CTBUH Journal

International Journal on Tall Buildings and Urban Habitat

Tall buildings: design, construction and operation | 2010 Issue III

Case Study: O-14 Folded Exoskeleton

New Solar Initiatives in Supertall Buildings: The Spire at Ras Al Khaimah

International Applications of Elevators for Fire Service Access and Occupant Egress in Fires

The High-rise as a Retirement Community

Greening Supertalls

The Economics of High-rise

CTBUH 2010 Awards Winners

Council on Tall Buildings and Urban Habitat

Editor's Message

Published by
The Council on Tall Buildings and Urban Habitat

ISSN: 1946-1186

Council on Tall Buildings and Urban Habitat
S.R. Crown Hall, Illinois Institute of Technology
3360 South State Street
Chicago, IL 60616-3793

t: +1 312 567 3487
f: +1 312 567 3820
e: info@ctbuh.org

www.ctbuh.org

Print
This Journal is printed by Source4, Chicago.

Front cover: O-14, View up façade. Back cover: Tower base.
© Reiser + Umemoto

Zak Kostura, Co-editor

With each passing year, the composition of tall buildings proposed around the world grows increasingly varied and creative. While we are quite familiar with the co-mingling of office, residential and hotel uses within a singular edifice, the proportion of such mixed-use towers within the tallest 100 is set to grow substantially within the coming years. Moreover, as cities grow ever denser, the industry continues to witness the foray of other building uses into the tall building typology.

The growth in the diversity of tall building uses is hinted at in the lists of tall buildings in the world proposed or under construction on the CTBUH website database, where one-day tall buildings, such as the Shanghai Tower and the Burj Mubarak Al Kabir, introduce exhibition and religious spaces to the list of conceivable partial uses for tall buildings. High-rise government, retail and civic space can also be found on the upper floors of proposed towers. For each new programmatic inclusion, the number of mixed-use permutations grows exponentially.

In this issue, the CTBUH Journal studies the novel inclusion of educational, health care and assisted living functions within a single edifice in Chicago. This building, known to its occupants as The Clare, demonstrates how the growth in mixed-use tall building typology is likely to impact the course of our industry in the coming years. The architects of Perkins + Will, who are both the designers of The Clare and the authors of the paper in this issue, highlight considerations that span most if not all technical disciplines involved in the design of such a tower. Indeed, novel programmatic inclusions raise questions about the most appropriate structural system to house these uses, how the individual uses should be ordered vertically to maximize movement and safety within the tower, and how to maintain a coherent exterior aesthetic despite varying requirements in floor-to-floor heights.

Mixed-use is not the only timely topic being covered in this issue. The case study of O-14 is a good example of a double skin façade, while the topics of energy creation and evacuation are being covered in two technical papers. The double interview with representatives of the greening projects of the Empire State Building and Taipei101, is all about sustainability.

As towers grow ever taller they are likely to take on even more of the character inherent to the city that surrounds them. As designers and builders of these towers, it will be necessary for us to envision how the city fabric will be manifested vertically, and how the systems we design can facilitate this progressive evolution. The CTBUH welcomes your thoughts and opinions on this shift in tall building use, as well as the myriad other topics covered by the technical papers, case studies and Council articles included in this issue. We welcome your feedback and hope you will join us in this important and ongoing discussion.

Cheers,

Zak Kostura

Inside

News and Events

Case Study

Research

Features

CTBUH

"Comparison of total evacuation time by stairs alone and by a combination of stairs and elevators estimated a 45% reduction in total evacuation time (to 90 minutes) with the elevators."

Richard Bukowski, page 28

Visit **www.ctbuh.org** for more on the global tall building industry and the Council on Tall Buildings and Urban Habitat

Global News

The CTBUH Global News Archive is an online resource for all the latest news on tall buildings, urban development and sustainable construction from around the world. Each issue, the CTBUH Journal publishes selected feeds from the online archive. For comprehensive industry news, visit the Global News Archive at: http://news.ctbuh.org

© Emaar Properties

Armani Hotel Dubai Opens in Burj Khalifa

The Burj Khalifa in Dubai is the home of the first hotel designed by Giorgio Armani. Located in the 828-meter tower, the five-star Armani Hotel Dubai is located from the building's base to the 8th floor and also on floors 38 and 39. The 160-room hotel includes restaurants, a spa and an outdoor swimming pool. The hotel's design reflects the warm earthtone colors of cocoa, tan and beige throughout. Minimal details give way to surfaces that reflect the desert's palette.

The hotel's opening by Emaar Properties, the developer, has been slightly delayed. The opening of the Observation Deck on the 124th floor in January 2010 was spectacular, but brief. Shortly thereafter, the Observation Deck was closed because of an elevator malfunction. It has since reopened. The hotel's delay was partly caused by volcano activity in Iceland that forced Mr. Armani to delay his travels. Mr. Armani and representatives from Emaar were on hand for the hotel's opening.

The timing for the opening is at a downturn in the Dubai economy. The Armani Hotel Dubai is a luxury hotel, aiming for the global destination market. Other five-star hotels in the area have had to reduce rates in order to fill rooms. The branding of the first Armani hotel in the tallest building in the world may prove successful in the long term.

Regal Comes to Birmingham

City officials in Birmingham, UK have granted permission for construction to begin for Regal Tower at Broad and Sheepcote Streets. Designed by Aedas Architects, the 56-story tower will contain 289 business hotel rooms, 256 serviced apartments and a conference center with retail on the grade-level podium floors. A Sky Bar on the 30th floor and a Winter Garden on the 53rd floor will provide views of the Birmingham skyline.

At 192 meters, this skyscraper will be the tallest building in Birmingham, surpassing the BT Tower and a proposed 51-story tower. Developed by Regal Property Group, the vote of confidence to proceed, from the city's leadership, signals a positive economic climate. The tower's landmark location is expected to increase the urban activity and experience of the city. The City's approval is contingent on completion of construction by 2013.

© Cok+Fox Architects

© Beyer Blinder Belle

Green Luxury Comes To New York City

This 21-story, 70-unit residential building at 100 Eleventh Avenue is located at 19th Street, near the High Line. Designed by Jean Nouvel who has teamed up with local architects Beyer Blinder Belle, it is to be LEED certified along with providing high-end luxury.

The tower is noteworthy for the 1,700 panes of glass, at slightly different angles, to reflect the city around it. Instead of one image, the façade reflects multiple images at the same time. Within the apartments, the floor to ceiling glass frames individual views as opposed to panoramic views. A restaurant will occupy the ground floor along with an entrance that contains a suspended garden.

The sustainable features include certified wood products, recycled materials, low VOC finishes and an indoor air quality management system.

...verticality

> "What is surprising is that Manhattan should be afraid of verticality."

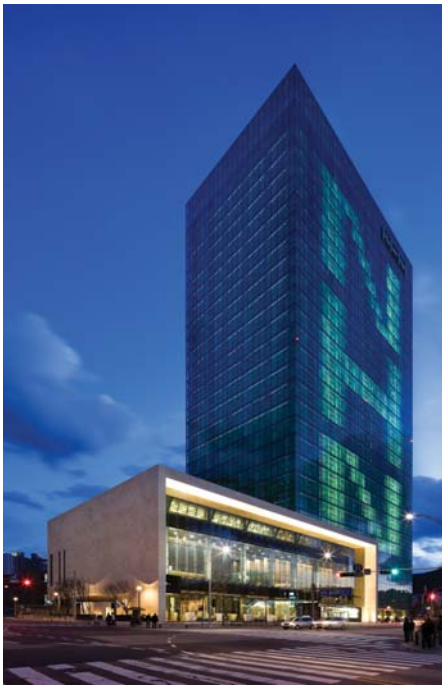
Jean Nouvel in an interview about his Tower Verre project in New York City. Source: http://nymag.com

Bringing the Outdoors Indoors

NHN Corporation has a new home in Bundang, in Seoul's business district. This office building has been designed differently than most corporate headquarters. The Internet company specifically directed Flexible Office of London, NBBJ and Samoo Architects and Engineers to design office space that brings the outdoors in. Instead of normal office layouts, they designed open-plan spaces that provide for high-density work areas and communal gathering places. The intent is to create a stimulating work environment for working groups to brainstorm.

The reinforced concrete structure is 28 stories tall with 101,660 square meters of office space. Underfloor ventilation systems provide fresh air to the office spaces. Louvers on the elevations provide shading from the sun's glare. In addition, they can also portray images to become an advertising billboard to the surrounding neighborhood.

Despite a tight construction schedule, the office headquarters was constructed by HanmiParsons and Hyundai Engineering and Construction on schedule and within budget.



© Samoo Architects

© Francis-Jones Morehen Thorp

Downtown Tower for Sydney

A new skyscraper is under construction on Castlereagh and Pitt Streets in the CBD of Sydney. It is named 163 Castlereagh and will contain 54,000 square meters of Class A office space within 43 floors. The generous grade-level plaza will contain 2,800 square meters of retail space for restaurants and amenities.

It was designed by FJMT and is jointly owned by Grocon, La Salle Investment Management and GPT Group. Major tenants will be Australia and New England Banking Group and Freehills. The site is a combination of several parcels, brought together for the tower as well as to provide a public plaza for the tenants and other city residents. Located in the financial center of the city, the plaza is expected to be a gathering place and increase pedestrian activity.

The skyscraper is being constructed by Grocon and is projected to top out at 198 meters in 2013.

Sky Center in Luanda

A future new town is named Sky Center in Luanda, Angola. With excellent ocean views, the objective of this new urban town is to promote a business environment.

One of the first developments of Sky Center is to be Sky Residence II + Sky Business Towers. Designed by RISCO Architects, the two towers are set side-by-side to maximize the ocean views. While their masses are similar, their elevations are distinctly different.

Sky Residence II is a 22-story residential tower with brise-soleil on the elevations to control the strong sunlight rays into the interior. Breaks are created on the elevations to provide more views to the ocean. A two-story podium lifts the tower from grade.

Sky Business is an office tower that has a structural elevation, thus eliminating many interior columns for greater office planning possibilities. This grid of the elevations is sometimes horizontally modulated and at other times vertically modulated. In both cases the structural members are shading devices for the glazing, controlling the sunlight entering the interiors. This tower is also lifted onto a two-story podium.

© RISCO Architects

Case Study: O-14 Folded Exoskeleton

Jesse Reiser

Nanako Umemoto

Jaime Ocampo

Authors

Jesse Reiser, Partner
Nanako Umemoto, Partner

Reiser + Umemoto RUR Architecture, PC
118 East 59th Street, #402. New York, NY, 10022

t: +1 212 421 8880 f: +1 212 421 8881
www.reiser-umemoto.com

Jaime Ocampo, Senior Vice President

Ysrael A. Seinuk, PC
228 East 45th Street, 2nd Floor. New York, NY 10017

t: +1 212 687 2233 f: +1 646 487 5555
www.yaseinuk.com

Jesse Reiser
Jesse Reiser received his Bachelor of Architecture degree from the Cooper Union in New York and completed his Masters of Architecture at the Cranbrook Academy of Art. He was a fellow of the American Academy in Rome in 1985 and he worked for the offices of John Hejduk and Aldo Rossi prior to forming Reiser + Umemoto with partner, Nanako Umemoto. Jesse is an Associate Professor of Architecture at Princeton University and has previously taught at various schools in the US and Asia, including Columbia University, Yale University, Ohio State University and Hong Kong University.

Nanako Umemoto
Nanako Umemoto received her Bachelor of Architecture from Cooper Union in New York in 1983, following studies at the School of Urban Design and Landscape Architecture at the Osaka University of Art, and formed Reiser + Umemoto with partner, Jesse Reiser in 1986. Nanako currently teaches at the University of Pennsylvania, and has previously taught at various schools in the US and Asia, including Harvard University, Columbia University, Hong Kong University, Kyoto University, Pratt Institute, and the Cooper Union.

Jaime Ocampo
Jaime M. Ocampo is a Senior Vice President with Ysrael A. Seinuk, P.C. in New York. Mr. Ocampo has over 33 years of experience in structural design and project management, with particular expertise in the design of high-rise buildings. His list of projects, nationwide and abroad, includes high-rise reinforced concrete residential and mixed-use buildings, hotels, institutional and office buildings and theaters.

"With O-14, the office tower typology has been turned inside out – structure and skin have flipped to offer a new economy of tectonics and of space. The concrete shell of O-14 provides an efficient structural exoskeleton that frees the core from the burden of lateral forces and creates highly efficient, column-free open spaces in the building's interior."

O-14 is a 22-story commercial tower characterized by 1,326 openings, randomly located and varying in size, throughout the whole exterior shell. The tower contains over 27,900 square meters (300,000 square feet) of office space and is located along the extension of Dubai Creek in the Business Bay area of Dubai, occupying a prominent location on the waterfront esplanade. O-14, named after its lot designation, broke ground in February 2007, and in May 2009, the tower's concrete structure was completed and the building topped out. It is one of the first towers to appear in the skyline of Business Bay, scheduled to be fully finished and occupied by the fall of 2010. The project has generated extraordinary international interest in the architectural press, as it is among the very first innovative designs to be constructed among a sea of generic office towers, which have come to be the standard in Dubai's current building boom.

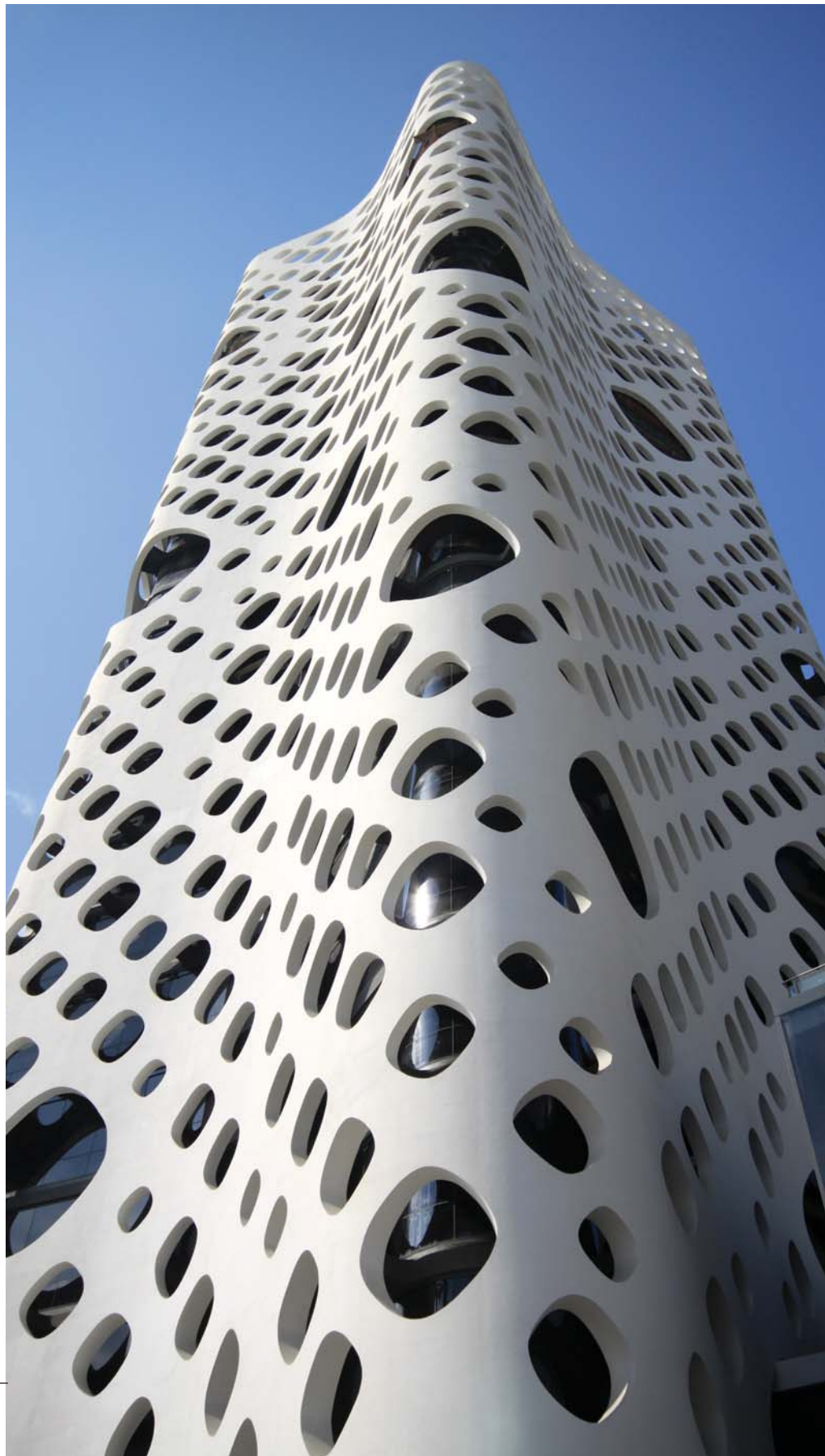
Architectural Overview

With O-14, the office tower typology has been turned inside out – structure and skin have flipped to offer a new economy of tectonics and of space. The concrete shell of O-14 provides an efficient structural exoskeleton that frees the core from the burden of lateral forces and creates highly efficient, column-free open spaces in the building's interior (see Figure 1). The exoskeleton of O-14 becomes the primary vertical and lateral structure for the building, allowing the column-free office slabs to span between it and the minimal core. By moving the lateral bracing for the building to the perimeter, the core, which is traditionally enlarged to receive lateral loading in most

curtain wall office towers, can be minimized for only vertical loading, utilities, and transportation. Additionally, the typical curtain-wall tower configuration results in floor plates that must be thickened to carry lateral loads to the core, yet in O-14 these can be minimized to only respond to span and vibration. Consequently, future tenants can arrange the flexible floor space according to their individual needs.

The shell is organized as a diagrid, the efficiency of which is wed to a system of continuous variation of openings, always maintaining a minimum structural member, adding material locally where necessary and taking away where possible. This efficiency and modulation enables the shell to create a wide range of atmospheric and visual effects in the structure without changing the basic structural form, allowing for systematic analysis and construction. As a result, the pattern design is a combination of a capillary branching field, gradients of vertical articulation, opacity, environmental effects, a structural field, and a turbulence field. Yet these moves are not solely programmatic, economic, and environmentally related. In fact, these benefits are by products of a design that preferences pattern in order to distance itself from the generic, break up the now-standard tower stratification in order to emphasize verticality, and to confuse a sense of scale and height.

In O-14, the fenestration, or perforation, is not tied to the overall regulating geometry. In a typical office building, the subdivision of form would locate programs in a predictable way, as in larger windows and offices at corners, etc. Here, rather, the pattern seeks to attenuate the monotony, while still preserving a sense of the sublime and the monumental. Its deliberate lack of coordination with the floorplates engenders a randomized connection – all of this confuses legibility and scale, and defeats easy reading of the building's height and reorganizes the hierarchy of office space. Modulation of pattern works like camouflage, becoming disruptive and de-materializing the tower block. The shell's pattern changes as its relationship to the viewer changes, and in conjunction with additional patterns of



International Applications of Elevators for Fire Service Access and Occupant Egress in Fires

Richard W. Bukowski

Author

Richard W. Bukowski, Senior Consultant

Rolf Jensen & Associates, Inc.
14502 Greenview Drive, Suite 500
Laurel, Maryland 20708

t: +1 301 490 3901
f: +1 301 490 4763
www.rjainc.com

Richard W. Bukowski
Mr. Bukowski is a Senior Consultant at the RJA Baltimore office. He joined RJA in 2009 after retiring from the federal government (NIST) with 35 years as a research fire protection engineer. His responsibilities included coordination with the US and international building regulatory and technical standards communities as they considered changes based on the research conducted by the agency.

Current work with RJA includes projects worldwide that involve code compliance including performance-based design, fire hazard and fire risk analysis, fire alarm systems, mass notification systems, fire modeling, transportation systems, and fire protected elevator systems for egress and fire service access.

...elegant

"I also admire Dubai's Burj Khalifa. It goes against all my sustainability values but it is such an elegant statement, as well as technical achievement, that I can't fail to be fascinated by it."

Peter Jackson, past chairman of the United Arab Emirates Architectural Heritage Society quotes in Cityscapes, Apr/May 2010

"Despite the absence of technical standards, tall buildings worldwide are incorporating elevators for occupant evacuation to achieve significant reductions in total evacuation times. Common requirements include emergency power, water protection, and hoist ways with protected lobbies with direct access to an exit stair."

For more than two decades, the elevator industry has told us that elevators may not be safe to use during a fire. The Safety Code for Elevators and Escalators [1] as well as building codes have required signs in every elevator lobby to advise occupants to use the stairs and not elevators in case of fire. Elevators are typically equipped with a special fire service operating mode with manual control by a firefighter in the car, but US elevators are not arranged to support high-rise firefighting operations as they are in England and other countries. The main concern of the elevator industry is that elevators may come to a stop for any number of reasons, entrapping the occupants where they might be exposed to smoke before the fire department can affect a rescue.

Background

Following the World Trade Center attacks of September 11, 2001, it became clear that evacuation of a very tall building can take far too long (evacuation of the WTC towers with the design occupant load was estimated to require 4 hours). Such evacuations also involve significant issues including fatigue, people with pre-existing disabilities or injuries received in the initiating event, and unfamiliarity with the egress stair system. Similarly, fire service access up stairs while carrying needed equipment was time consuming and exhausting.

Since 2004 the National Institute of Standards and Technology (NIST), American Society of Mechanical Engineers (ASME), the elevator industry, and other interested parties have been developing requirements and procedures for fire service access elevators and occupant self-evacuation elevators that will be safe to use in fires. However, the obvious benefits for timely evacuation of very tall buildings, the provision of an effective evacuation means for people with disabilities, and the ability to provide for egress from assembly spaces high in buildings without the need for increased stair capacity (at significant cost in reduced rentable space) through the entire building, all led to the application of egress elevators in numerous tall buildings throughout the world before the requirements and procedures under development could be promulgated.

During the development process, numerous technical papers were presented at international conferences by participants (and especially this author) discussing approaches that were under discussion and were likely to be incorporated into the final regulations [2, 3, 4, 5]. These papers became the basis for many of the arrangements that were incorporated into buildings as performance based design elements. Some existing buildings even incorporated elevator evacuation protocols that were shown to reduce total evacuation times. The result is many systems in use that do not incorporate all of the features deemed necessary by the experts and which are one-of-a-kind arrangements that may lead to confusion as the standardized systems are put in place.

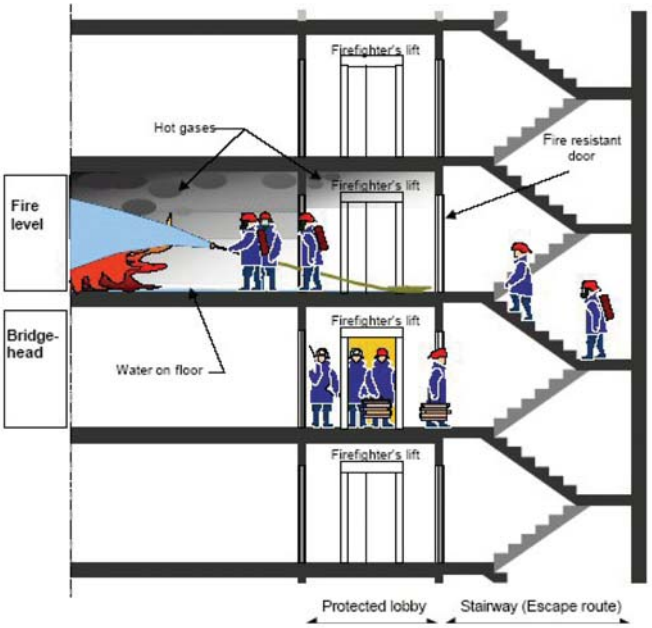


Figure 1. The use of the firefighting shaft in a high-rise fire (from BS5588/CEN standards)

The British firefighter lift standard has been extended for use throughout the European Union[6], and certain countries in the Middle East and Asia have applied this approach to very tall buildings; however, US fire departments have had some trepidations about embracing the technology.

Firefighter Lifts

In the mid-1980's the US began installing smoke detectors in elevator lobbies to initiate recall (Firefighters Emergency Operation) should smoke threaten the system. Signs were required stating that elevators are not to be used in fires. At the same time, England adopted a standard [7] containing requirements for a firefighter lift in buildings over 30 meters (100 feet) in height. The firefighter lift was part of a firefighting shaft that included an enclosed lobby on every floor with direct access to a stair containing a standpipe, all of which were intended to support high-rise firefighting practice.

Because most of the building is above fire department ladders, high-rise fires must be fought from the interior by moving people and equipment to a forward command post one- or two-floors below the fire, then advancing up the stairs to the fire floor where hoses are connected to the standpipe and advanced to extinguish the fire. In the US people and equipment (often 100 pounds of equipment is carried by each firefighter) move entirely up the stairs in a time-consuming and fatiguing process. With a firefighter lift, that can be used to move to the forward command post quickly and avoiding the exhaustion.

The American fire service did not trust the safety of elevators and continued to use the stairs until the events of September 11, 2001. Several (big city) departments began to incorporate elevator access into their high-rise fire fighting procedures with extreme caution. The NIST/ASME project included several representatives of the fire service to ensure that their safety needs were met by the requirements that were developed.

The NIST/ASME effort identified several areas where the British approach needed modification. First, the British standard requires the firefighter lift to be located in a separate hoistway. This can lead to piston effect drawing smoke into the hoistway as the car moves, and makes it more difficult to rescue an entrapped firefighter (should such occur) from the adjacent car. The separation serves no purpose since a fire in the hoistway would render the system unsafe, so this was not included in the US system.

Second, the British system has the firefighters advancing the attack hose through the elevator lobby. This will permit smoke to enter the lobby and compromise the elevator (see Figure 1). Since US elevators have the smoke detector triggered recall, this would be triggered and the elevator would be taken out of service. The US requirements include a door from the stair to the floor to advance the hose without going back through the lobby, maintaining the lobby smoke free and preventing recall.

In addition, the US system added real time monitoring of conditions in the lobbies and machine room and of power to the elevators, all displayed in the fire command center. Should things go wrong the fire department people can warn their colleagues by radio (other regulatory changes have addressed the reliability of fire department communications within high-rise buildings). Most international requirements for firefighter lifts are based on the British Standard, but it is likely that the US modifications will affect future system designs.

Case Studies:

Stratosphere Tower [8] (Las Vegas, NV)

One of the many unique buildings gracing the Las Vegas skyline is Stratosphere Tower (see Figure 2), which is essentially an 11-story building (called the "pod") atop a slim base

Figure 2. Stratosphere Tower, Las Vegas
© Marshall Gerometta

About the Council

The Council on Tall Buildings and Urban Habitat, based at the Illinois Institute of Technology in Chicago, is an international not-for-profit organization supported by architecture, engineering, planning, development and construction professionals. Founded in 1969, the Council's mission is to disseminate multi-disciplinary information on tall buildings and sustainable urban environments, to maximize the international interaction of professionals involved in creating the built environment, and to make the latest knowledge available to professionals in a useful form.

The CTBUH disseminates its findings, and facilitates business exchange, through: the publication of books, monographs, proceedings and reports; the organization of world congresses, international, regional and specialty conferences and workshops; the maintaining of an extensive website and tall building databases of built, under construction and proposed buildings; the distribution of a monthly international tall building e-newsletter; the maintaining of an international resource center; the bestowing of annual awards for design and construction excellence and individual lifetime achievement; the management of special task forces/working groups; the hosting of technical forums; and the publication of the CTBUH Journal, a professional journal containing refereed papers written by researchers, scholars and practicing professionals. The Council actively undertakes research into relevant fields in conjunction with its members and industrial partners, and has in place an international "Country Representative" network, with regional CTBUH representatives promoting the mission of the Council across the globe.

The Council is the arbiter of the criteria upon which tall building height is measured, and thus the title of "The World's Tallest Building" determined. CTBUH is the world's leading body dedicated to the field of tall buildings and urban habitat and the recognized international source for information in these fields.

Council on Tall Buildings and Urban Habitat

Council on Tall Buildings and Urban Habitat

S.R. Crown Hall
Illinois Institute of Technology
3360 South State Street
Chicago, IL, 60616

Phone: +1 (312) 567 3487
Fax: +1 (312) 567 3820
Email: info@ctbuh.org
http://www.ctbuh.org

ISSN: 1946 - 1186