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## The Madrid Windsor Tower Building Fire, 14-15 February 2005

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Landmark 29-floor tower on Madrid skyline remained standing despite a 26-hour, multiple-floor fire.

Despite a complete burn-out, the strength provided by a technical concrete floor, plus the passive fire resistance of the building's concrete core and frame, prevented the building from collapse.

The only part of the building to collapse was the network of steel perimeter columns supporting the slab on the upper floors.

The building was in the process of refurbishment and fireproofing to modern standards when the fire occurred; some fireproofing was being provided on the steel perimeter columns.

NIST's interim report on the World Trade Center disaster recommends the inclusion of 'strong points' within the building frame design - the Madrid Windsor Building's strong points were its two concrete 'technical' floors and the concrete core system enabling the building to survive complete burnout.

This case study is an example of the excellent performance of a concrete frame designed using traditional methods and subjected to an intense fire. It also highlights the risks when active fire protection measures fail or are not included in steel frame construction.

The Madrid Windsor Building is situated in the heart of the Spanish capital's financial district and was a distinct and familiar landmark on the city's skyline. Built between 1974 and 1978 by architects Alas Casariego, its occupants included high profile corporate clients including accountants Deloitte and Spanish legal firm Garrigues.

The building totalled 32 storeys, with 29 floors above ground and three below. A concrete core and concrete frame supported the first 16 floors. Above that was a central support system of concrete columns, supporting concrete floors with steel perimeter columns. An additional feature was the presence of two 'technical floors' - concrete floors designed to give the building more strength. One was just above the ground level and the other at the 17th floor.

The tower was built using normal strength concrete and before modern fire proofing standards, without any sprinkler system. It was undergoing a complete refurbishment, including the installation of various active fire prevention and resistance measures, when the fire began at around 11pm on 14 February 2005. Fortunately the building was empty of people at the time.

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The fire started on the 21st floor and quickly spread both above and below. Upward spread was by means of internal openings made as a result of the refurbishment and the failure of fire stops between the perimeter column and steel/glass façade. Downward spread is thought to have been caused by burning façade debris falling through windows on lower floors.

Because of the height of the structure and the extent of the blaze, firefighters could only mount a containment operation and ensure that neighbouring buildings were protected. The fire eventually finished 26 hours later, leaving a complete burn-out above the fifth floor. The steel-glass façade was completely destroyed, exposing the concrete perimeter columns. The steel columns above the 17th floor suffered complete collapse, partially coming to rest on the upper technical floor. The insurance value of the total damage caused was €122 million.

Crucially, the building remained standing despite the intensity of the fire. An investigation is underway between Spanish technical agency Intemac and UK authorities including Arup Fire, the University of Edinburgh and the concrete industry including Cembureau, BCA and The Concrete Centre. Preliminary findings suggest that a combination of the upper technical floor and the excellent passive fire resistance of the tower's concrete columns and core prevented total building collapse.

The fire is significant in terms of its potential similarities between the collapse of the building's steel frame above the 17th floor and the experience seen at the World Trade Center. Notably, one of the recommendations of NIST's interim report on the World Trade Center disaster is for tall building design to incorporate 'strong points' within the frame.

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