Construction strategies to avoid progressive collapse

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The Skyline Plaza Apartments in Fairfax County, Va after a 1973 progressive collapse that occured during construction of the 24th floor. The collapse involved the full height of the tower, and falling debris also caused the horizontal progressive collapse of an entire parking garage under construction adjacent to the tower. Fourteen workers were killed, 34 workers were injured. Credit: Hai S. Lew/NIST

The 1995 terrorist attack on the Oklahoma City Alfred P. Murrah Federal Building heightened concern on the vulnerability of multi-story buildings to “progressive collapse,” the spread of an initial local structural failure by chain reaction that results in the collapse of an entire structure or a disproportionately large part of it. The National Institute of

Standards and Technology recently issued a guide to help owners, engineers and building officials avoid such collapses through prudent planning and design of structures. The guide also summarizes national and international best practices for designing buildings resistant to progressive collapse of buildings.

The report, Best Practices for Reducing the Potential for Progressive Collapse in Buildings, argues that although no building system can be engineered and constructed to be absolutely risk-free, risk-informed assessment and decision-making can reduce the risk of progressive collapse. According to the researchers, engineers must not simply work to the minimum requirements of the building code; they need to consider ways to improve structural integrity and robustness to accommodate local failures.

According to NIST engineers, hazards that increase the risk of local structural failures that, in turn, can lead to a partial or complete progressive collapse include design and construction errors, fire, gas explosion, the transport and storage of hazardous materials, vehicular collision, and bomb explosions.

The NIST report cites a lack of continuity of support within a building system, a lack of ductility in structural materials, members and connections, and lack of structural redundancy in providing alternate load paths as critical factors that limit structural integrity. The use of large-paneled or bearing wall construction, for example, can limit continuity and ductility. Such systems may be poorly suited to absorb or dissipate energy resulting from unforeseen events such as gas explosion and sabotage.

The guide catalogs a number of cost-effective engineering solutions for retrofitting existing structures.

The document summarizes “existing knowledge” for use by engineers in making risk-informed planning and design decisions. It is not intended to provide step-by-step guidance. Appendix A describes applicable design standards from around the world. Appendix B identifies research needs relevant to progressive collapse. Appendix C provides case studies of progressive collapse.

Source: National Institute of Standards and Technology

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