruption of building activities and services. Furthermore Fire Service attendance cannot be relied upon due to the likelihood of multiple callouts and possible impediment/blockage of road access.

The BRANZ study report SR147 in .pdf form is available free of charge from:
http://www.branz.co.nz/main.php?page=Free%20Publications&pagenumber=7

* drift ratio is the horizontal movement of a wall divided by the height of the wall expressed as a percentage - e.g. a 1% drift ratio is a 30 mm horizontal movement over a 3000 mm height.