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Authors: John Lahey, Chairman, Solomon Cordwell Buenz
Martin Wolf, Senior Principal, Solomon Cordwell Buenz
Ron Klemencic, President, Magnusson Klemencic Associates
Ola Johansson, Principal, Magnusson Klemencic Associates

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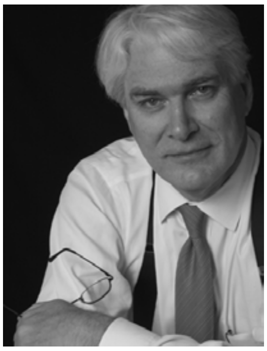
A Tale of Two Cities: Collaborative Innovations for Sustainable Towers

John Lahey, AIA[1], Martin Wolf, FAIA[2], Ron Klemencic, P.E., S.E.[3] and Ola Johansson, P.E.[4]

[1]Chairman - Solomon Cordwell Buenz, [2]Senior Principal - Solomon Cordwell Buenz
625 North Michigan Avenue, Suite 800, Chicago, Illinois 60611
[3]President – Magnusson Klemencic Associates, [4]Principal – Magnusson Klemencic Associates
1301 Fifth Avenue, Suite 3200, Seattle, Washington 98101



john.lahey@scb.com

rklemencic@mka.com

John Lahey

John Lahey, AIA, is Chairman of Solomon Cordwell Buenz (SCB), leads corporate operations and firm-wide management for SCB offices in Chicago and San Francisco. As a Principal-in-Charge of Design, he oversees the design of many of the firm's residential, office, institutional, hospitality and academic projects.

Lahey is recognized as one of the country's leading experts on residential high-rise and urban mixed-use buildings. Believing that tall towers are a sustainable solution to urban density, John's designs have been catalysts for the resurgence of livability in the American city. Since joining SCB in 1982, he has completed multiple projects across the country, including over 20,000 residential units and over 6 million square feet of corporate office development. Recent projects include the 72-story mixed-use condominium tower, The Legacy at Millennium Park in Chicago; the twin 55-story and 45-story,One Rincon Hill residential complex in San Francisco and the 57-story Heritage at Millennium Park mixed-use complex in Chicago.

Ron Klemencic

Ron Klemencic, P.E., S.E., is President of Magnusson Klemencic Associates, an award-winning structural and civil engineering firm headquartered in Seattle, Washington. Ron earned his bachelor's degree in civil engineering from Purdue University in 1985 and his master's degree in structural engineering from University of California at Berkeley in 1986. He came to MKA in 1992 and was named President just six years later.

Over his 20-year career, Ron has acquired a reputation among developers, architects, and contractors alike as an "idea guy," with creative engineering solutions, value-added innovations, and an innate ability to see the big picture. Although extremely busy in his capacity as President, Ron has served as active Principal-in-Charge for $4.8 billion worth of projects in the last 5 years alone. The effects of his involvement can be seen in the success of a number of high-rise projects worldwide, including the 73-story Highcliff Apartments on a cliff's edge in Hong Kong; the 45- and 57-story residential towers of One Rincon Hill in seismically active San Francisco; and the newly completed 51-story 111 South Wacker office tower in Chicago. Ron's projects can be found in 16 states and 14 countries.

Ron is very involved in the industry, giving presentations and lectures almost monthly around the country – and world. He is an active member of the Structural Engineers Associations of Washington and Illinois; the American Concrete Institute; Urban Land Institute; and Young President's Organization; and he is a former 5-year Chairman of the Council on Tall Buildings and Urban Habitat. His accomplishments with CTBUH include organizing seven national or international conferences (including the 7th World Congress in New York), declaring Taipei 101 in Taiwan the "Tallest Building" in the world, and commenting on tall buildings to dozens of news media around the world.

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Abstract

Tall residential buildings are integral to the establishment and maintenance of sustainable cities. The increased density these buildings offer is key to ending inefficient and environmentally counterproductive urban sprawl.

Policies in a number of American cities encourage increased residential density and height, as well as new standards for sustainability. However, creative and sensitive responses to the design, engineering, and cost challenges posed by this complex building type are critical to its long-term acceptance and success.

Two recent collaborations by Solomon Cordwell Buenz and Magnusson Klemencic Associates are examples of a collaborative multi-disciplined design approach allowing architect, engineer, and contractor to pioneer technology balancing maximum occupant comfort, sustainability, and the building's economic viability.

In Chicago, 340 on the Park is the city's first and tallest all-residential tower to achieved LEED Silver certification. In San Francisco, One Rincon Hill is establishing new height standards for residential buildings and raising green standards in the Bay Area. Both projects present architectural and engineering innovations that meet the demands of their unique sites and project goals. Moreover, they exemplify the important role of a multi-disciplined design approach to successfully shape urban public policies encouraging density and sustainability.

Keywords: high-rise, residential, LEED, sustainable, performance-based design

Density and Sustainability

In the debate over the potential successes or failures of tall buildings as a sustainable solution, livability is a defining issue. The United Nations predicts the world's urban population is set to double in the next 50 years, leading many to conclude the quality of life within an urban density is central to the responsible use of the world's resources (Source: United Nations Population Information Network Cities and Urbanization World Urbanization Prospects).

As illustrated in Table 1, myriad statistics support that dense cities are more sustainable than sprawl. For example:

- population density increases the efficiency of utility distribution and consumption
- energy use per capita in a single family home is 2.0 to 2.5 times that of a high-density, multi-family high-rise
- negative impacts on air and water quality are reduced in urban centers because of increased reliance on mass transit, as well as reduced travel distances between home and work

Table 1. Statistical arguments for density (Source: International Association of Public Transport)

	Population density/ hectare	% journeys by foot, bike, mass transit	Cost of journey/ % GDP
U.S./Canada	18	15%	12.7%
W. Europe	55	52%	8.3%
Japan/ Hong Kong/ Singapore	134	62%	5.4%

Decline of Cities

In the post World War II building boom, the promise of space and a white-picket fence were very much part of the American dream. Suburbanization in the United States was a result of public policy decisions and initiatives that made life outside the city more accessible and affordable for the everyman. As a result, the typical landscape changed forever (see Figure 1).

Figure 1. Typical suburban residential development (photo courtesy SCB)

Stateside, the connections between public policy and sprawl were instituted through such programs as those that funded the construction of interstate highways, subsidized the automobile industry, and resulted in so-called Federal Housing Authority's White Flight. In the 20 years between 1960 and 1980, as the population spread out from the city, there came sprawl, gridlock, and – within our cities – poverty, decay, and unrest. Some examples include the Watts Riots in 1965 and the New York City garbage strikes in 1975.

Re-Urbanization of America

Since the mid-1990s, there has been a resurgence of interest in urban living, resulting in a revitalization of many of our cities. The flow of people moving back into the center from the suburbs is motivated, in part, by recognition of the advantages of city life: easier access to culture, entertainment, and recreation; convenience; diversity; and social interaction. Governments are increasingly supporting policies like Tax Increment Financing Zones to stimulate economic development in blighted urban neighborhoods.

This is where opportunity waits. While density delivers clear benefits, good design is what creates the environments that attract people to tall buildings. An architect's job is to promote a sense of place that is responsive to human scale, applying designs to create livable and sustainable density.

Working in close collaboration with building partners has allowed the authors of this paper to move beyond the theories of sustainability and successfully execute and advance the interpretation of tall residential towers. Two such projects are 340 on the Park in Chicago and One Rincon Hill in San Francisco.

340 on the Park

Chicago has a long and rich history with building residential high-rises, so with 340 on the Park (see Figure 2), tall was always the desired solution. Respecting the city's commitment to building green, this project was an excellent opportunity to enhance the quality of urban life, incorporate sustainable technology, and make a statement about living in the modern age.

Figure 2. Aerial view of site, with the finished building right of center (photo courtesy SCB)

At 62 stories, 340 on the Park is the tallest all-residential tower in Chicago, and the first in the Midwestern United States to meet Leadership in Energy and Environmental Design (LEED) Silver certification requirements. As such, 340 on the Park has sustainable standards that include an efficient, unitized curtain wall; green roofs; and sophisticated management systems – all features that allow the building to operate using 10 percent less source energy than a conventionally designed building of the same size. More on its sustainable characteristics will be discussed later.

Figure 3. Overview of Grant Park and Lakeshore East site (rendering courtesy Magellan Development)

While 340 on the Park pioneered green design for a structure of its type, size, and scale, it was the building's spectacular setting that gave it its form: a prominent site at the north end of Grant Park in the heart of Chicago's cultural center (see Figure 3). This building (itself featuring 347 units on 61 floors) is part of a 28-acre development of former rail yards that calls for a total of 16 residential high rises totaling more than 5,000 units.

Capitalizing on views overlooking the parks, Lake Michigan, and the city, the architects of 340 on the Park envisioned a predominantly glass tower. The building has a distinctive, prow-shaped profile oriented for optimal sightlines in all directions, with special emphasis toward the lake.

Glass is the key element giving character to the exterior form. Planes of floor-to-ceiling glass are combined with a framework of metal panels to create a deep matrix of space, within which are positioned arrays of balconies on the south and north façades (see Figures 4 and 5). For the north façade, a lyrical curve offers views of the Lake Michigan shoreline to the north and northeast. Balconies are carved into the mass of the curved surface, and a serrated plan further enhances the lake views.

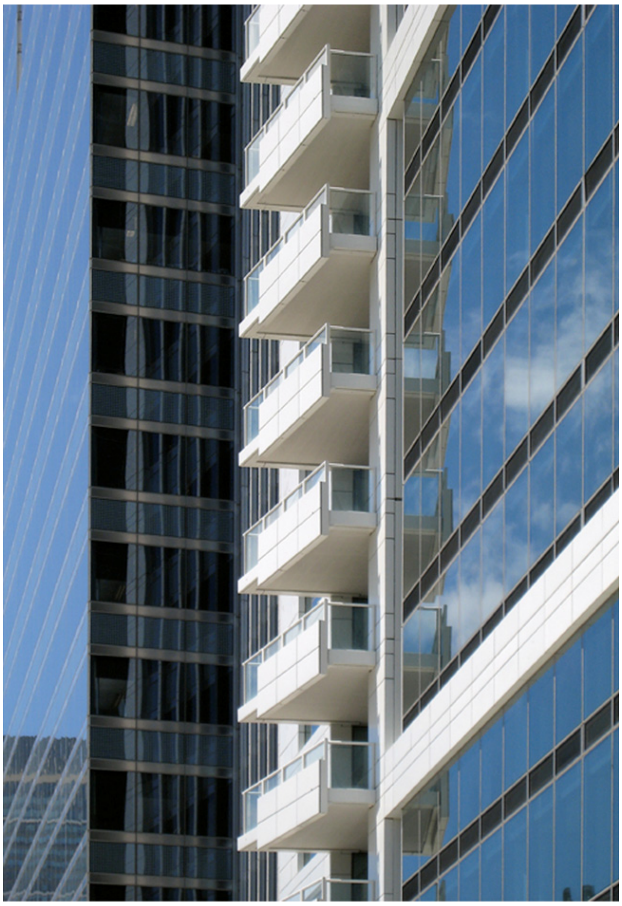

Figure 4. South façade (photo courtesy SCB)

Figure 5. North façade (photo courtesy SCB)

A winter garden on the 25th floor serves as a light-filled common area for all building residents and is flanked to the south by an outdoor terrace overlooking the city and lake below. This two-story interior garden opens through 14-foot-tall glass doors to the exterior space, allowing residents open air and the spectacular vista to the south. Other common amenities on the floor include a fitness room, a two-lane lap pool and a lounge, all treated as a suite of open spaces sharing a common 20-foot ceiling (see Figure 6).

Figure 6. Winter garden (photo courtesy SCB)

At ground level, the design of the tower features an undulating glass envelope, which encloses the lobby and celebrates views to the street, offering a graceful transition between the entry space and the spectacular outdoor setting (see Figure 7).

Figure 7. Building lobby (photo courtesy SCB)

Achieving LEED Silver

From the outset of this project, which began in 2002, the developer – Related Midwest – desired a building that would be the most environmentally conscious of its peers. Research showed that while building green has the potential to add to the cost of design and construction, there is an interest and appetite in the marketplace for such buildings that appeal to an intellectual commitment to be green, while costing less to operate. Throughout the design process, the architects were conscious of opportunities to apply sustainable standards.

The most significant of these features include an exterior curtain-wall system of low-E tinted glass and aluminum panels in a thermally broken aluminum frame to minimize energy transference in or out of the building, thus reducing energy consumption. The thermal properties of the enclosure system, plus efficient and sophisticated mechanical systems, allow the building to use 10 percent less source energy than a building designed to conventional design standards – enough to provide energy for another sixty 2,000-square-foot homes.

The building features two green roofs: a highly reflective, light-colored roof at the top, and a highly landscaped second-floor roof that absorbs rainwater for irrigation. Rainwater is also captured and held in an 11,000-gallon capacity storage tank under a ramp in the garage to further supply the drip irrigation system.

The green roofs both minimize "heat island" effect (an advantage for the building occupants) while reducing the storm water entering the City of Chicago's water processing system (an advantage for the City).

Throughout construction, the ventilation system, duct materials, air handling units, and fan coil systems were rigorously protected to minimize dust inside the completed building. Air filters were replaced upon completion of the units.

Exactly 82 percent of construction waste on this site was recycled, meaning more than 2,800 tons of waste was saved from landfill – enough to fill about 300 Chicago garbage trucks. Additionally, 27 percent of the building products were produced locally within a 500-mile radius.

The building also includes innovations outside the LEED program that increase its green appeal. Using chilled water delivered through pipes from a district cooling system provides 340 on the Park with more efficient air conditioning than an on-site chilled water plant could provide. This district cooling system has allowed the building to avoid the cost and aesthetic of incorporating cooling towers and a chiller plant.

Other sustainable elements of the project include:

- **Sophisticated Systems** Mechanical management systems operate according to demand load, with sensors that tell exhaust fans and replacement air systems when to operate so they don't operate continuously and waste energy
- **Indoor Air Quality** The ventilation systems and unit design and construction minimize transfer of odor from one unit to another
- **Low-VOC Products** Materials low in volatile organic compounds were used in the interiors of the building to promote better indoor air quality
- **Project Site Cleanliness** The project site was kept clean to ensure better air quality in the completed building; there was no standing water, and trash was disposed of regularly
- **Green Pest Control** Only products with low environmental impact were used
- **Renewable Flooring** Bamboo, which grows as much as a foot a day or more, was the selected flooring for all the residential living areas
- **Transportation Alternatives** The project includes a dedicated "I-GO" car, access to multiple modes of public transit (including buses and trains), and a plaza-level bike room accommodating 343 bicycles
- **Green Construction Practices** Recycled materials included:
  - 100% of concrete reinforcing steel
  - 90% of other miscellaneous metals
  - 99% of typical interior drywall
  - 48% of drywall used at perimeter walls

Architectural collaboration with the developer, engineer, and contractor partners made it possible to effectively incorporate these and other sustainable features and advance the design of this green tower.

Engineering Expertise

Supporting the striking architecture of 340 on the Park is a creative structural framing system that provides unobstructed views of the park and Lake Michigan while also maintaining a high degree of efficiency.

A Non-Typical Post-Tensioned Solution

While post-tensioned slabs are not a new technology, their historical use in Chicago's high-rise residential market has been limited. Their perceived construction cost premium and lack of skilled labor available for installation meant use of post-tensioned slabs was certainly the exception and not the rule in high-rise structural systems.

During the initial design stages of 340 on the Park, a post-tensioned slab system was compared to more traditional reinforcing schemes, and the merits of each were evaluated. Post-tensioned slabs offered the benefits of longer spans (up to 32 feet), allowing for greater flexibility in the design of the residential units. Greater spans also allowed for a more efficient parking layout in the garage beneath the tower's footprint. These factors swayed the design in favor of the post-tensioned slab option.

Prior to construction, significant effort was expended coordinating the plumbing and electrical trades to avoid conflicts between the post-tensioning cables and the required building services. This effort paid off, as the contractor was able to achieve a 3-day construction cycle for the typical high-rise floors. A typical floor is seen in Figure 8.

Another benefit of the post-tensioned slab design realized during construction was the reduced deflection of the typical floor slabs. A level floor is required in residential construction with higher-end floor finishes such as wood or stone. More traditional construction methods routinely require the addition of a significant amount of floor leveling compound after the initial frame is constructed to address common slab deflections. With a post-tensioned slab, the amount of leveling compound required is significantly reduced. At 658 feet, 340 on the Park is now the tallest post-tensioned building in North America.

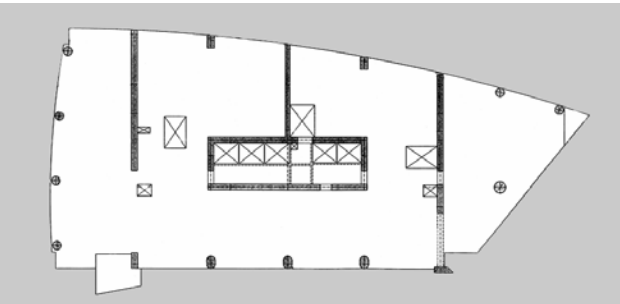

Figure 8. Typical floor plan (illustration courtesy MKA)

Bracing for the Wind with Outriggers

The wind bracing for the tower includes a combination of concrete shear walls arranged about the central core of the tower and a series of outrigger and belt walls strategically placed throughout the tower's height. Working closely with the architect, the structural engineers wove the outriggers and belt walls into locations with minimal architectural impact and maximum effectiveness (see Figure 9), including:

- The residential unit design just above the lobby level
- The mid-height mechanical and amenities level
- The mechanical and storage spaces at the top of the tower

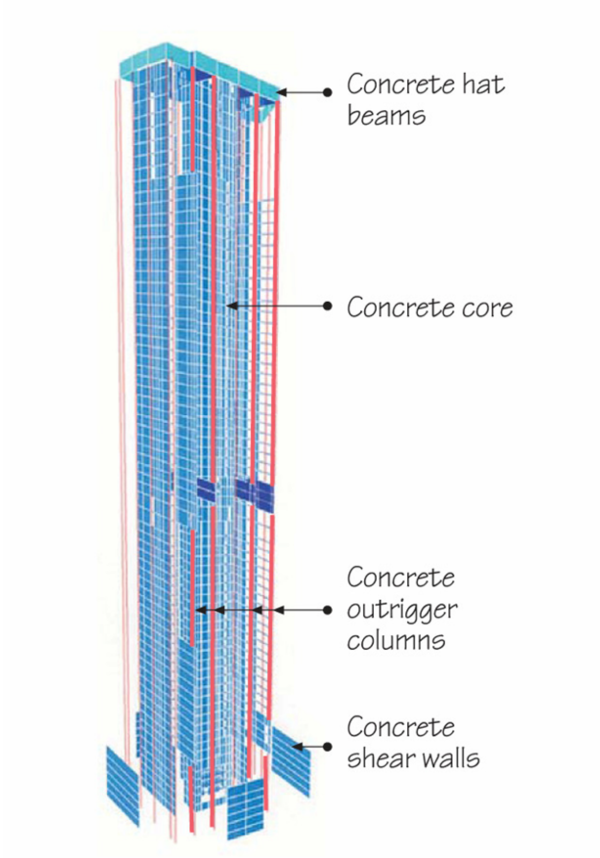

Figure 9. Isometric view of lateral system (illustration courtesy MKA)

The belt walls at the top of the tower also provide support for the exterior wall system. This approach to bracing minimizes structural encumbrances on the typical residential floors while maintaining an efficient distribution of stiffness to control the sway of the tower due to winds.

During initial design stages, many bracing schemes were considered. Marrying the overall building program, architectural expression, and required structural bracing was key to realizing the most economical outcome.

One Rincon Hill

In Chicago, the existing surrounding neighborhood for 340 on the Park had a precedent for tall buildings; however, in San Francisco, there are virtually no tall residential towers. The city had been slow to embrace this building form, partly for cultural inclinations, but also out of concern for the region's active seismic zones. When presented with the site for the Rincon Hill development, 100 feet above the city, the prospect of a tall tower reaching even higher seemed exceptional.

The Model

In 1964, the architects of One Rincon designed a project in Chicago that set the stage for the project (see Figure 10). Sandburg Village was an urban renewal project that created a successful residential community by utilizing a hybrid of low- and high-rise buildings around a series of communal plazas and small parks that worked to conceal parking and form a strong street edge. All of these principles were brought to bear in the design of One Rincon Hill.

Figure 10. Chicago's Sandburg Village (photo courtesy SCB)

The Site

One Rincon Hill's 1.3-acre L-shaped site was an underutilized parcel where the Bay Bridge connects to the peninsula, in the center of the emerging South of Market District. Formerly occupied by a three-story building, the site has great views of San Francisco Bay and the Bay Bridge to the south and east, and downtown to the north and west. The Bay Bridge lands on the brink of the hill with on-and-off ramps curling around the site (see Figure 11).

Figure 11. Aerial view of construction site (photo courtesy MKA)

The developer originally proposed two 35-story residential buildings, but city planners decided the site was ready for a taller solution (see Figure 12). The caveat was that height would need to be achieved at the expense of exceedingly small floor plates of less than 10,000 square feet. Work began on a phased development that, when completed, would include two tall, slender towers

Figure 12. Rincon Hill district master plan (rendering courtesy San Francisco Department of Planning)

Design Response

During design development for the first and tallest tower, the design team was sensitive to the reality that this building would be the most conspicuous addition to the city skyline in more than 30 years. Its location meant the first tower would stand alone – and stand out. Creating a memorable and suitable landmark for the primary entry to San Francisco was a significant concern. How to do it safely was the other issue.

Just as was the case with Chicago's 340 on the Park, from the outset of design for One Rincon Hill, the owner, architect, engineer, and contractor worked together. There was no other way to successfully meet the challenges of the required height and slenderness, the desire for floor to ceiling glass to maximize views and the need to develop and incorporate technology respecting the Bay Area's seismicity issues. This was an opportunity to apply new technology and pioneer high-rise residential design, and the design team needed all heads together to make it happen.

Some of the more notable attributes of the resulting building – many being innovations in structural engineering – include the following:

- Tallest residential structure on the west coast of the United States
- Tallest cast-in-place concrete building on the west coast of the United States
- Tallest performance-based design building in the United States
- First use of buckling restrained braces as outriggers in a high-rise building
- First use of a tuned liquid mass damper for occupant comfort in the United States

With these advancements, this highly visible project has taken the form of two structurally unique towers providing 695 condominiums and 14 townhouses (see Figure 13). The towers are 55 stories and 45 stories respectively, with floor plates around 9,800 gross square feet and additional setbacks at the top to 8,400 gross square feet.

Figure 13. One Rincon Hill (rendering courtesy SCB)

Varying heights positioned in diagonally opposite quadrants of the site preserve views and create compositional interest, with Tower One emphasizing the crest of the hill. Two- and three-story townhouses envelop the podium on three sides, preserving street level vitality. For a city of neighborhoods – and one highly suspicious of the potential of high rises to contribute to the community vibe – the building's relationship to the street was paramount. At the same time, the architects were able to maximize the center of the podium as space for the majority of the parking volume, with the remainder below ground. The parking count is 1:1, but the design reduced the total parking area by nearly 40 percent by placing the bulk of Tower Two's parking on lifts.

Sustainable Elements

While achieving LEED certification was not a stated priority, the Energy Code for the city of San Francisco is one of the most restrictive in the nation. As a result, One Rincon Hill achieves sustainable status, due in part to its small footprint, well-insulated envelope, low-E glazing, and high efficient cooling and heating equipment.

Another unique feature of the building are the operable sashes located at the inboard surface of the curtain wall, allowing windows to open and augmenting the efficient cooling and ventilation of the building, while still maintaining broad expanses of glass and view.

The top of the podium is landscaped with expansive reflecting pools, plantings, and decomposed granite terrace areas to help limit rainwater runoff while enhancing the residents' communal space.

Other sustainable elements in the project include:

- a smaller footprint overall which allows more daylight both inside the residential units and at street level
- a unitized curtain-wall system which features high-performance insulated glazing units with tinted glass and a low-E coating
- ride-share parking in the garage and bicycle parking in excess of what is required by code
- low VOC materials and furnishes
- a building heating plant which utilizes 87% efficient boilers for space heating and domestic hot water use

The result of these efforts and other sustainable elements is a stunning building that has reshaped the San Francisco skyline and pioneered technology that is advancing tall building design. It is establishing new height standards for residential buildings in the Bay area, and leading the city's efforts to transform the entire Rincon Hill district into a mixed-use downtown neighborhood with housing potential for as many as 10,000 new residents.

Pioneering Engineering

As this project was to be developed in phases, it was critical for the architects that the design minimize structural encumbrances in order to maintain flexibility for unit planning. Meeting these goals in a 625-foot-tall tower approximately 7 miles from the San Andreas Fault in a city with a history of disastrous earthquakes demanded a high level of safety. With construction to begin in 2006, the 100th anniversary of the most famous earthquake recorded in the United States, it seemed as if all eyes were watching how the design would unfold.

A New Structural Design Approach

In regions of high seismicity, the prescriptive language of the Uniform Building Code (UBC) identifies only two structural systems allowed for buildings taller than 240 feet: moment frames and dual systems. Moment frames, traditionally at a building's perimeter, include very large beams and columns, which can significantly encumber views, limit balconies, and create obstacles for unit planning. For tall buildings, relatively flexible moment frames are not an efficient way to provide the required stiffness and strength.

Dual systems offer a more effective means to provide the stiffness required for a tall building by including a stiff, central core of concrete or steel. However, as illustrated in Figure 14, the encumbrances of the perimeter moment frame remain.

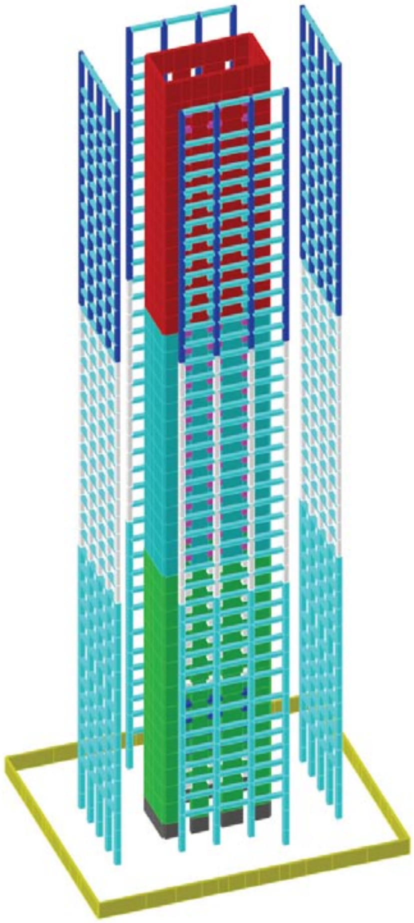

Figure 14. A traditional dual lateral system (image courtesy MKA)

Noting that these traditional structural systems were directly at odds with the primary goals of the development, a new approach to structural design was required. Starting with a blank sheet of paper, the design team developed a building geometry which responds directly to maximizing views, maintaining unit-planning flexibility, and minimizing structural encumbrances. The resulting structural system comprises a strong, stiff central core surrounding the elevators, stairs, and service areas of the tower, with 8-inch-thick post-tensioned concrete flat slabs extending to the perimeter of the building, creating the desired flexibility for unit planning (see Figure 15).

The stiff, central concrete core is too slender to support the tower by itself, so additional bracing in the form of outriggers were added to the design. The location of the outriggers in the height of the tower was determined considering the mix of residential units desired by the developer. Unique residential units were designed by the architect on the floors where the outriggers were placed to minimize their impact. Residential units above and below the outriggers maintained a common design.

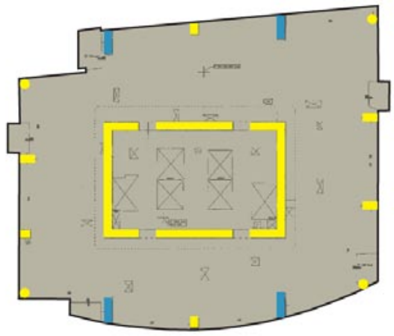

Figure 15. Typical floor plan (image courtesy MKA)

The outriggers took the form of "K" bracing at Levels 28 to 32 and Levels 51 to 54. The braces themselves are comprised of buckling restrained braces (BRBs) and were selected due to their predictable and reliable behavior when subjected to significant earthquake demands. One Rincon Hill's innovative lateral system can be seen in Figure 16.

With the desired geometry established, a design methodology and appropriate design criteria were required. Performance-based design (PBD), where specific performance objectives are established for various levels of demand, provided an obvious framework for the design to proceed. Specifically, three levels of seismic ground motion were considered, along with three levels of building performance. Frequently occurring earthquakes (approximately once every 50 years) will result in little, if any, damage to the building. Rare earthquakes (occurring approximately once every 500 years) will result in some structural damage that will likely require repair. Very rare earthquakes (occurring approximately once every 1,000 years) will result in significant structural damage, but the building will remain safe from collapse.

Considering each of these events, quantifiable structural performance criteria were established against which the structural design could be tested through computer simulation. For the minor and moderate seismic events, traditional analysis tools allowed a relatively simple assessment of the design. For the very rare earthquake, a series of seven different computer simulations was performed considering different earthquake ground motions.

Sophisticated nonlinear time history analysis was conducted for each of the seven earthquake ground motions, and the results of the simulations were compared against the performance criteria to ensure the design met the desired level of safety. The analysis tools used to conduct these simulations have become commercially viable only in the last several years. The result of this sophisticated and rigorous approach to the structural engineering is a safe, reliable design which meets the goals of the development.

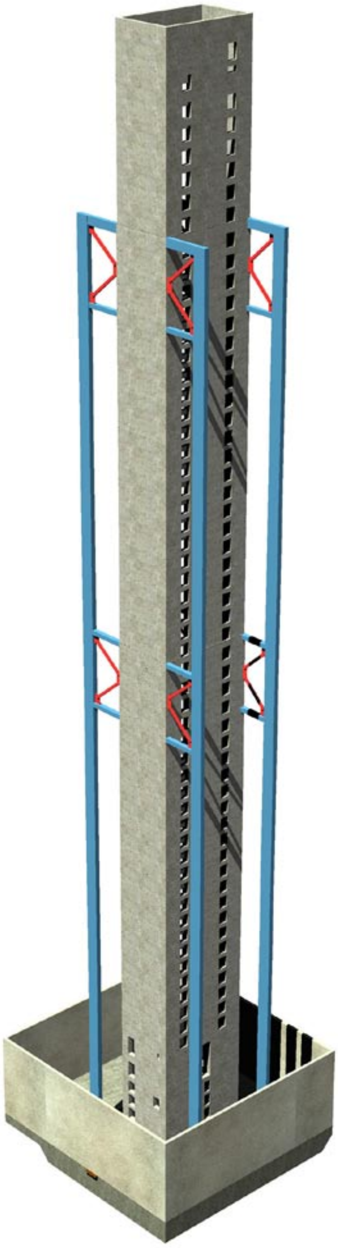

Figure 16. Innovative lateral system solution (image courtesy MKA)

Taming the Wind

With the project in San Francisco, most of the structural engineering effort was focused on the seismic design. For most buildings, especially relatively heavy concrete buildings, wind is only a secondary consideration. However, given this project's extreme exposure, perched on top of a hill with no buildings to shield the winds from any direction and San Francisco Bay less than 1 mile away, the response of the tower to wind proved particularly critical. The curved western façade of the tower channels the wind flow around the building similar to the flow of air over an airplane wing, creating the equivalent of "lift" in the building and causing its sway to increase.

The results of a detailed wind tunnel study revealed a significant cross-wind response (sway) of the tower driven by vortex shedding of the wind.

Occupant comfort in high winds became an additional focus of the structural design. With the location, shape, and orientation of the tower already established, the need to manage the tower's response to high winds suggested the introduction of a structural damping system. Damping systems work similar to shock absorbers in cars, i.e., the damping system "absorbs" the energy of the wind and reduces the movement of the building.

While several systems were considered, a tuned liquid mass damper (TLMD; see Figure 17), was selected as the best choice for the project. Advantages of TLMDs include of ease of construction, no requirement for permanent power, and the ability to "tune" the damper to the building's actual measured response.

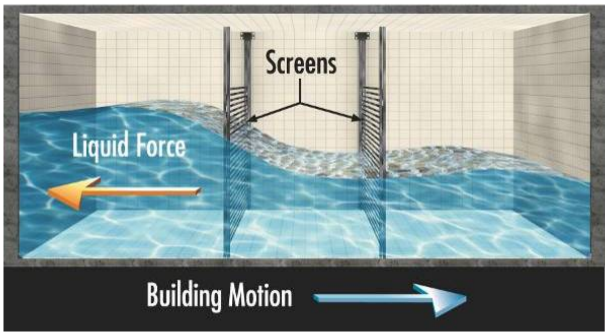

Figure 17. Tuned liquid mass damper (illustration courtesy MKA)

The final design of One Rincon's TLMD includes four water tanks on the roof of the building holding a total of 45,000 gallons of water. In order to tune the performance of the TLMDs, a series of accelerometers were installed in the tower during construction to monitor the response of the building. Response data have been collected and will be used to tune the final depth of water in the tanks. After the tanks have been filled to the specified depth, the building's performance will be verified.

The Road Ahead

One Rincon Hill has paved the way for structural engineers to pursue a new avenue of thinking. Gone are the days of simply applying the provisions of the building code to the design of tall buildings. There is clear recognition by the engineering community that current building code provisions may not be appropriate for every building. In particular, the unique response of tall buildings to wind and earthquake demands requires a more rigorous approach. With this increased rigor comes the benefit of architectural freedom. New building forms with challenging and unique geometries are now possible in regions of high seismicity.

Several professional organizations, including the Structural Engineers Association of Northern California, the Los Angeles Tall Buildings Structural Design Council (LATBSDC), the San Francisco Department of Building Inspection (SFDBI), the Los Angeles Building Department, and the Pacific Earthquake Engineering Research Center, have invested significant effort toward creating a consistent framework within which structural engineers can practice outside the prescriptive language of the building code. SFDBI and LATBSDC have both recently published guidelines for structural engineers to follow for the non-prescriptive design of tall buildings. These documents are a direct result of the groundbreaking work done on the One Rincon Hill project.

A new breed of buildings is now possible in regions of high seismicity. The hands of the architects and structural engineers have been untied. Exciting new building forms, which will identify the signature skylines of the future, are now possible.

Conclusion

Both 340 on the Park in Chicago and One Rincon Hill in San Francisco bring high-quality residential design to urban centers in the form of sustainable, inventive, and elegant buildings.

340 on the Park has been welcomed in a city where architectural tradition embraces invention and high-rise residential design.

One Rincon Hill is opening a new chapter in San Francisco's building tradition, where high-rise residential projects are testing new water with cutting-edge technology and a novel approach to building codes.

It can be wholeheartedly concluded that the design approach used on these projects – involving collaboration among design team members, ownership, and city officials, as well as a common desire to bring about something new – is at the forefront of best practice.