St. Regis Hotel & Residences—A Vibrant Gem in San Francisco's Fine Arts Center

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In San Francisco, the mixed-use St. Regis tower rises 42 stories in one of California's most prestigious urban real estate venues. The St. Regis is home to an elegant five-star hotel, luxury condominiums, and the new Museum for the African Diaspora. With distinctive geometries and multitextured, multicolored, precast concrete skin, this graceful tower was completed in 2005 and offers four levels of subterranean parking with a total enclosed area of 677,658 ft² (62,954 m²). In this article, the authors discuss the design solution, the unusual and challenging aspects of producing and erecting the precast concrete and glass skin that cloaks the tower, and the integration of a historic 1907 building for this important San Francisco landmark structure. The details of creating multiple colors, textures, and intermeshed planes for the precast, preglazed concrete wall panels are revealed; in particular, the authors articulate the development of the "woven-cloth" pattern and translucent appearance of this vibrant cultural center, now the tallest reinforced concrete structure in the United States in Seismic Zone 4.

On one of the most prestigious national urban sites and located on the last remaining property offered for development by San Francisco's Yerba Buena Redevelopment Project Area in California, the St. Regis Hotel & Residences rises 480 ft (150 m) in the midst of a bustling, world-renowned cultural center (**Fig. 1**). Located on the corner of Third and Mission Streets, the St. Regis is adja-

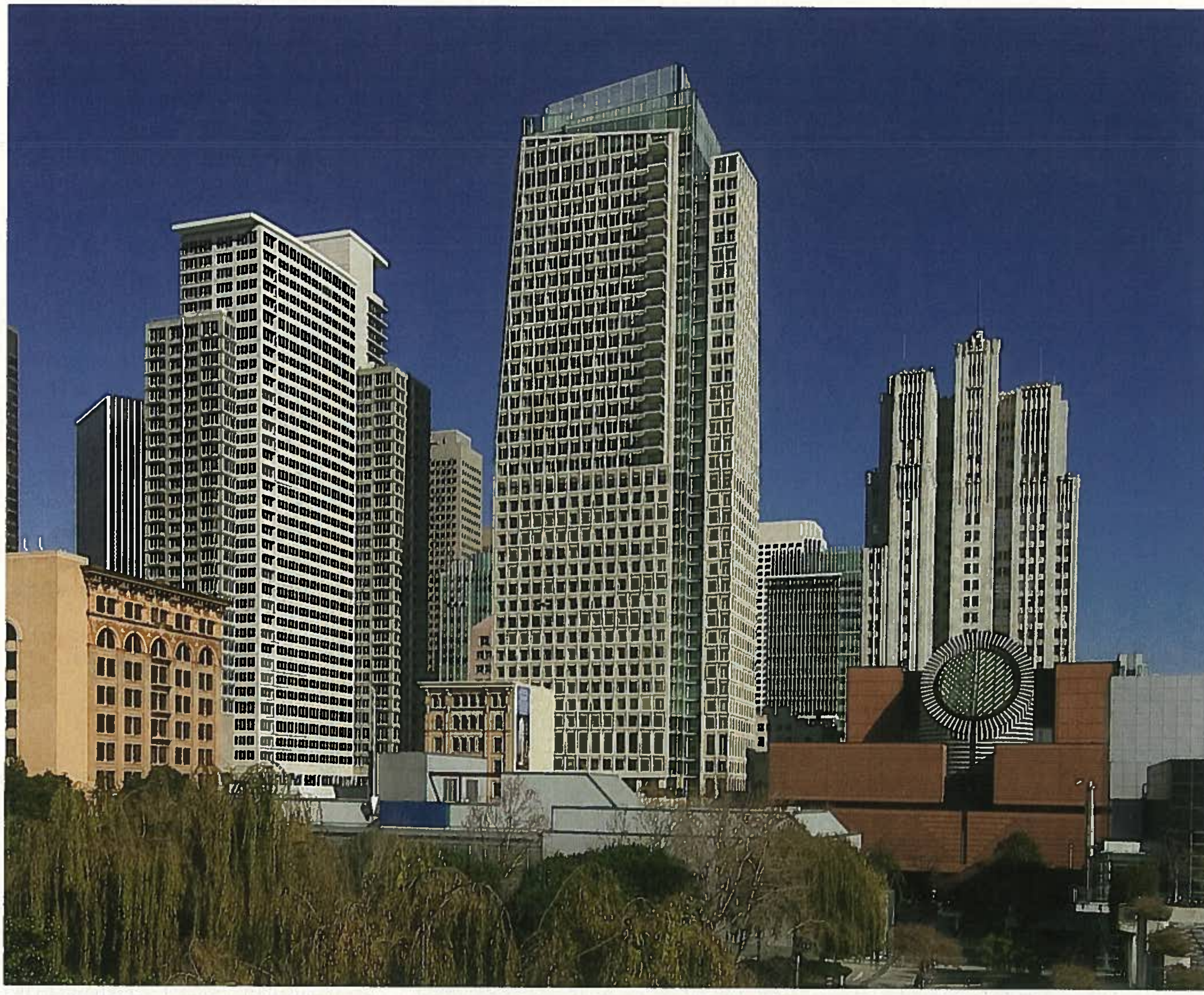


Fig. 1. The St. Regis Hotel & Residences graces the skyline and complements the rich cultural and physical context of the city's fine arts redevelopment area, a site that includes numerous museums, cultural centers, outdoor gardens, and public parks in San Francisco, Calif.

cent to the city's distinctive Museum of Modern Art, directly across the street from the new Center for the Arts and civic park, and catercorner to the proposed Contemporary Jewish Museum designed by Daniel Liebeskind, and the new Mexican Museum by architect Ricardo Legoretta.

Home to a 260-room five-star hotel, the mixed-use tower stands 42 stories above grade, offering over 100 luxury condominiums and the new 20,000 ft^2 (1900 m^2) Museum for the African Diaspora. The first 20 floors are occupied by the hotel, the 21st floor houses the mechanical systems, and the upper floors feature luxury residences and additional mechanical spaces. There are four below-grade parking levels. Altogether, the structure supports a total of 775,650 ft^2 (72,000 m^2) of usable space, with 677,658 ft^2 (63,000 m^2) of that total comprising the enclosed spaces. St. Regis design work began in the fall of 1999 and the structure was completed in the summer of 2005 (**Table 1**).

Responding to the scale of the adjacent buildings, the carefully articulated massing of the St. Regis structure displays an intricate tapestry of a multitextured and multicolored precast concrete skin, or "cloak." With a surface character that continually changes throughout

Table 1. St. Regis Project Timeline from Design to Occupancy.

Start of design	Fall 1999
Onset of construction	Summer 2000
Design complete	Summer 2002
Start of precast concrete manufacturing	March 2002 to March 2003
Precast concrete erection	October 2002 to June 2003
Completion date	Summer 2005
Occupancy date for hotel	July 2005
Occupancy date for condominiums	September 2005

the day in San Francisco's bright sunlight, this inspired design allows for an effective use of reinforced architectural precast concrete exterior cladding. The tower is currently the tallest concrete structure in the United States built in the Uniform Building Code's (UBC) Seismic Zone 4.

URBAN DESIGN CHALLENGES

The urban parcel for the tower site represented an unconventional, and therefore challenging, shape for a number of reasons. First, an existing historic 1907 building occupies the northwest corner of the site, demanding innovative design and construction strategies for integrating this century-old structure to create a compelling and gracious entry for the St. Regis project. (See "Integrating the Historic 1907 Williams Building".) Second, because the neighborhood's street grid is rotated 38 degrees from the adjacent older city grid, the view corridor generates a diagonal axis through the St. Regis tower site (**Fig. 2, 3**).

The overriding architectural and urban planning project objectives were to accomplish the following:

- Respect the vibrant cultural and physical context of San Francisco's fine arts redevelopment district, environs that offer numerous museums, cultural centers, outdoor gardens, and places of public assembly;
- Gracefully integrate the site's existing 1907 historical building;
- Meet height restrictions negotiated with the city (434 ft [130 m] to the top of the last occupied floor and 480 ft [150 m] to the highest structural element) while maximizing the amount of program space; and
- Find and balance the synergies among spatial character and functional requirements for the three distinct program elements—five-star hotel, luxury condominiums, and cultural museum—while developing and enhancing the singularity and continuity of the St. Regis tower as a whole.

CRITICAL DESIGN SOLUTIONS

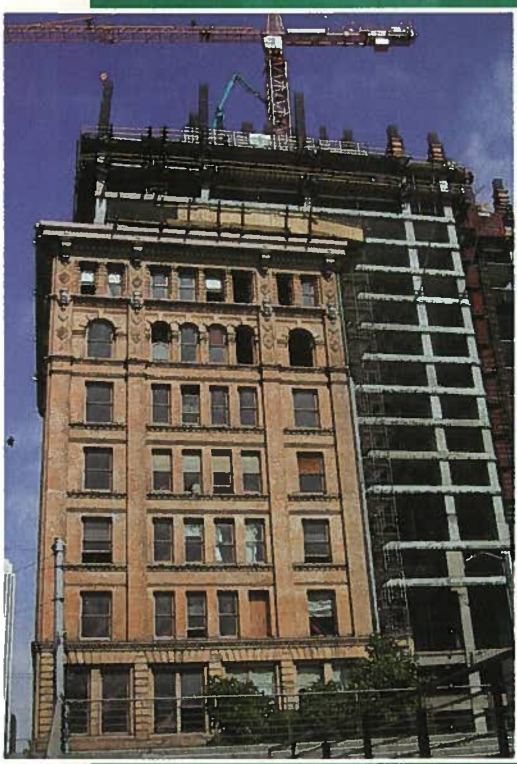
Site Conditions

Placing the St. Regis Hotel & Residences on the site was the first challenge facing designers from Skidmore, Owings & Merrill LLP of San Francisco. As the tower ascends skyward, the structure's elevation profile is set back in varying amounts to allow the lower elements of the project to respond to the height and scale of adjacent buildings; this scaled geometry opens up views between tall buildings back to the city. The overall form of the tower uses the different materials of the architectural precast concrete and glass cladding materials to effectively modulate views toward and from the tower in response to the rotated city-grid view corridors. This creates opportunities for vistas of the nearby San Francisco Bay and coastal hills from inside the southern portions of the tower.

The presence of the 1907 Williams Building on the most prominent urban corner of the tower site presented the opportunity to arrange entry and exit on the quieter, more serene southern-facing side street (**Fig. 4**). This informed approach to pedestrian and vehicular access captures and enriches the space of the side street between the project and the adjacent Museum of Modern Art, creating an intimate indoor-outdoor room.

INTEGRATING THE HISTORIC 1907 WILLIAMS BUILDING

Integration of the historic Williams Building into the new St. Regis Hotel & Residences presented an unusual design challenge for Skidmore, Owings & Merrill's (SOM) architects and engineers. Built in 1907, the eight-story Williams Building was built with a space frame, one basement, and an unreinforced masonry exterior. Suffering significant damage during the Loma Prieta Earthquake of 1989, the building had been temporarily retrofitted with shearwalls and steel braces, the latter of which obstructed windows.



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The design solution goes well beyond the woven-textured, cream- and ochre-colored precast concrete panels that complement this structure in detail and warmth. To reduce the impact of seismic strengthening on the historic elements, SOM designed a structural system that uses the new tower to support the Williams Building. The retrofit consists of a skin of shotcrete on the masonry walls, retaining shearwalls (to the extent possible), a new mat foundation, and tying aligning floor diaphragms at the Williams Building to the floors of the new tower. Connecting the floors of the old and new structures allows the significantly stiffer tower to provide lateral support for this historic structure during a seismic event. Because the Williams Building is adjacent to the five-level-deep parking structure, underpinning on two sides and a complex excavation and shoring sequence were required to prevent settlement damage.

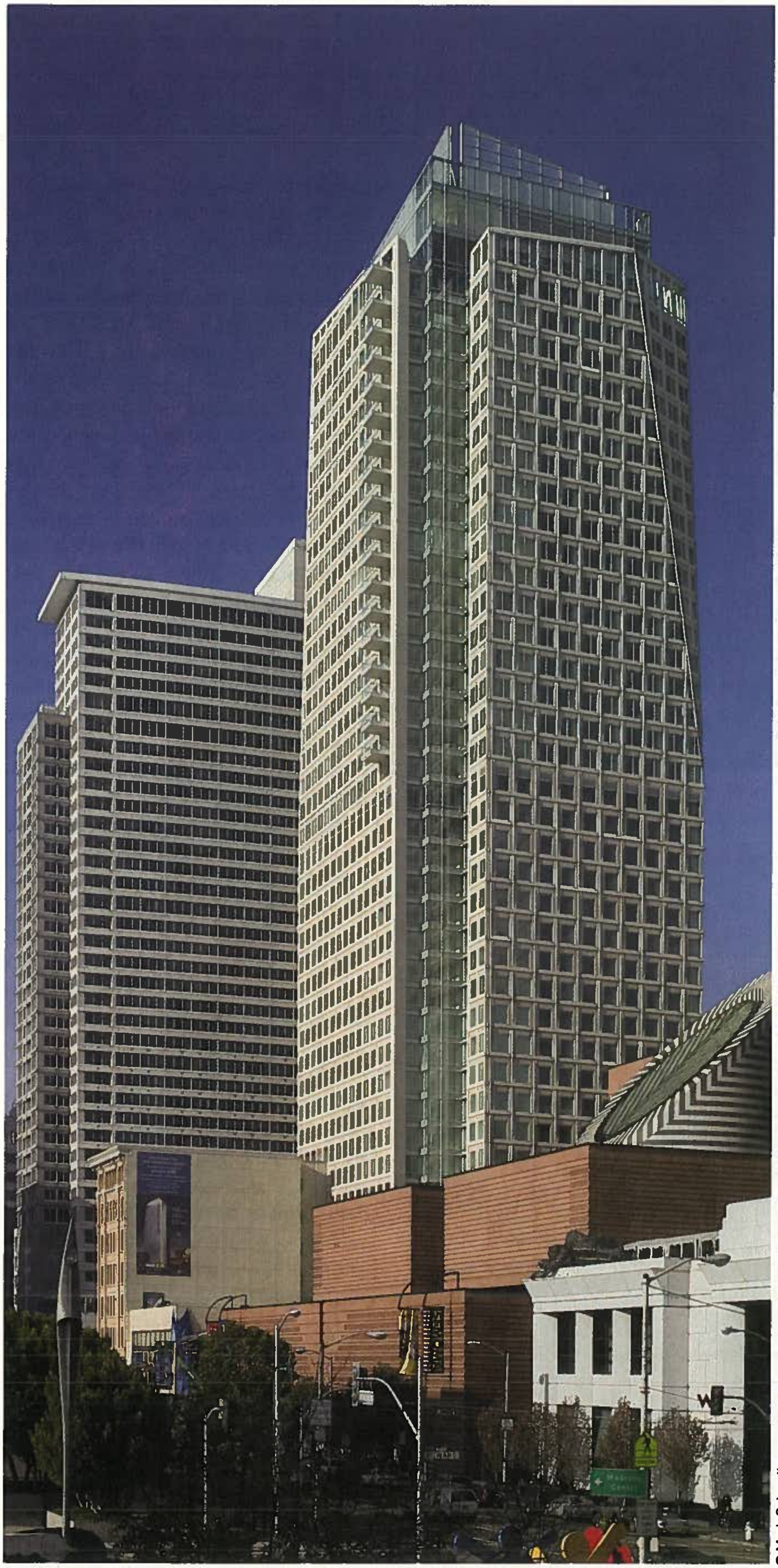

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Fig. 2. The chief planning objective for the design of the St. Regis Hotel & Residences focused on respecting the vibrant cultural center of San Francisco's Yerba Buena Redevelopment Project Area.

Multiple Initial Design Schemes

The architectural precast concrete exterior wall system for the tower uses advanced design and construction techniques to achieve the desired aesthetics and performance. The precast concrete cladding system integrates a completely prefabricated, unitized system that includes the glazing for the facades and supports for the exterior building maintenance operations and requirements (see "Chamfers Pose Unusual Challenges," p. 70).

Panel geometries were designed to create relief in the tower's facade, maximizing the possibilities of light and shadow while minimizing materials. Precast concrete sections were designed to minimize additional seismic mass of the superstructure while accommodating elastic and inelastic

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Fig. 3. The city's shifting grid pattern created a diagonal axis through the St. Regis Hotel & Residences site, allowing unexpected views of the structure.

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Fig. 4. The St. Regis Hotel & Residences is set back from adjacent streets, respecting the stature of the historic 1907 Williams Building, seen here at the lower left.

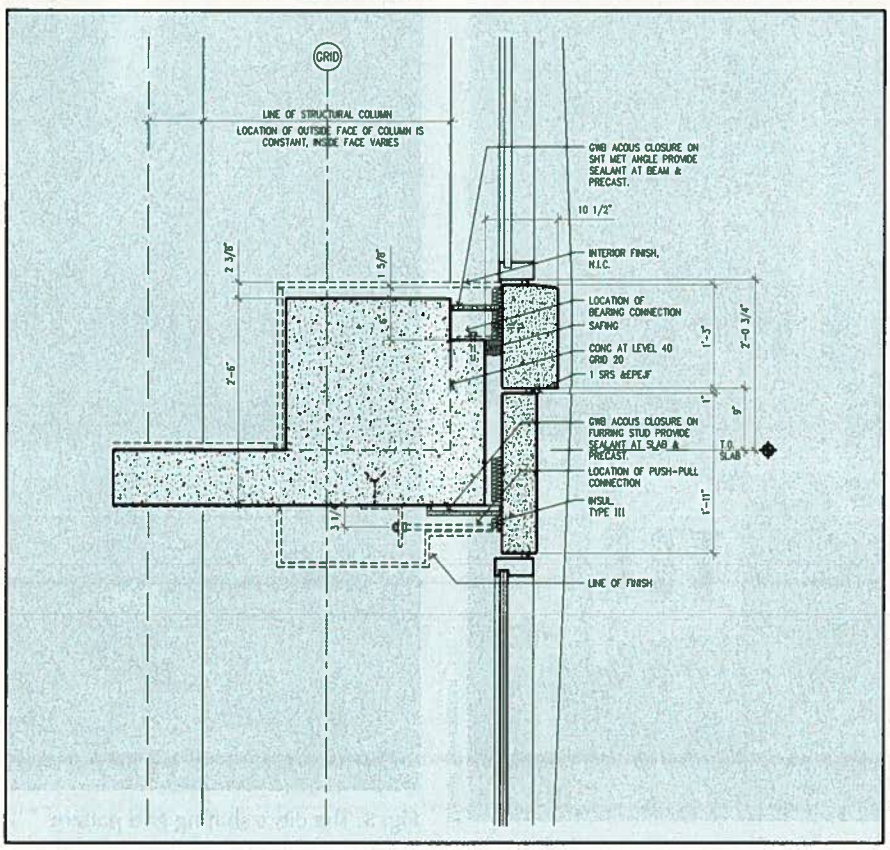

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Fig. 5. Drawing of typical precast concrete facade connection detail for the St. Regis Hotel & Residences. Note: 1 ft = 0.3048 m; 1 in. = 25.4 mm.

drift movements due to extreme seismic ground motion. By minimizing the additional seismic mass of the precast concrete elements, designers successfully reduced the load demands on base building's gravity and lateral systems, thereby reducing structural materials and total construction costs.

To achieve the central idea of a woven structural fabric with colored and textured "ribbon" elements, several primary design detail studies of the exterior wall system were performed early in the project. These studies focused on the shape and configuration of the precast concrete panels and the method of attachment to the structural frame. Selection of the architectural precast concrete material occurred very early in the design process due to the inherent ability of precast concrete fabrication methods to achieve the desired visual depth, produce the desired offsets for column cover/spandrel areas, and present opportunities for setting the glazed openings back from the outer plane of precast concrete wall through the use of a single, flexible construction material.

Initial design studies focused on the height and location of the window openings in the precast concrete walls relative to the location of floor and ceiling finishes for the hotel rooms and condominiums. Multiple structural frame schemes were studied and narrowed to two primary options: Use a more conventional concrete slab with beam below, and design a concrete slab with upturned beam. The upturned beam approach was selected to allow the perimeter beam to serve as a window seat and to allow a continuous ceiling plane to the window head and precast concrete wall opening—without resulting in a beam projection into the line of the ceiling plane.

This second approach also minimized the potential for architectural precast concrete anchorage interference with the post-tensioned concrete slab. Panel gravity connections were placed in the upturned concrete beam, allowing the post-tensioning forces to occur independently in the concrete slab and not transfer future forces to the precast concrete panels. The lateral precast concrete wall connectors, referred to as the "push-pull" type, were

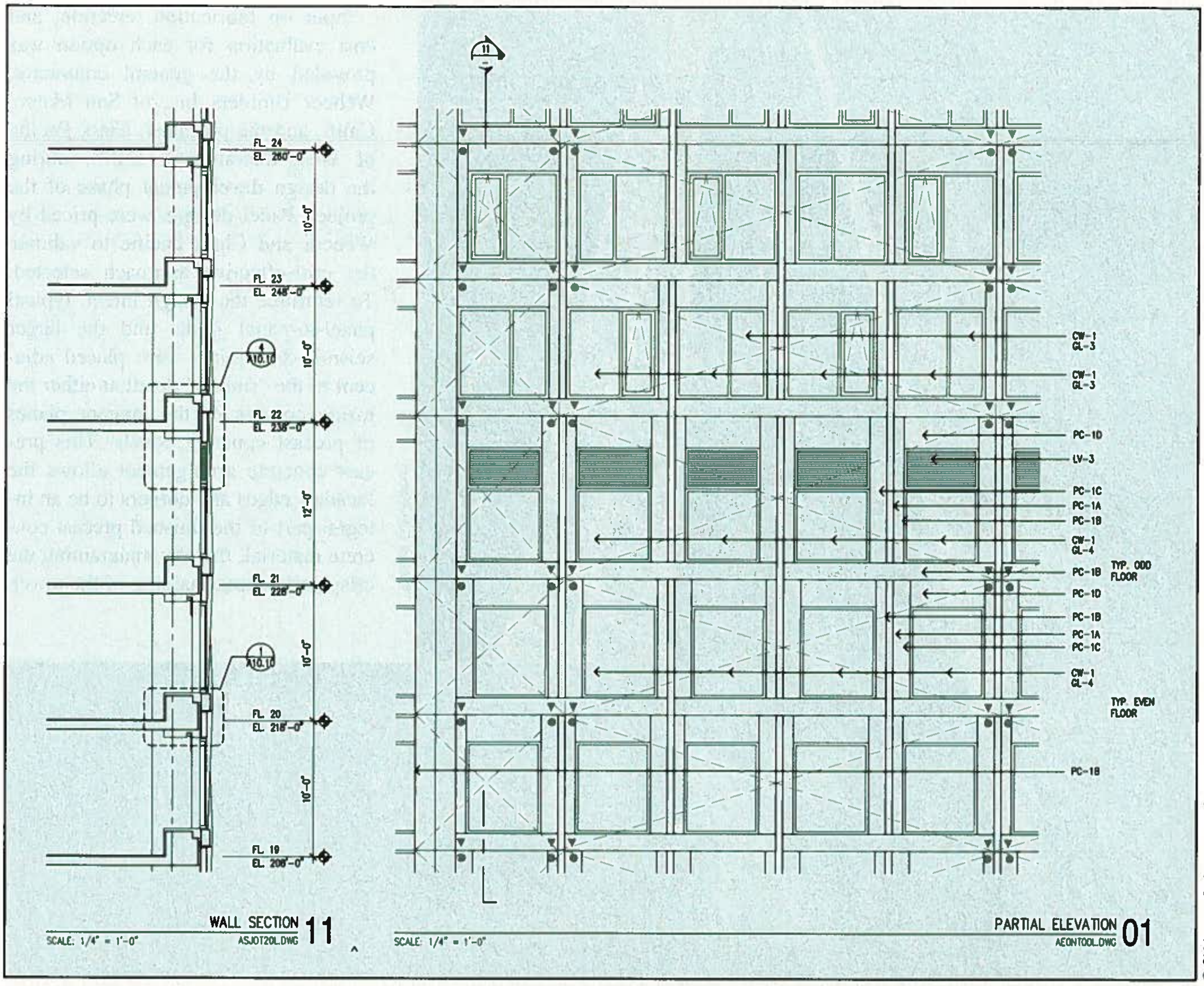

Fig. 6. Typical precast concrete facade wall section and elevation for the St. Regis Hotel & Residences. Note: 1 ft = 0.3048 m; 1 in. = 25.4 mm.

specified for the bottom of the slab, and the relatively thin profile of the selected attachment hardware facilitated the design of a continuous uninterrupted ceiling plane (**Fig. 5, 6**).

Multiple precast concrete panel configurations were studied and possibilities were narrowed during design development to two options. The first option offered a "punched-opening" panel where spandrel and column covers are cast together as a simple panel with window openings. The second option featured a precast concrete system with separate spandrels and column covers. The primary objective of this panel option investigation was to minimize the joinery size between precast concrete sections at all connection conditions, with specific focus on joinery at the precast concrete panel corners.

Fig. 7. Architectural precast concrete fulfills its structural metaphor as a "cloak" woven over the glass fenestrations and clear glass curtain wall on the St. Regis Hotel & Residences.

Input on fabrication, erection, and cost evaluation for each option was provided by the general contractor, Webcor Builders Inc. of San Mateo, Calif., and the precaster, Clark Pacific of West Sacramento, Calif., during the design development phase of the project. Panel designs were priced by Webcor and Clark Pacific to validate the cost-effective approach selected. To reinforce the design intent, typical panel-to-panel joints and the larger seismic-drift joints were placed adjacent to the "ribbon" detail at either the inside corners or the tangent planes of precast concrete panels. This precast concrete arrangement allows the facade's edges and corners to be an integral part of the finished precast concrete material, thereby maintaining the crisp pattern and massing of the tower.

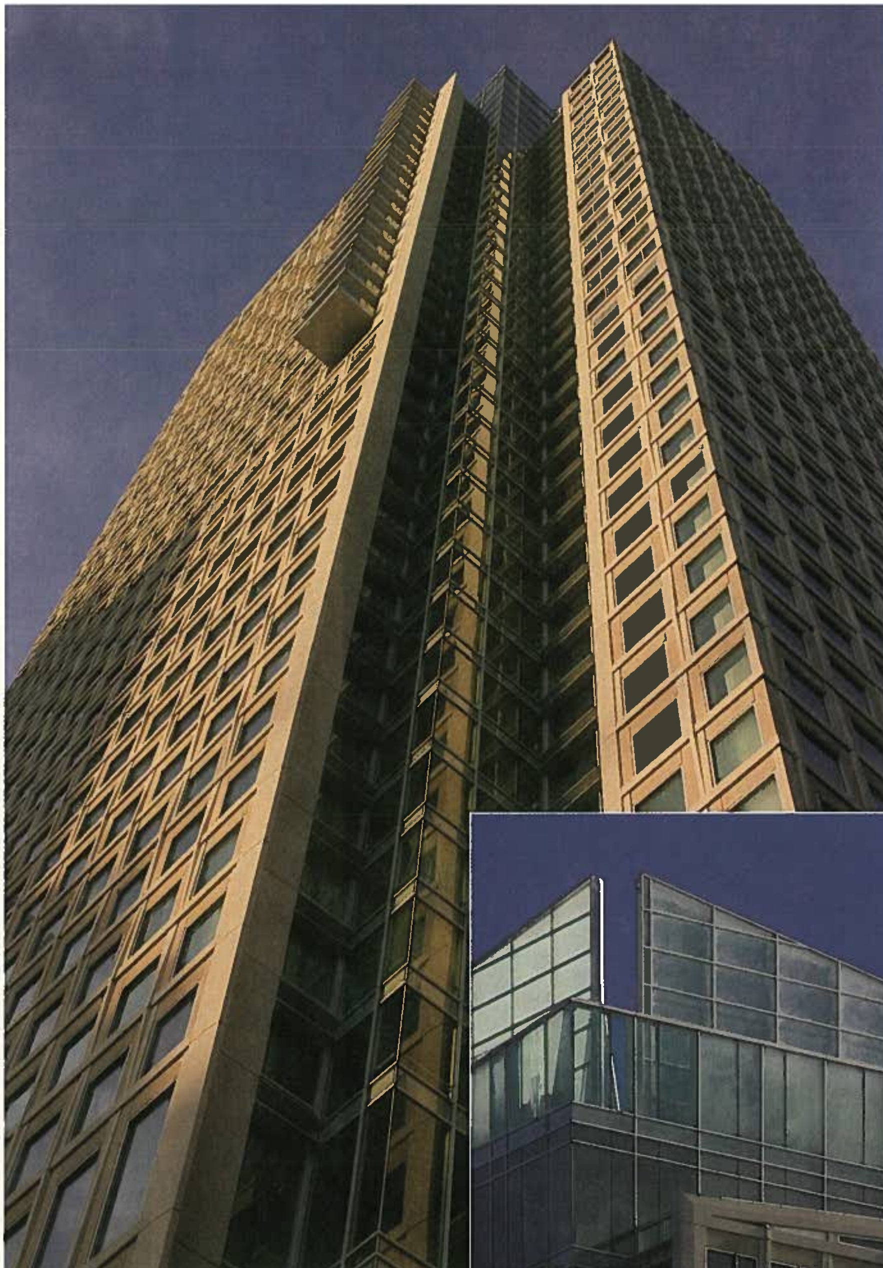

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Fig. 8. The outer skin of the St. Regis Hotel & Residences is split into two materials: glass and architectural precast concrete. These two materials fold around the corners of the structure in specifically designed ways so that the viewer perceives an elegant, uninterrupted line from the top of the building to its base.

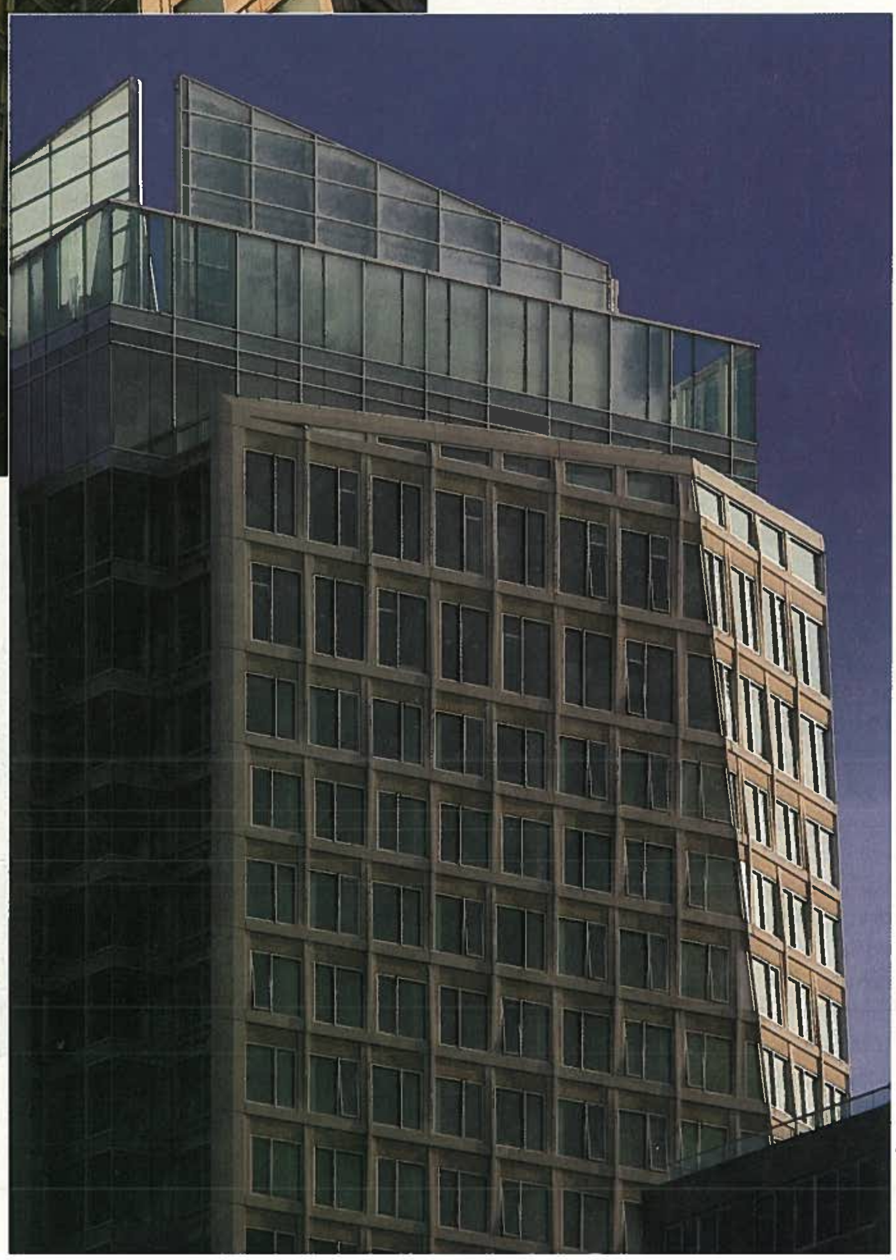

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Fig. 9. As a draped fabric falling over the shoulder, the upper corners of the concrete cloak are dramatically chamfered back, reducing the mass of the St. Regis Hotel & Residences and generating a distinctive skyline silhouette. The non-standard elements and connections of the chamfered design, however, presented daunting challenges for the precaster.

This approach to the tower's geometric detailing was also specified for tower starter panels and all vertical edges of the precast cloak to better express the fluid continuity of material.

Panel configurations along the primary faces of the tower are column-to-column bay-width panels. The panel anchor is designed with a sliding-type gravity connection to accommodate movement parallel to the plane of the wall and to allow the panels to tilt with building movement perpendicular to the wall. At corner intersections, the seismic-drift joints occur a distance away from the corner, hidden visually by the vertical precast concrete panel weaves. The perceived depth, characteristic of this architectural precast concrete finish, provides for clean, defined outside corners that maintain the aesthetic of the tower profile.

At the chamfered corners on floors 22 through 40, the panel configuration incorporates an independent precast concrete spandrel and column cover to accommodate seismic movement. These chamfered corners presented special challenges for the Webcor Builders Concrete Group. Floor sizing, layout, and embed location changed at every floor on two opposite sides of the building, requiring close coordination between all design elements.

Fig. 10. Use of two concrete colors and two sandblasted finishes created four distinct elements that are woven like threads across the "fabric" of the St. Regis Hotel & Residences skin.

Details of "Woven" Design for Architectural Panels

The layered massing of the tower is a direct response to the conditions of the site and the constraints imposed by program and zoning. The articulated, or stepped, massing desired by the city was achieved by separating the skin of the building into three distinct components: an outermost layer of architectural precast concrete and framed window openings (**Fig. 7**); an intermediate layer of primarily clear glass curtain wall (**Fig. 8**); and an innermost layer of translucent glass expressed at the top of the building (**Fig. 9**).

Of the tower's three massing layers, the precast concrete outer layer, in particular, is the most expressive and responsive element; it effectively conveys the central design metaphor of a cloak-like material draped over the simpler, smaller form of the intermediate glass layer. Using a cloak as a metaphor for the design function of the precast concrete fulfilled the main focus and objective of the project's urban aesthetic goals.

The tower's outer skin is split into two pieces. Two distinct materials—concrete and glass—with contrasting textures and characteristics cover two primary faces of the building and fold around corners in a very specific configuration. The gaps between these two material pieces at the primary northwest and southeast view corners reveal an intermediate glass layer, allowing the form at the top of the building to run without interruption to the building's base, emphasizing the tower's height and continuity (Fig. 8).

The corners of the architectural precast concrete cloak are chamfered back at the upper half of the tower, suggesting the drape and fall of cloth over a shoulder. This stepped geometry works effectively to dramatically reduce the mass of the building, provide a unique and immediately recognizable silhouette for the project in the San Francisco skyline, and take maximum advantage of the transitioning patterns of light and shadow generated by the sun's passage over the tower's angled profiles.

Continuing its design metaphor, the architectural precast concrete represents a sheathing fabric in its detailing; the two colors and two different degrees of sandblasting produce four distinct finishes that appear interwoven. Rather than being seen as various surface finishes to a material, the tower's skin is perceived as four distinct woven elements: projected horizontal sills; flat, horizontal spandrel panels; narrow, sloping vertical mullions, or "threads", and flat, vertical pilasters (**Fig. 10**).

The architectural precast panel configurations display two separate colors—cream and ochre—within the same panel; both colors were produced by starting with white cement. The darker ochre shade is mixed with integral colors of yellow and red, local brown sand, and architectural aggregates. The lighter cream hue is mixed with titanium dioxide (a white pigment), white sand, crushed limestone, mica, and brown sand. Use of these two colors coupled with two patterns of sandblasted finishes creates a four-color palette. Color delineation occurs at recessed rustication joints to allow placement of different concrete within each panel.

The vertical precast concrete "threads" are cast with the lightest-colored concrete and only slightly sandblasted; as these thread elements project beyond the horizontal sills on alternate floors, the precast concrete finish produces a dramatic woven effect, especially when bright sunlight casts long, dark, oblique shadows over the facade. Glazed openings in the precast concrete facade are recessed as deeply as possible, resulting in an architectural dressing of unusual depth, texture, and variety of shadow.

To create and emphasize the scale and variegation of residential buildings (as opposed to the repetitive grid pattern of office towers), the flat vertical precast concrete pilasters alternate in color, width, and position from one floor to the next. At the transition level from the hotel to the condominiums, one of the two types of pilasters used is removed from the facade, allowing larger openings for condominium window views and giving the opaque facade grid a sense of lightness as the building reaches the sky (**Fig. 11**).

Rather than being terminated in a flat or symmetrical roof, the top of the precast concrete facade is shaped and altered to respond to the programs it encloses. At the south side, the precast concrete skin ends at the 39th floor, allowing for a large south-facing terrace, sheltered from the wind by the tower behind and the projection of the precast concrete skin. At the west and east sides, the skin slopes from the 39th level up to the 41st floor on the north side, emphasizing continuity of the surround while optimizing the amount of indoor and outdoor program (**Fig. 12**).

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Fig. 11. Transition from hotel to condominiums in the St. Regis Hotel & Residences is marked by a shift to single precast concrete pilasters, operable windows, chamfered shoulders, and balconies.

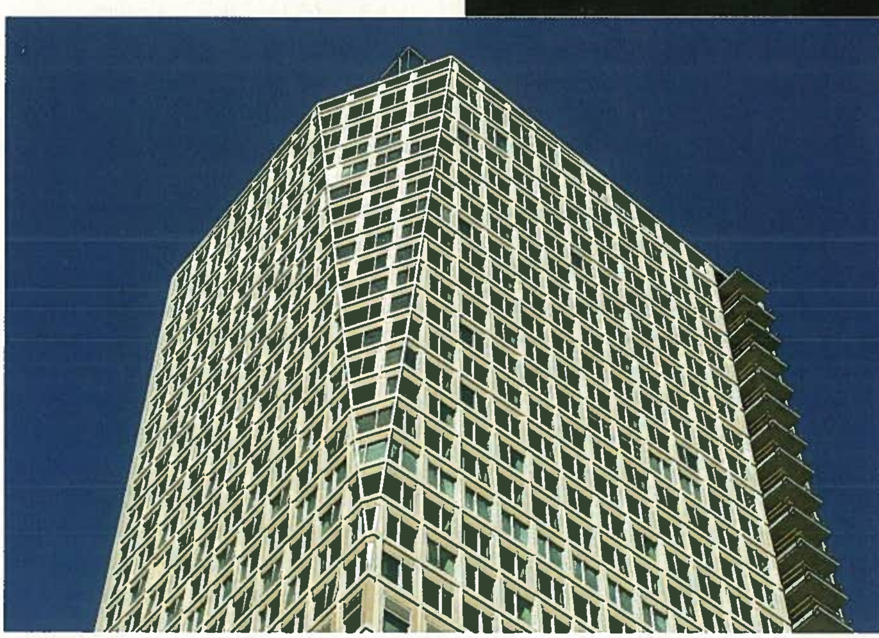


Photo courtesy of Clark Pacific.

Fig. 12. An angled roof line of the St. Regis Hotel & Residences helps to articulate the crown.

Structural System

The superstructure system for the building's base comprises reinforced concrete framed slabs and 9-in.-thick (230 mm) flat plates in the lower podium levels, and 8-in.-thick (200 mm) post-tensioned flat plates at the typical levels above (9 in. [230 mm] flat plates are used at the mechanical floor). Core slabs are 12 in. (300 mm) thick, conventionally reinforced, and without downturned beams. A dual lateral system consists of special moment-resisting perimeter frames and a shear wall "box" core (**Fig. 13**). The core walls are 2.0 ft (0.6 m) thick.

Webcor was able to cut four months off the construction schedule by utilizing flying forms. This was made possible by working with the structural engineer to create a flat-soffit, an upturned-perimeter beam, and a uniform column layout around a shearwall core that utilized a self-erecting jump form. The core walls of the building were built out ahead of the floor slabs; core walls also supported the self-climbing tower crane used on the project. Concrete strengths in the lateral system components typically vary from 8000 psi (55 MPa) to 5000 psi (35 MPa), with 10,000 psi (70 MPa) concrete used in specific locations. The building has a ballroom in the podium with a steel frame, composite metal deck slabs, and deep, long-span, steel roof girders.

In the foundation, 6000 psi (40 MPa) reinforced concrete is used in the mat slab; the foundation mat is 8 ft (2.4 m) thick at its maximum under the tower core and 3 ft (0.9 m) thick under the low-rise podium areas. Grade 75 (520 MPa) reinforcement in one layer was specified under the tower to minimize the number of steel reinforcing bars required and to reduce the need for construction support steel. In the basement, walls are generally 18 in. (460 mm) thick in lower levels, and floor slabs are 9-in.-thick (230 mm) reinforced concrete flat plates.

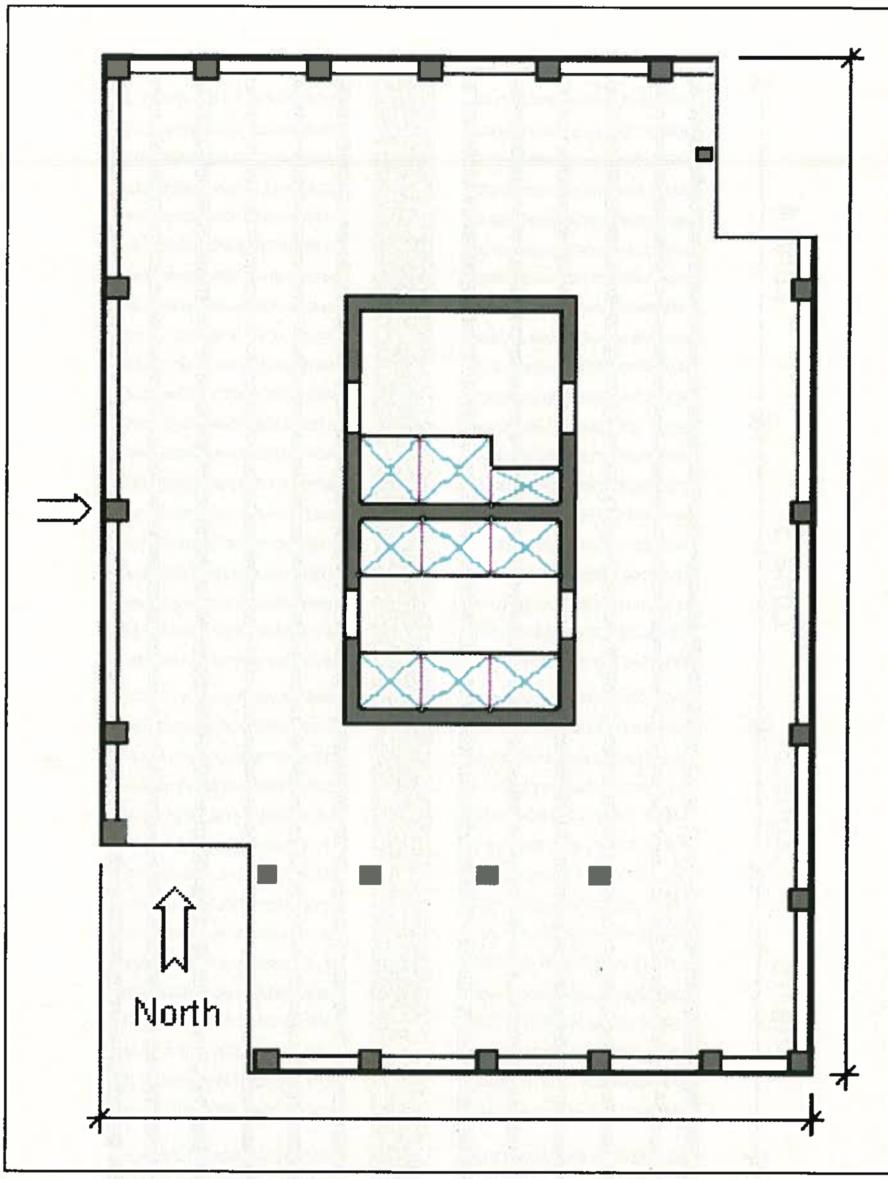


Fig. 13. Typical St. Regis Hotel & Residences floor plan, with a shearwall "box" core. Note: 1 ft = 0.3048 m; 1 in. = 25.4 mm.

Tower Displacements Due to Seismic Loading

In the St. Regis Hotel & Residences—as is usual in the case of tall buildings whose shearwall cores are primarily responsible for providing lateral stiffness and stability—interstory drifts, particularly at upper levels, seem to result more from cumulative rotations of the core with height (and the corresponding rigid body translations rotations engender) than from elastic and inelastic deformations within individual stories. Lateral drifts of the tower superstructure informed the design of the precast concrete panel connections to the base building.

Lateral stiffness required to satisfy the code drift limitations governed the sizing of the core walls of the St. Regis, particularly in the east-west direction. The accuracy of design assumptions regarding effective stiffness properties of the structural components, notably for the shear walls, was extremely important. If the effective stiffness properties were underestimated, the result could be, at best, a soft building with movement perception issues and the potential of non-structural damage even in relatively minor earthquakes; if overestimated, the building would not be economical to build.

Because of the tower's height and the need to minimize structural materials and cost, the superstructure performance during extreme ground shaking was carefully evaluated using the actual Design Basis Earthquake (DBE) inelastic response displacements determined by a nonlinear dynamic-time-history analysis and accurate effective-section properties. Displacements were compared to results computed using the UBC approach and a full-building, three-dimensional, finite element model. The UBC approach consisted of assuming effective member section properties and performing linear, elastic time-history analyses at base shear levels that were scaled to match the UBC-stipulated design levels. This analysis determined the elastic design level response displacements (Δ_S) and scaled them up by 0.7 × R (where R is the appropriate UBC stipulated response modification factor) to yield the

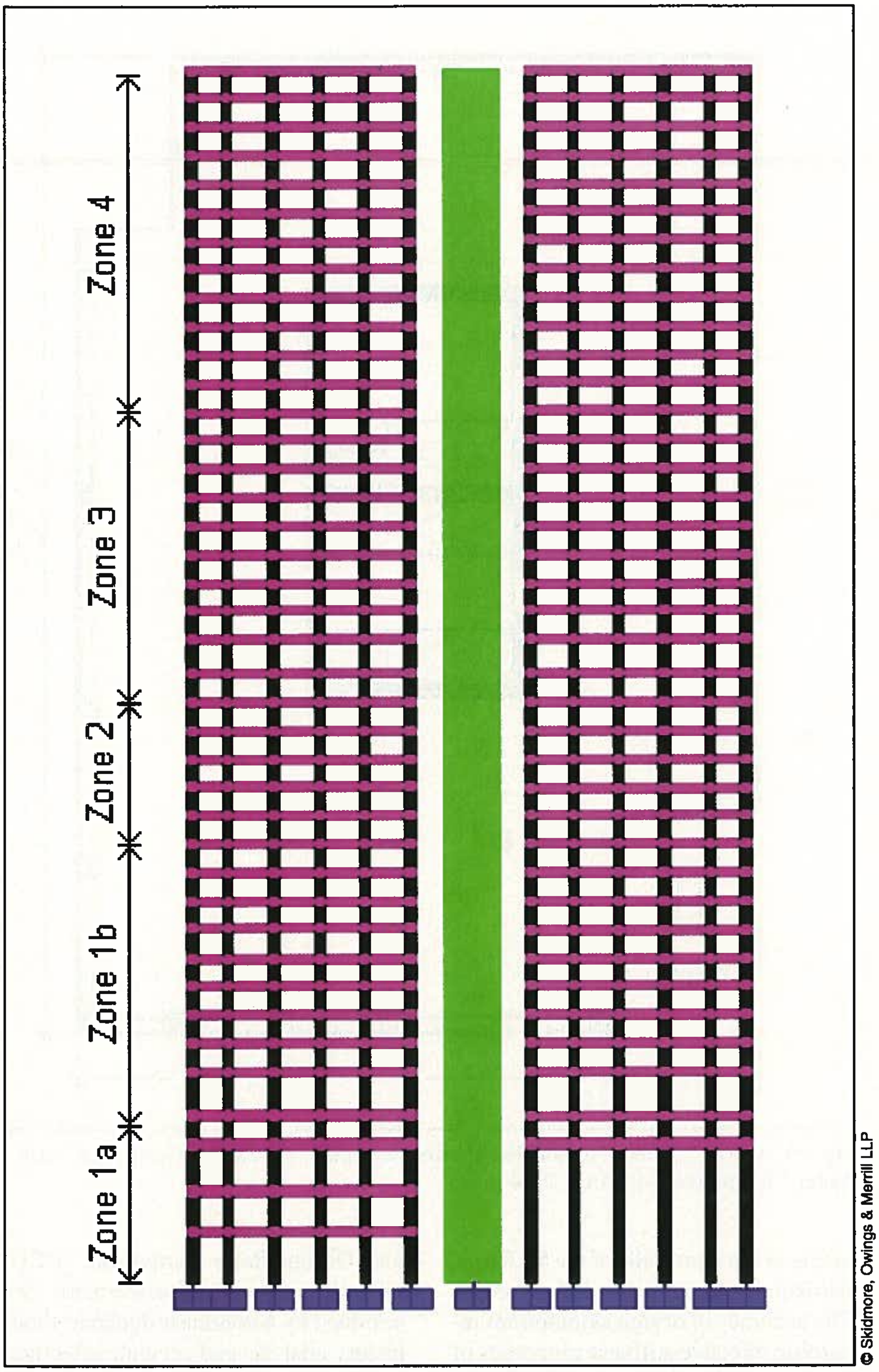


Fig. 14. Schematic of St. Regis Hotel & Residences identifies zones for moment frame and core analysis.

Table 2. Moment Frame and Core Analysis Data.

Zones	Beams	Columns	Core Wall
Zone 1a	8000 psi 32, × 36 in.	8000 psi, 36 × 36 in.	8000 psi
Zone 1b	8000 psi 29, × 30 in.	8000 psi, 36 × 36 in.	8000 psi
Zone 2	7000 psi 29, × 30 in.	7000 psi, 36 × 36 in.	7000 psi
Zone 3	6000 psi 29, × 30 in.	6000 psi, 36 × 36 in.	6000 psi
Zone 4	5000 psi 25, × 30 in.	5000 psi, 36 × 36 in.	5000 psi

Note: 1 ft = 0.3048 m; 1 in. = 25.4 mm.

elastically estimated maximum inelastic response displacements (Δ_M) anticipated in the DBE.

Since building drift was controlled by behavior in the east-west direction, a two-dimensional representation of the structural system for the east-west direction was modeled using SAP2000-NL (nonlinear) V.8 program[1] (**Fig. 14** and **Table 2**). The model considered the east-west moment frames and the shearwall core modeled as a single "mega-column" at the center.

Elements of the moment frames and the core were modeled for five different zones in the tower's elevation, matching the variance in sectional geometry, reinforcement, and concrete strength in the actual structure. The concrete strength used in the frames and the core varies from 8000 psi to 5000 psi (55 MPa to 35 MPa) along the height of the building. The moment frames and core are linked with rigid diaphragms at every level.

Deformations of the tower, including hinging of key structural elements, were studied using the nonlinear model (**Fig. 15**). As a result of this analysis, an accurate assessment of the structure's behavior was achieved, leading to the optimization of member sizes and a reduction in materials and cost. This design approach also accurately informed the design requirements for the cladding system where building drifts could be described throughout the elevation.

WEAVING THE FABRIC—ONE PANEL'S ODYSSEY

Forming and Placing

Figures 16 through **30** depict the production and erection, or odyssey, of a typical architectural precast concrete panel for the St. Regis tower, including the forming, placing, and finishing at Clark Pacific's West Sacramento manufacturing facility and transporting, glazing, and placement in the structure. The typical punched window panel forming used deep raised-steel forms to carry the draft necessary for the reveal design (Fig 16). A pre-tied reinforcing steel cage was placed in the form (Fig. 17) and cages were suspended with additional form supports to ensure that the stripped precast concrete face appearance would not be adversely affected by the movement of internal reinforcement during concrete placement (Fig. 18, 19).

Finishing and Handling

In the case of the precast concrete panels for the St. Regis, great care was needed in concrete placement to ensure that the designated-color concrete was placed into the correct portion of the form. A lighter concrete color was used for the horizontal and vertical "threads," and a darker cream color was specified for the face and backing mixtures. Panels were stripped in the morning after attaining required overnight strength targets (Fig. 20). Special attention to the wall panels was given before stripping because of the relative fragility of the punched window design.

Creating the two different finish textures with two separate integral concrete colors was a complicated achievement for the precaster (Fig. 21). Craftsmen at Clark Pacific's manufacturing facility took particular care in maintaining quality control for the alternating light and medium sandblast required for the project. To ease handling, cast inserts provided lifting points to facilitate transport of the finished panels to the storage yard (Fig. 22). Precast concrete panels were carefully placed according to the predetermined tower erection sequence. All stored panels were aligned facing north so that no inadvertent sun bleaching could occur that might negatively affect the desired palette of the final finish appearance (Fig. 23). **Table 3** lists the precast concrete elements and project price.

Transportation and Erection

Precast concrete panels were loaded on trailers, with two panels on each transport (Fig. 24). Panels were then transported not directly to the jobsite, as is typically done, but to the project's glass and aluminum subcontractor's facilities about 80 miles (130 km) from the construction site (Fig. 25). Webcor, the precaster, and the glass subcontractor used the art of prefabrication to its fullest in successfully coordinating operations for preglazing the punched precast concrete window panels (Fig. 26). In advance of the material needs of the erection sequence—but on a just-in-time basis—wall panel loads were shuttled to the glass and aluminum subcontractor, where the glass and frames were installed while panels were still on the trailers.

Once the precast concrete wall panels were complete with glass window inserts, the loads were transported another 10 miles (16 km) to the San Francisco jobsite for erection (Fig. 27). During the entire wall panel manufacture, assembly, and erection operations, only one or two panels were damaged. Preglazing of the precast concrete panels prior to erection offered significant labor cost and schedule economies in addition to substantially enclosing the building from the weather. Caulking was done following erection completion, thereby eliminating any chance of

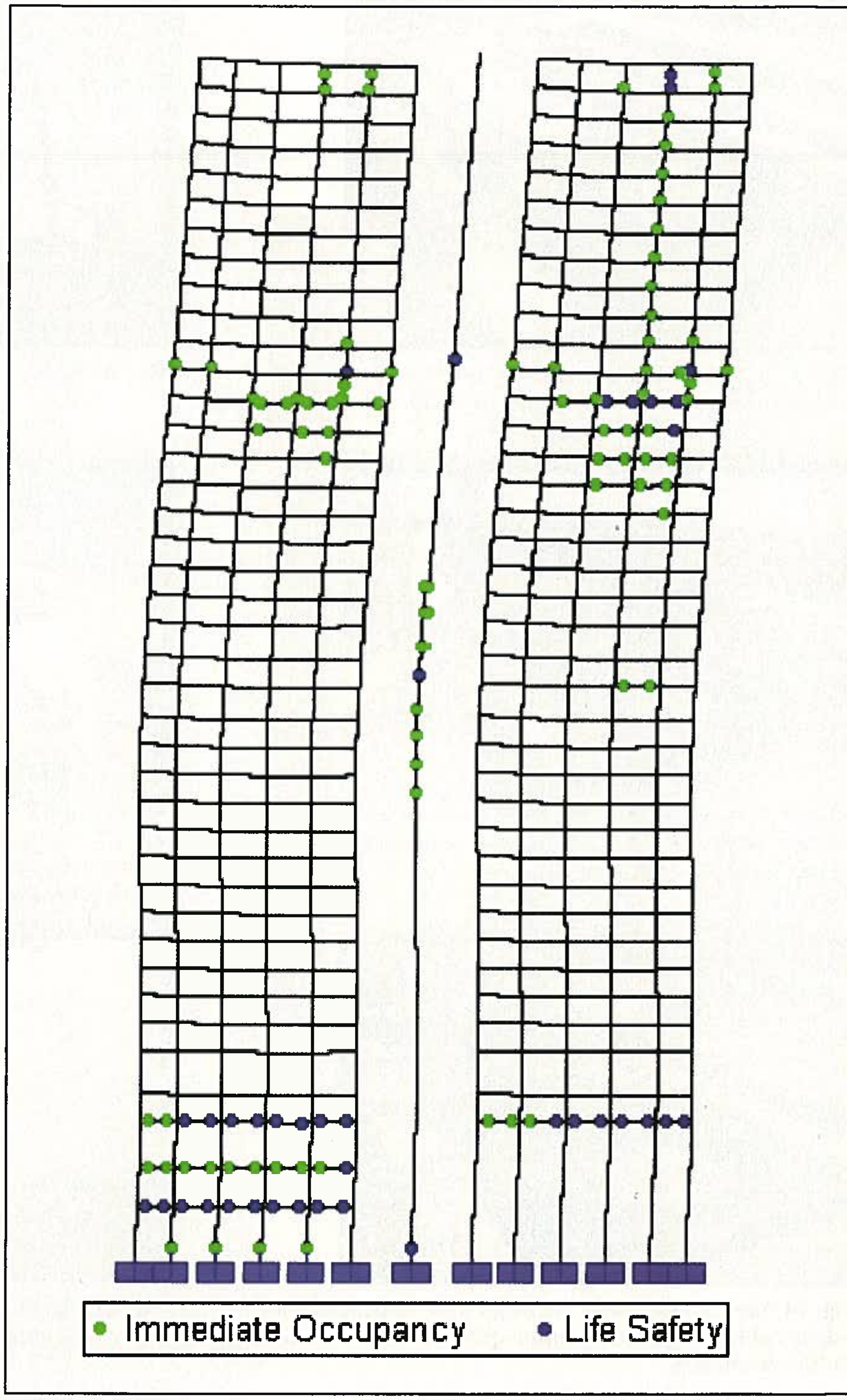


Fig. 15. Hinge formations resulting from nonlinear time-history analysis for St. Regis Hotel & Residences.

Fig. 16. Deep raised steel forms were used for forming the punched precast concrete window panels.

Fig. 17. The placement of pre-tied steel reinforcing cage is shown being put into form.

Fig. 18. Steel reinforcement bar cages were suspended with additional form supports to ensure quality control of final finish appearance.

Fig. 19. The placement of concrete is shown being poured into forms.

Fig. 20. Panels are stripped in the morning.

Fig. 21. Sandblasting required special care and attention by the finishing craftsmen and Clark Pacific's West Sacramento, Calif., manufacturing facility.

Fig. 22. Handling of precast panels was facilitated by cast lift inserts.

Fig. 23. Precast panels are stored facing north to avoid ultraviolet-radiation bleaching.

Fig. 24. Two panels are readied for transport.

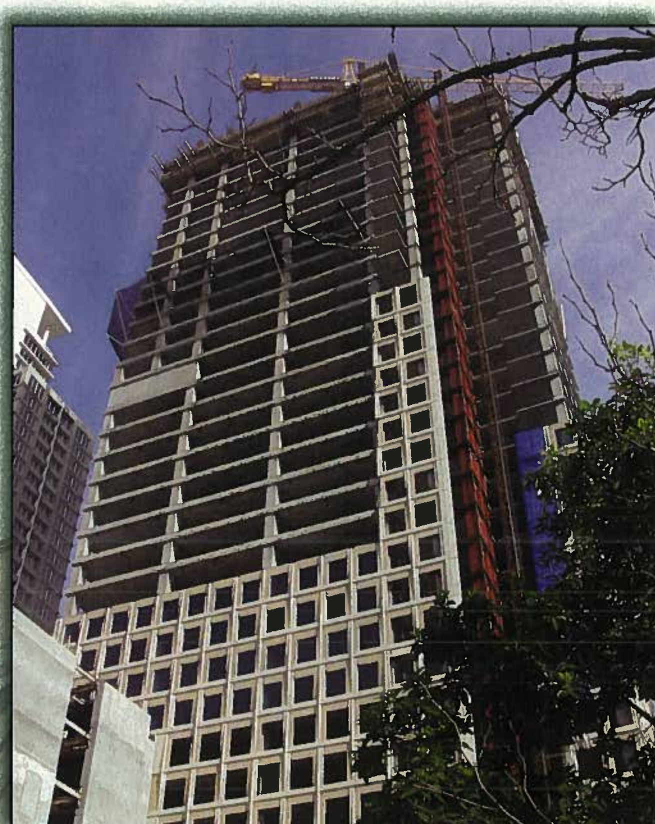
Fig. 25. Loads were transported about 80 miles (130 km) to the Oakland, Calif., facility of the glazier, Architectural Glass and Aluminum.

Fig. 26. Pre-glazing of wall panels prior to erection is an excellent example of utilizing the optimum efficiencies possible with precast concrete manufacturing.

Fig. 27. Coordination between the precaster and the glazier resulted in cost savings and schedule acceleration.

Fig. 28. By utilizing the tower crane at night, the precast concrete erectors maximized the efficient use of equipment by all trades on the St. Regis project.

Fig. 29. This photo shows nighttime erection of precast concrete wall panels.



Photos pp. 68–69 courtesy of Clark Pacific.

Fig. 30. Erection of preglazed and finished precast wall panels resulted in rapid story completion for the St. Regis Hotel & Residences.

Table 3. Precast Concrete Pieces and Architectural Precast Concrete Price.

Element	Number	Dimension, Weight
Punched window panels	532	32 × 10 ft 14,000 lb
Column cover panels	155	10 × 6 ft 4000 lb
Spandrels	57	32 × 7 ft 15,000 lb
Other	24	
Total precast concrete panels	768	
Total precast concrete price: $4,669,000		

Note: 1 ft = 0.3048 m; 1 lb = 0.4536 kg.

caulking failure due to the lifting and erection forces applied to the glazed panels.

In coordination with the other trades working on the tower, the precaster maximized the efficient use of the tower crane by electing to erect the preglazed panels at night (Fig. 28, 29). This sequencing allowed concrete construction to proceed above the precast concrete erection floors during the day shift. Night-shift construction had a number of benefits for the erection crew, not the least of which was the incredible panoramic evening view of San Francisco. The tower's facade took shape fairly quickly. In keeping with the architectural precast concrete's design metaphor as the tower's cloak, each completed story became, literally, another woven stitch added to the "fabric" of the architectural design (Fig. 30).

CHAMFERS POSE UNUSUAL CHALLENGES

The "shoulders" of the structure—large inward-sloping faces beginning at the tower's corners and proceeding dramatically up the building—provide unique expression and give the building its own distinct place in the cityscape. This sloped element, how-

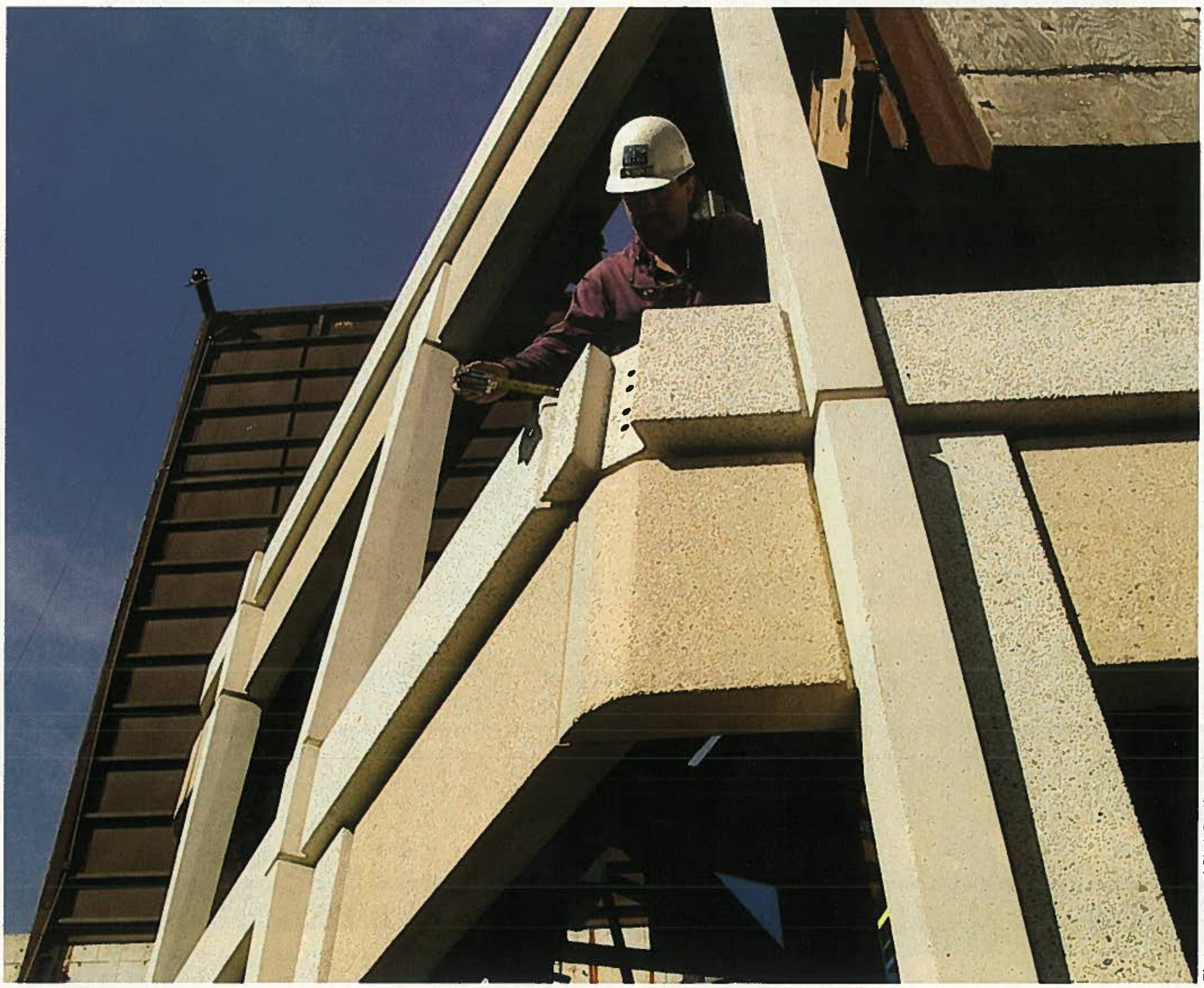
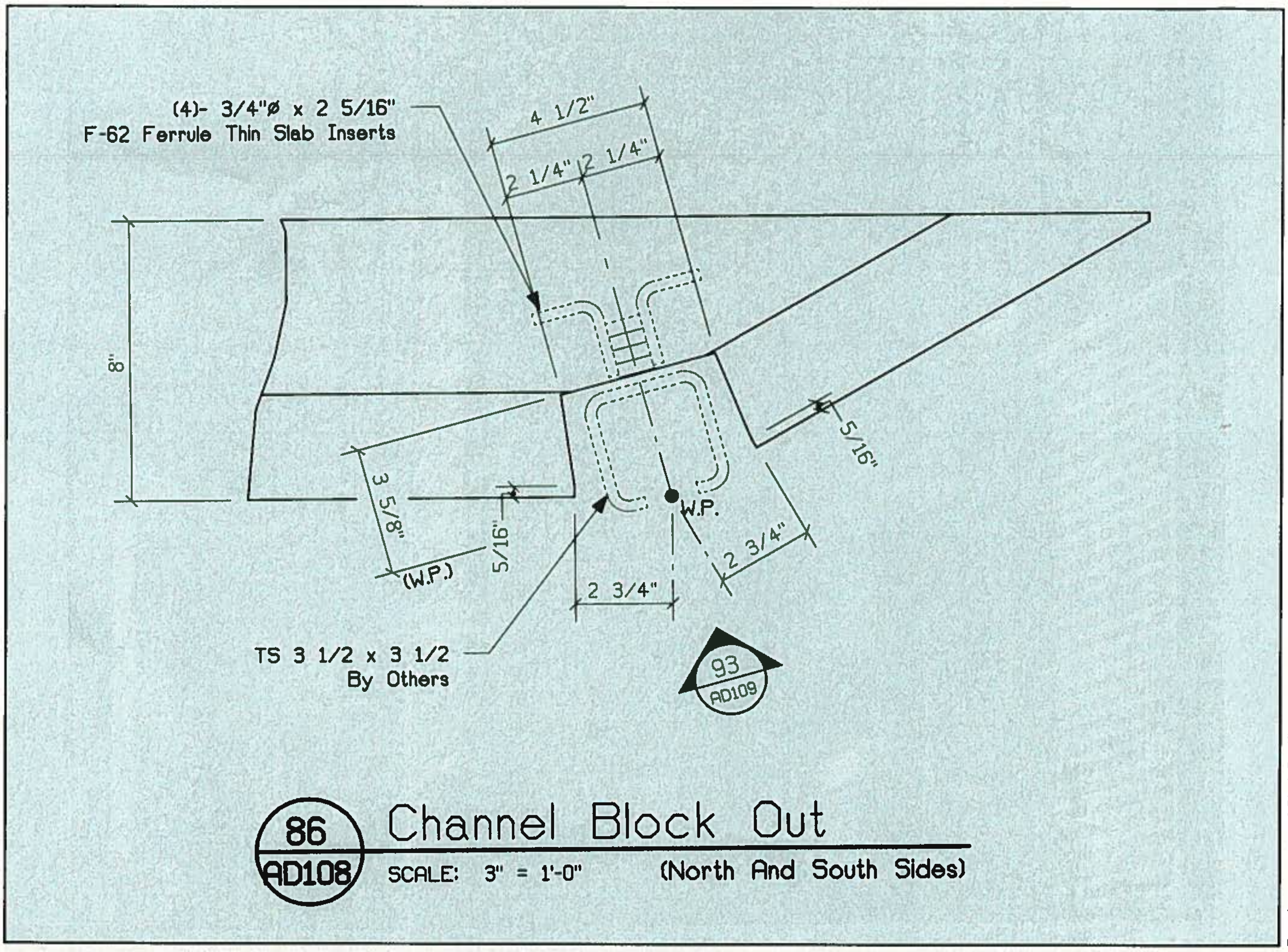


Photo courtesy of Clark Pacific.

Fig. 31. Erection of full-scale mock-up chamfers is shown for the St. Regis Hotel & Residences.



Drawing courtesy of Clark Pacific.

Fig. 32. Block-out in precast concrete system for the St. Regis Hotel & Residences.

ever, posed significant challenges for the precaster. This challenge was achieved by very involved computer-aid-to-drafting design exercises, precaster shop mock-up efforts, and intensive architectural and system performance trials—all in advance of the actual construction (**Fig. 31**).

The sloping geometry of the chamfers also posed several challenges for the tower's building maintenance operations because California law requires that window-cleaning platforms be secured to the building intermittently along the facade. As the upper portion of the building slopes away from the outside southeast and northwest corners, these corners at the lower half of the tower's chamfers are not directly beneath any portion of the upper part of the building. To satisfy state safety requirements, the design team developed a unique system in which the maintenance platform attaches to a load-bearing guide track recessed into the facade

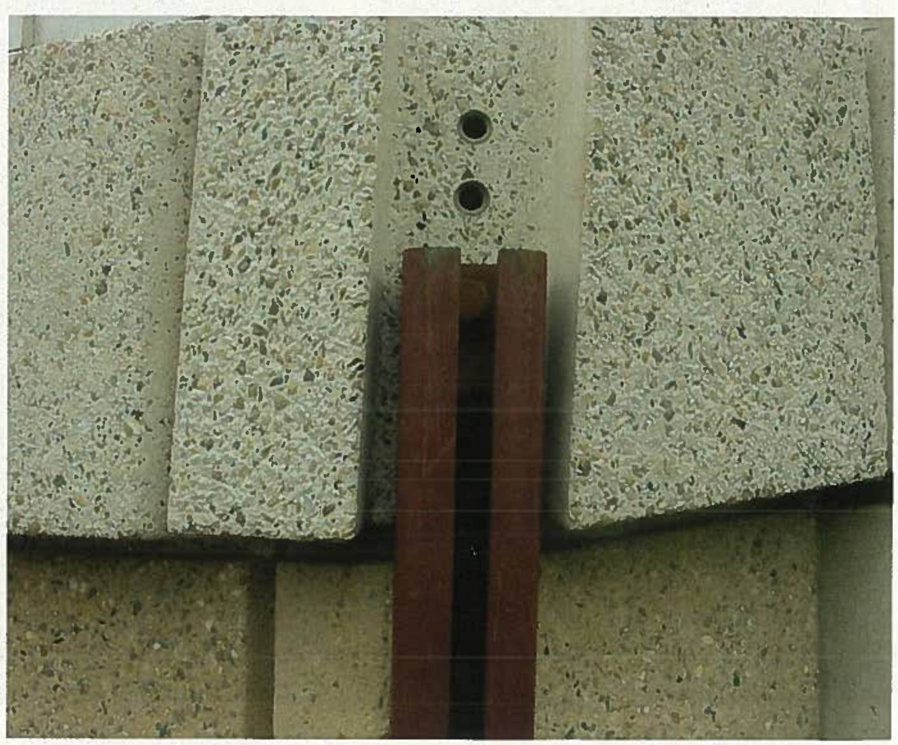


Photo courtesy of Clark Pacific.

Fig. 33. Mock-up shows steel channel in the precast concrete block-out for the St. Regis Hotel & Residences.

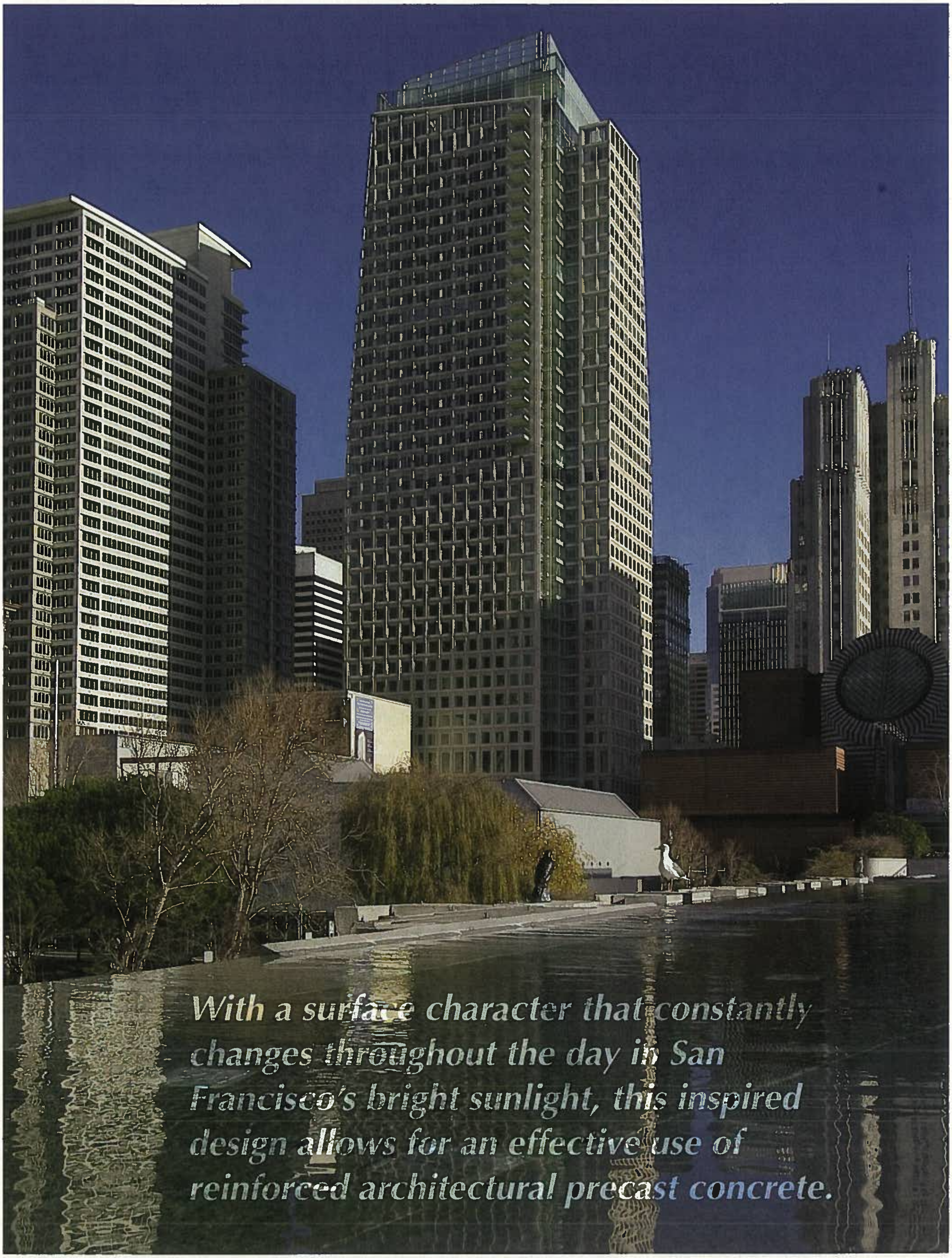


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Fig. 34. With a distinctly sophisticated presence among its prestigious neighbors, the completed St. Regis Hotel & Residences in San Francisco, Calif., proudly rises as elegant proof of the varied design possibilities and incomparable aesthetics of precast concrete systems.

along the edge of the chamfered corner (**Fig. 32, 33**).

In this system, as a window-cleaning platform is lowered by crane from atop the building, the angled track pulls the platform laterally across the face of the building. At the base of the sloping facade, support cables for the maintenance platform are hooked into a temporary pulley that stabilizes the cable and allows the platform to drop straight down over the lower portion of the facade. The engineering of this track required that it be able to accommodate the loads imposed by the laterally shifting work platform and allow the track to move adequately in a seismic event—to avoid binding two floors of precast concrete cladding together and causing damage to the attachments. The integration of this track into the precast concrete and glazing system serves to complement the sculpted geometry of the chamfered corners by providing a distinct crease along the inflection line while maintaining the overall continuity of the facade.

CONCLUSION

The new 42-story St. Regis now graces San Francisco's urban landscape and brings to the community critically needed housing, an elegant hotel for the city's many visitors, and a cultural museum—one of a number of such institutions that make up this city's growing fine arts neighborhood (**Fig. 34**).

The project's design intent was fully expressed by the application of architectural precast concrete, utilizing multiple colors, textures, and planes within the same panel to convey the unique woven-cloth pattern of the program's cloak theme. A precast concrete skin was a fitting material for the St. Regis Hotel & Residences—now the tallest reinforced concrete structure in a Seismic Zone 4 in the United States.

CREDITS

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