SC/08/024

THE FIRE AT THE TORRE WINDSOR OFFICE BUILDING, MADRID 2005

This sheet is based on a number of available sources which are scheduled at the end of the text.

Background

The 30 storey Torre Windsor office building was constructed in the 1970s. It consisted of a reinforced concrete core and six reinforced concrete columns within the floor plate area, and steel load-bearing mullions (steel edge columns) around the perimeter. At the time of the design the relevant codes did not require these mullions to have any fire protection. The floor was of concrete waffle slab construction. There were ‘strong’ transfer floors at the 3rd and 17th levels.

A refurbishment programme was commenced in 2005, instigated partly to bring the building up to current fire standards through the installation of active fire prevention and resistance measures. These included protection to the external mullions, new fire doors, and the provision of a sprinkler system. A new external steel escape staircase was also included. At the time of the incident the fire protection to the mullions had been applied below the 17th strong floor (apart from floor 9) but not to those mullions above the 17th floor; the new sprinkler system was not operational.

The Fire

During this refurbishment work a fire broke out on the 21st floor. The fire spread downwards to the 2nd floor, and upwards to the top of the building. It burnt for some 19 hours and engulfed the entire building. Although local progressive collapses occurred a total collapse was narrowly averted. The new staircase performed well (see photo below). However the building was later completely demolished.

The studies concluded that the fire spread as a consequence of the lack of operational fire doors, fire stopping and through radiant heat. Cladding failure worsened the situation by allowing the fire to spread between floors Several floors burnt simultaneously giving rise to very high temperatures as the size of conflagration resulted in a lack of cooling from external air sources.

Courtesy C G Bailey

Consequential damage

In the absence of any protection the mullions weakened in the heat. A sufficient number lost their required load capacity causing sections of the building above the upper strong floor at level 17 to collapse. It is likely that only the presence of this floor prevented total progressive collapse. At lower levels none of the fire protected mullions failed. The mullions distorted at the 9th level (yet to receive their protection), but there was sufficient load sharing amongst the remainder-above and below this level- to prevent collapse of the floors. Notwithstanding the failure of the mullions, the reinforced concrete structure also suffered serious damage as a consequence of the temperature attained.

Conclusions from the investigation

An extensive investigation was carried out by INEMAC [1]. Their key conclusions included:

Research related

i) The need to recognise that concrete structures continue to heat up during extinction of the fire and after the gas reaches its maximum temperature, even though the temperature on the surface of members begins to reduce.The need to acquire a better understanding of the effects of the cooling phase on concrete structures.

Design and construction related

ii) The need to ensure recognition is given to the different cooling rates between steel and concrete where fire proofing is installed on composite sections

Maintenance related

iii) The need for scrupulous upkeep of the systems that limit propagation of fire between fire compartments.

To which SCOSS would add:

iv) The need for a suitable and sufficient risk assessment from all foreseeable hazards during a refurbishment project. This is particularly important where the building may be occupied, and for intermediate stages which can pose unacceptably high risks unless managed properly (examples of fires occcurring in the UK during consruction/refurbishment would include the Broadgate office fire (1990), the Uppark House National Trust Property fire (1989) and the Beaufort Park development in Colindale (2006)).

v) Although the contractor is responsible for adequate on-site fire precautions during construction/refurbishment, on complex projects the designer has a key role to play at the design stage in the consideration of, for example, buildability issues, necessary contractual constraints, formalised methods of working.

vi) This event demonstrates the benefits of 'strong floors' and of alternative load paths i.e. robustness.

References

1 Fire in the Windsor building, Madrid. Survey of the fire resistance and residual bearing capacity of the structure after the fire. INTEMAC NIT 2-05 December 2005 (English translation).
2 Lessons from Madrid. R Pope NSC pp26-29. March 2006.
3 A review by Manchester University at http://www.mace.manchester.ac.uk/project/research/structures/strucfire/CaseStudy/HistoricFires/BuildingFires/default.htm (including a comprehensive data base of fire related information).
4 New Civil Engineer (NCE) 17 February, 9 & 16 March, 2 June 2005.

June 2008.