

Mixed-Use Development in China Requires Many Fire Strategies

Challenge. The Nanjing Greenland Financial Center in eastern China is a 65-story office and hotel tower with about 60,000 square meters of office space on levels 11-34; 52,000 square meters of hotel space on levels 36-64; a hotel sky lobby and coffee shop on levels 36-37; a public observation deck on level 59; and restaurants and suites on levels 61-64. This mixed-use development is adjacent to two other buildings that were also part of the design project: 1) a 22-story tower with about 20,000 square meters of office space; and 2) a seven-story podium building that includes 50,000 square meters of retail space interconnected by a six-story atrium, restaurants, six cinemas, hotel ballroom and meeting rooms, three levels of below-grade parking, and a hotel pool and health club located on the roof.

Several key features of the building design were not fully addressed by Chinese codes and needed to follow a performance-based design approach. These features were: the primary tower, which exceeds the 250-meter height limit of the code; high-occupancy spaces in the upper levels of the primary tower and the podium building, instead of below the third floor as permitted by code; area of refuge floors in the tower serving up to 23 floors rather than 15 as code specifies; and a single fire compartment for each office floor of the tower.

The design of the atrium space in the podium building also posed a challenge, because it called for a single fire compartment connecting all levels of the podium building, a design of the atrium mechanical smoke exhaust system based on performance measures, and a reduction of fire resistance rating for certain structural elements of the atrium roof structure, as well as circulation walkway bridges and escalators within the atrium.

Solution. Rolf Jensen & Associates' (RJA) strategies included providing: adequately sized and well-distributed exit paths; structural fireproofing and fire barriers that limit fire spread and protect buildings from collapse during occupant exit; various fire detection and notification systems; active fire suppression and smoke extraction systems that limit fire size and spread of smoke to enable occupants to safely exit and to minimize building damage; and infrastructure elements that promote safe and efficient firefighting operations.

For building features that met Chinese codes, RJA evaluated them for code compliance in the normal course of plan review and approvals. Features that didn't meet code, however, needed to be evaluated using a performance-based design analysis consisting of computer fire and egress modeling.

Specifically, the analysis evaluated representative high-rise and retail atrium areas to validate the proposed fire-protection design solution. This analysis included: heat effects and smoke flow from a design fire, activation of automatic fire detection and suppression systems, tenability conditions of egress routes, evacuation times of representative areas, and performance and reliability of fire safety features.

Result. RJA's fire and egress modeling verified that proposed building design features that did not meet Chinese code and were required to undergo performance-based design analysis did, in fact, meet the established performance criteria and were equal to the fire safety intended by the code. Fire growth scenarios, based both on accepted theoretical models and on existing fire test data, aptly assessed the effects of a fire within representative areas of the building and validated the appropriateness of proposed fire safety features.

RJA's analysis formed the basis for design acceptance by the Authorities Having Jurisdiction, and the development is on target for completion in 2008.



- Code Consulting
- Performance-Based Design
- Fire Protection Design

**RJA**
ROLF JENSEN & ASSOCIATES, INC.
FIRE PROTECTION CONSULTANTS

rjainc.com

