Issue 18 - Building Design - Structural Integrity in Fire

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Fire Research & Investigation Unit

Heads Up

BACKGROUND

A fire occurred in a self-storage site in Wellington. This led to the loss and damage to items stored in numerous individual storage lockers on the upper level of the building. Despite the presence of a fire detection system, staff members present and intervention by the Fire Service, the building was subsequently demolished. The secured divisions of the storage spaces were non fire rated. This, together with the absence of a sprinkler system meant that effective measures to stop the fire could not be taken.

The building was one of 5 units on the site. The unit involved was 24 metres wide and an average of 50 metres long.

The building construction was concrete floor and end-walls, the side walls and roof were constructed of a steel-frame with external steel cladding. The interior of the building had a full-extent intermediate floor and both the lower and upper levels were sub-divided into secure storage units: approximately 200 on each of the lower and upper levels. Each unit was secured with a lock provided by the client. The first picture (below) shows a view of a corridor in a relatively undamaged part of the lower level. The second picture shows a similar view in a fire-damaged area.

The building had beam-type smoke detection and key points inside and outside the building were covered by CCTV cameras linked to the security system. However, the building had been designed without a sprinkler system. Access to the site is available at all times.

Left photo shows a view of a corridor in a relatively undamaged part of the lower level.

Right photo shows a similar view in a fire-damaged area.

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Vehicular access to the site was monitored; however it was possible for a pedestrian to enter the site without being identified. Access to the building required knowledge of the key code as well as possession of the key for the individual unit. The nature of the building meant that the management where not aware of what was stored inside the units.

INCIDENT DETAILS

The fire alarm operated shortly after 12.43a.m. on a Friday morning and alerted the staff-members on site. The Fire Service arrived within 4 minutes of being called. The staff directed the fire-fighters to the unit and provided the available information.

Fire crews were faced with fire and smoke in the south-eastern corner on the upper level but, because of the secured lockers, were unable to fight the fire directly. The crews withdrew and fire-fighting concentrated on cooling the structure and preventing the spread of fire to neighbouring buildings on and off site. The fire was escalated to a major incident within the 1st hour and lasted approximately 42 hours.

Sufficient water was available from the reticulated water supply.

FURTHER INFORMATION

The design of the structure supporting the full-extent, intermediate floor allowed for structural stability of only 4 minutes (see picture right). This was based on the estimated time it would take for occupants to evacuate in an emergency.

LESSONS LEARNED/RECOMMENDATIONS

The lessons learned are applicable to building owners and users, designers and to the Fire Service.

- The prescriptive acceptable solution required the intermediate floor to have a structural stability rating of at least 15 minutes. For this building the fire engineer adopted a performance based approach and estimated the structural integrity time of four minutes based only for egress of occupants when a fire is first detected and ignored the safety of fire-fighters. Because they weren't aware of the design, fire-fighters investigating the fire were present inside the building more than four minutes after the fire was detected. Had the fire been on the lower level, any collapse could have trapped or injured those fire-fighters. The structural stability of the building is important for firefighter safety and designs only allowing for evacuation of occupants places firefighters in danger.
- The security requirements in self-storage buildings means that individual lockers cannot be readily accessed. Therefore, unless a sprinkler system is provided, it is unlikely that fire can be prevented from spreading inside the building and from damaging or destroying the structure and its contents.
- The uninsulated steel construction allowed rapid spread of heat and fire through the individual lockers throughout the building. Installation of a sprinkler system would prevent this occurring.
- Media reported that items of unique cultural and economic importance were lost in this fire. The New Zealand Fire Service recommends that that building owners and users consider the provision of sprinklers systems as a means to minimise the chance of significant losses to themselves and their clients.

INFORMATION SOURCES: NZFS Internal Incident, Fire Investigation & Post-Incident Analysis Reports