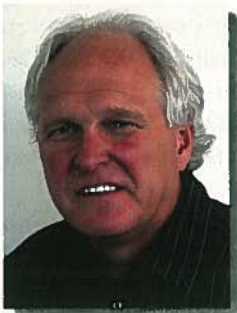


All-Precast Design Innovatively Simulates Stonework for Starz Encore Headquarters



Michael Barber
President and Director of Design
Barber Architecture
Denver, Colorado



Paul Todd
Director of Architectural Design
Barber Architecture
Denver, Colorado



Joseph G. Rapp, P.E.
Associate Principal
S. A. Miro, Inc.
Denver, Colorado



Michael Hemberger
Plant Manager
Rocky Mountain Prestress, Inc.
Denver, Colorado

Starz Encore, owned by Liberty Media Corporation in Douglas County, Colorado, is the largest provider of cable and satellite-delivered movie channels in the United States. The owner wanted the design of the Starz Encore office and technology center to match the neoclassic style and cut-granite cladding of the smaller Liberty Media Headquarters, located in the same corporate campus. The major challenge for Barber Architecture of Denver, Colorado, was to create a complementary design and finish for the larger 308,000 sq ft (28600 m²) Starz Encore building – but with a much tighter budget. A number of project intangibles dictated that planning and design for the Starz Encore building progress concurrently with ongoing development for 24-hour media services. Barber Architecture worked closely with broadcast-uplink system designers to understand their technical requirements while developing an economical all-precast concrete system that would simulate a fine stonework finish while maintaining the classical architectural theme of the campus master plan.

The master plan for the 40 acre (16 ha) Liberty Media Corporate Campus in Douglas County, Colorado, called for the harmonious combination of classic design, signature landscaping, and state-of-the-art infrastructure for this dynamic telecommunications enterprise. The most significant element of this corporate community is the Olmstead-influenced corporate park that effectively blends and incorporates the beautiful exterior spaces and infras-



Fig. 1. The Starz Encore Headquarters in Englewood, Colorado, is the largest provider of cable and satellite-delivered movie channels in the United States.

structure into a cohesive composition, much like that of a university campus.

Barber Architecture of Denver, Colorado, successfully completed three corporate park facilities: Liberty Media Corporate Headquarters, Starz Encore Corporate Headquarters and Broadcast Production Center, and the Liberty Flight Operations Center.

This paper explains the main challenges of the Starz Encore project: creatively converting a granite-clad design into an all-precast solution that met the owner mandates, which included an economical granite-like finish, conformance with the established architectural style, and adequate facilities to serve a dynamic industry well into the future.

PROJECT DESCRIPTION

The Starz Encore building supports a state-of-the-art, digital, satellite-up-link telecommunication operation in Englewood, Colorado (a suburb of Denver). This facility transmits premium programming for over 100 million customers. Located on the park-like setting of the Liberty Media Corporate Campus, Starz Encore provides 308,000 sq ft (28,600 m²) of high-tech broadcasting infrastructure



Fig. 2. Close-up view of the classic portals at the main visitor entrance, a glass-walled, domed rotunda, fronted by tapered Roman-Tuscan columns and entablature.

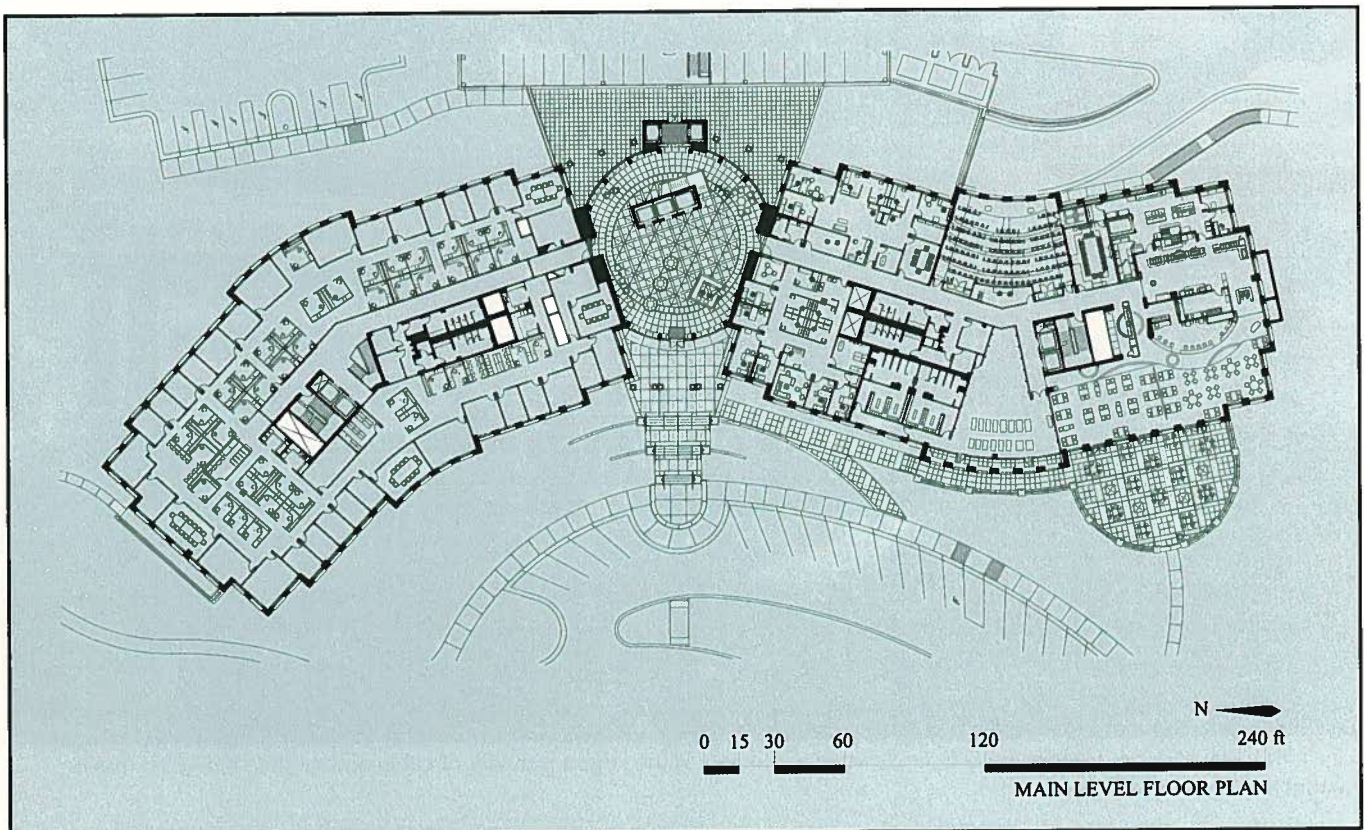


Fig. 3. Main-level floor plan shows the propeller-like wings that project outward from the central rotunda of the Starz Encore design.



Fig. 4. Two dogleg-shaped units turned 180 degrees connect at a central glass atrium with steel framing.

in an all-precast structural system of exacting architectural prescription.

Designed by Barber Architecture, the Starz Encore Headquarters is one of five buildings ultimately planned for the Liberty Campus in Douglas County. Envisioned much like a prestigious university, this corporate environs incorporates signature landscaping, a consistent

Roman-Tuscan architectural theme (see Figs. 1 and 2), and a defining 8.0 acre (3.2 ha) park that serves to integrate space, pathways, and structure into a cohesive community.

The Starz Encore building honors, in form and materials, the 60,000 sq ft (5600 m²), two-story Liberty Media Headquarters to the west. With occu-

pancy for over 550 employees, these wings are clad in architectural precast concrete that closely matches the Texas Pearl granite of Liberty's detail and finish. Two five-story wings protrude outward from the center like propeller blades, anchored by the glass-walled, light-filled rotunda of the main visitor entry (see Figs. 3 and 4).

Ribbed metal roofs on each wing follow the curve of the sinuous wall below and serve to screen mechanical equipment from view (see Fig. 5). Amenities include a full-service cafeteria with outdoor dining terrace, an employee fitness center, and an indoor racquetball court.

The all-precast structural design includes loadbearing exterior panels that simulate rock-cut stonework construction. A precast concrete system made it possible for the building's exterior to go up at the same time as the structure itself, and the entire building was enclosed in 20 months. The exacting production required for Roman-Tuscan tapered columns (with horizontal-appearing joints) was only possible with the creative flexibility inherent in precast designs (see Fig. 6).

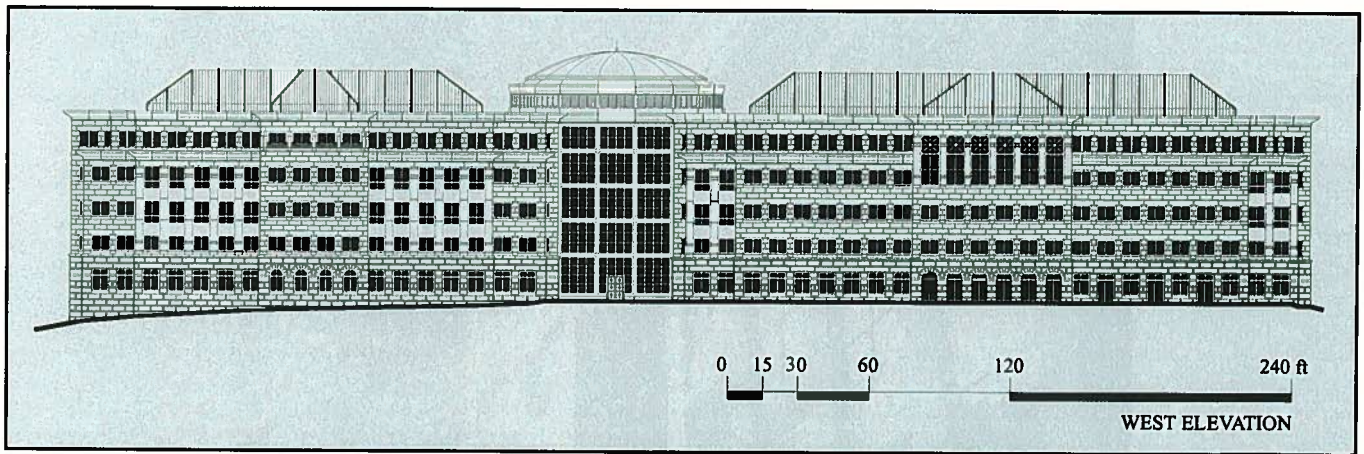


Fig. 5. West elevation of the five-story, 550-employee Starz Encore telecommunication facility, showing the ribbed metal roofing on each wing and the intricate architectural precast cladding in front of the building.

While the majority of the structure is precast concrete construction, there are some feature stairs that are steel, and the link between the two major wings (the glass-walled rotunda and connecting bridge) is framed with structural steel. This includes the central dome roof and the circular mechanical floor directly beneath the roof.

DESIGN CHALLENGES

Perhaps the biggest technical challenge at Starz Encore was to provide adequate infrastructure to support a state-of-the-art digital 24-hour television playback and satellite-uplink operation. Planning and detailed designs for the new building were concurrent with the development of Starz Encore's new broadcast technology system. Barber Architecture worked closely with the broadcast and uplink systems designers to understand their technical requirements. The final design incorporated operating spaces and mechanical systems accordingly to allow for the continued expansion of the telecommunication operations.

With general contractor Weitz Construction Company of Denver, Barber Architecture developed a phased construction process that enabled the broadcast technology contractor to begin equipment installation only seven months after the first precast concrete structure was erected. The result of this intense collaboration resulted in the onset of broadcast and uplink operations six months earlier than originally planned. Both the Lib-



Fig. 6. Tapered Roman-Tuscan columns with the appearance of horizontal "stonework" joints, and prescribed architecture for historically precise entablature.

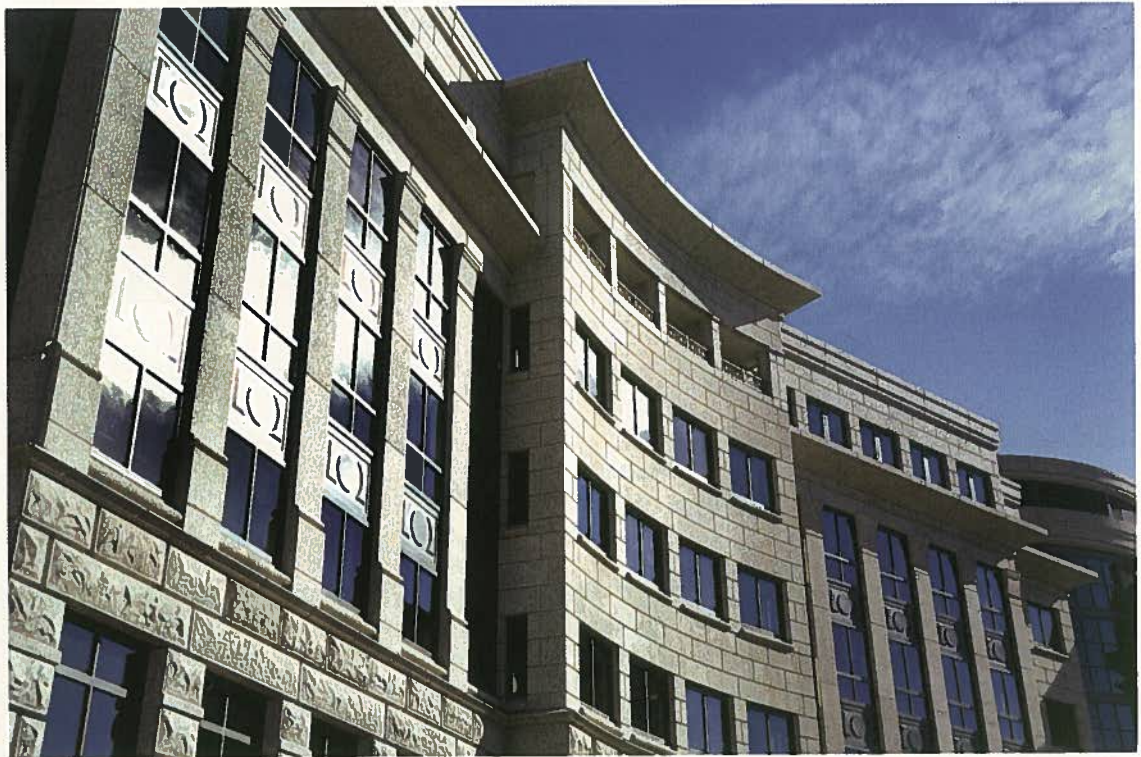


Fig. 7. Precast cornice work includes elements that project 3.0 ft (1 m) from the wall, necessitating cantilever-type connections and detailing.

erty Media and Starz Encore Headquarter buildings were constructed at the same time, complicating design and construction work.

Liberty Media Corporation, owner of Starz Encore, is the largest provider of cable and multiple satellite-delivered movie channels in the United States. Only ten years old, Starz Encore had no clear sense of its space needs as it struggled to keep pace with its burgeoning growth. Compounding this uncertainty was the impending integration of a remote broadcast operation within the new headquarters.

Demanding Architectural Standard

Located at the northeast edge of the 40 acre (16 ha) corporate park, Starz Encore needed to relate harmoniously in form and materials to the architectural standards of the Liberty Media Headquarters Building, located 200 yd (180 m) to the west, as well as architectural standards established for the park. The real challenge was to create a much larger building that could complement the existing site and architecture, only under a much smaller budget than its predecessor.

The owner had an affinity for classical design and wanted to project an

image of corporate permanence and give market confidence to telecommunication and media investors. Precast panels cast in a variety of hand-molded forms provided the critical variability to the stone textures, simulating the look and texture of more expensive cut granite.

The successful simulation of a granite-stone finish and the elaborate architectural detail of the Starz Encore facility were only possible through the production efficiencies, material flexibility, and design creativity provided by a precast concrete system. The more limited budget for the Starz Encore building was an opportunity to utilize the inherent elegance and economy of a carefully wrought precast design and fabrication under controlled plant production conditions.

Expansive Foundation Soils

Highly expansive soils were found on the building site. When subjected to moisture, these soils can expand as much as 13 percent, movement that can be very damaging to any structure built directly on these soils. To mitigate potential damage, the foundation of the building is supported on drilled pier shafts that penetrate through the

expansive soils until meeting resistance of the bedrock below.

The entire basement level cast-in-place (CIP) structural slab is supported on drilled piers. A 12 in. (300 mm) void is maintained beneath the grade beams, caps, and structural slab. This void provides space for expansion of active soils should they become wetted, preventing damage to the foundation and structural elements.

The expansion void was achieved by placing the CIP structural slab directly onto a corrugated cardboard form. Designed to support the weight of the concrete prior to hardening, the cardboard form will deteriorate over time as it is exposed to subgrade moisture. This deterioration creates a void, and the resulting space provides structural protection from upward movement, or heaving, of saturated soils.

The satellite receptors located on the property are also supported on drilled piers. The precise position of the wave guides that run from satellite receptors into the telecommunication building is very critical to their performance. Consequently, the wave guides are also supported on a structural CIP slab over a created void located 15 ft (4.6 m) below grade.

Foundation challenges were also

presented by the precast structural components. In the front terrace area, loadbearing precast walls rest on drilled piers. At the back of the building, the walls are supported by 56 in. (1400 mm) wide inverted-tee beams that actually cantilever over the basement space. As free-standing elements, these components were especially difficult to design to resist seismic and wind loads while also presenting finished surfaces on all sides.

Transportation and Historical Entablature

Rocky Mountain Prestress, the project precaster, is located about 20 miles (30 km) from the Englewood project site. Delivering and erecting the precast components was complicated by the weight of some precast panels. Weighing almost 70,000 lbs (32000 kg), the heaviest precast units were difficult to handle, transport, and erect. Large handling equipment was used in the precast plant, and two Triple-8 Manitowoc cranes [both rated at 250 ton (230 Mg) capacity] were needed to erect the components. The general contractor and precaster worked collaboratively to make effective use of erection equipment at critical locations and keep the project on schedule.

Another formidable challenge that arose on the project came in designing and erecting the elaborate entablature (column, architrave, frieze, and cornice) that fronts both entrances to the building. The owners wanted the visitor entrance and rotunda to make a positive statement as a pedestrian-scale transition into the glass atrium. These elegant welcoming portals feature historically accurate Tuscan columns that align with the belt course of stone-like panels on the building. The column portals would be visible on all sides, requiring the precaster to fabricate cleverly hidden connections.

The cornice overhangs, as well as column entablature projections, extended as much as 1.5 to 3.0 ft (0.5 to 0.9 m) from the face of the supporting walls and tapered columns (see Fig. 7). The cantilever forces required special tieback connections and larger precast element seating details. Over-



Fig. 8. Innovative filler pieces or “soaps” were used to create imperceptible connections between precast panels.

all, the projecting or cantilevered precast elements proved to be very difficult to position and erect.

In the central dome, two bands of projecting precast panels are supported from a steel tension ring. The 1.5 ft (0.5 m) projection of the precast panels from the ring centerline increased the difficulty of the already complex connection between the steel and 18 to 24 in. (460 to 610 mm) thick concrete bands. This meant the flexible steel had to extend structural support over a significant distance in order to pick up the projecting concrete loads. Large seats and tieback connections were designed for the steel-to-concrete connections.

Historical accuracy aside, The Starz Encore structural design was much easier to address. The building is three bays wide, framed with 10 ft (3 m) wide double tees and precast concrete core walls providing lateral support. Inverted-tee beams and columns support the center span loading. Precast loadbearing walls rest on grade beams supported on drilled piers.

PRECAST CONSIDERATIONS

The economic advantage of precast concrete loadbearing walls – that incorporate both structural elements and an elegant, simulated stonework finish – was made obvious through a com-

parison to a system of precast cladding over steel structural framing. By just the addition of a few more inches (about 50 mm) of thickness to produce a precast loadbearing wall, the designer was able to eliminate the material, fabrication and labor costs of steel from the design.

Project budget restraints were not the only limits to selecting a structural system. Valuable construction time was saved and an early occupancy made possible for the owner because the exterior enclosure of the Starz Encore Headquarters was rising at the same time as the structural elements. In fact, the only building material that could meet the tight construction schedule and demanding architectural standard was an all-precast design.

Connection “Soaps”

Production included an innovative system to eliminate vertical joints typical in precast elements. Vertical joints would interrupt the appearance of a mason’s stonework jointing. Small, shallow connecting pieces called “soaps” were cast in the same molds of the larger panels (see Fig. 8). These soaps were grouted into precast connections to span the joint space to create the exacting fit necessary to simulate the smooth, uniform appearance of stonework. Because the panels were fairly thick, the filler pieces had to

Fig. 9. Clay forms were hand-sculpted into diverse cut-stone patterns and variations at Rocky Mountain Prestress to simulate the Texas Pearl granite of the Liberty Media Corporate Headquarters.



cast vertically in rubber forms. The column called for horizontal finish joints designed to duplicate historic stone masonry. Probably the only simple aspect of column fabrication was their removal; cast upside-down, the tapered columns slipped easily from their forms.

Column fabrication proved problematic for the precaster. The first five pieces were rejected before the crew developed an effective casting procedure. Vibrating tables were used to consolidate the concrete into the intricate mold. If vibration was excessive, water migration lines appeared in the finished piece. With insufficient vibration, voids (pinholes) would appear in the concrete surface.

The final design features three drums in the column plus a plinth and capital, elements that were post-tensioned together using Dywidag™ bars. An architectural patch concealed the post-tensioned connections at the top of the entablature, as this surface would also be visible from the upper floors inside the building.

Hand-Sculpted Form Liners

Simulation of the Texas Pearl granite of the companion buildings involved designing specific color, texture, shapes, and hidden precast joints using 458 rubber forms as part of the intricate precast forming system (see Figs. 9 to 12). The molds were reused for economy, but assembled in a manner that minimized any apparent repetition of stonework patterns.

Rocky Mountain Prestress was able to satisfy the precise dimensional tolerances, color textures and intricate finishes demanded in the panel design. The precaster knew of no existing form liners that would adequately simulate the variability of granite stonework. No available textures met the finish requirements of the established architecture of the Liberty Media corporate campus. The real success of the project hinged on the ingenuity and skill of both the designer and precaster in producing a precast finish that replicated the actual granite construction.

The stone course work presented four key challenges for the precaster:



Fig. 10. Creating the intricate patterns and textures in the clay required skill, patience, and precision.

have just the right design to disguise the connection to the precast sides and completely fill the joint.

Tapered-Column Consolidation

Starz Encore's impressive welcoming portals duplicate historically accurate Roman-Tuscan columns and classical entablature above. These portals

were designed to be viewed by visitors from all angles, specifying a six-sided precast finish with ingeniously concealed panel joint connections. Through a careful research of architectural history, the precaster was able to verify the exact angle of taper for a specific Tuscan column, and then assess the construction feasibility.

The tapered round columns were



Fig. 11. A completed clay sculpture showing the realistic textures of hewn granite.

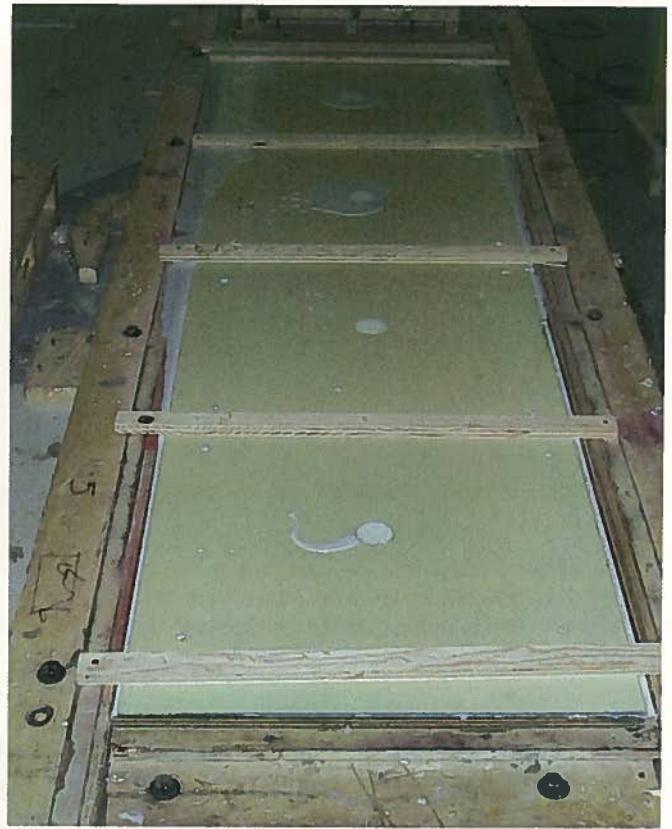


Fig. 12. Negative rubber form liners were produced using the completed clay molds.

- Matching the color of the Texas Pearl granite used on Liberty Media Headquarters.
- Simulating the mottled texture of granite's elegant crystalline appearance.
- Providing sufficient variation in the custom form liners to minimize apparent pattern repetitions.
- Hiding the normally vertical joints of the precast panel system with connection pieces that simulate the horizontal joints of a stone mason.

Mottled Finish and Texture of Granite

Creating the mottled effect in a cement matrix proved difficult. The pre-caster manipulated color tints as well as the quantity, size and type of fine and coarse aggregates in the concrete mixture. Acid etching and concrete retarders were tested in a number of combinations to produce the most variation in surface texture for the precast finish.

The final design mix incorporated three coarse aggregates from local sources, two sands, and the addition of



Fig. 13. A finished precast panel after acid washing the surface to expose quartz crystals.

quartz crystals to provide the elegant "sparkle" of cut granite stonework. In fact, quartz composed about 75 percent of the total aggregate in the mix, by weight, resulting in a premium concrete mix.

The architects provided granite samples from the Liberty building, and the pre-caster in turn produced 46 different

1.0 x 1.0 ft (0.3 x 0.3 m) samples using a variety of local aggregates. Originally, an extremely deep acid etching was specified based on results from these small samples. In applying the acid to the much larger panels, however, it was found that the larger panels cured at a higher strength than the acid-etching chemical could penetrate.



Fig. 14. Two 250 ton Manitowoc cranes were used to erect the precast elements at the central rotunda of the Starz Encore Headquarters. Heavier precast panels weighed as much as 58,000 lbs (26000 kg).



Fig. 15. Nearing the end of the installation of the architectural precast façade.

In the end, a light concrete retarder was sprayed onto the forms to ensure a more uniform finish. The precaster was able to finesse the commonly inconsistent effects of retarders, working to eliminate any hard spots or veins in the surface finish (see Figs. 11, 12 and 13).

After touring downtown Denver to look at granite stonework construction, the precaster knew that duplicating the texture and surface relief of real stone would not be simple. The team took digital photographs of actual stonework, and these formed the

basis for the form liners that Rocky Mountain devised for the casts. For acceptable variability in appearance, 15 different 2.2 x 1.6 ft (0.7 x 0.6 m) panels were produced. Each panel presented different stone relief, including variation in edges, depth of relief and molding that effectively reproduced an acceptable appearance of granite.

Final shapes for the granite panels were sculpted into 458 clay models that simulated cut-rock faces. Clay proved to be the best choice for molding liners after failed attempts with polystyrene material and deformed

lead sheets. Negative rubber liners were fabricated from the clay molds to create the form liners for the precast elements. These fabricated forms were rotated and assembled in combinations so that no two adjacent precast “stone” sections would repeat a visually obvious pattern. While creating a sufficiently random pattern, the precaster maximized the reuse of panels for production efficiencies and economies.

Some panels featured specialized, one-time-use, custom designs for use as arches or framing pieces that were not repeated elsewhere. In addition, some panels presented curved surfaces to create the convex and concave wall shapes of the building wings.

Figs. 14 and 15 show the erection of precast components at the domed central rotunda using Manitowoc cranes. Construction of the Starz Encore Headquarters concluded with completion of the central glass-walled rotunda. Erection of the dome ring steel and precast concrete cornice connections required careful coordination of the two cranes in this limited space. Maneuvering the structural elements of the rotunda into position under these constraints needed constant vigilance.

A finished view of the building is shown in Fig. 16.

CONCLUDING REMARKS

From initial design to full occupancy, the Starz Encore project took only 22 months to construct, with the office structure erected in 218 calendar days. The smaller Liberty Media building began construction before the much larger Starz Encore facility, yet the all-precast system with its simulated-granite cut-stone facade was completed first. Often working in uncharted waters in terms of constructibility, the combination of teamwork and innovation in design ultimately led to the successful completion of this complex project.

The Starz project was a dual winner in PCI’s 2003 Design Awards Competition, held in Chicago on June 13 this year. Not only was it a co-winner of the Harry H. Edwards Industry Advancement Award, but it was also the sole winner of the award for Best All-



Fig. 16.
Finished view
of Starz Encore
Headquarters Building.

Precast Solution. In selecting this stand-out project from nearly 140 entries, the jury commented:

“This state-of-the-art facility makes optimum use of the capabilities of precast concrete by integrating the architectural and structural elements of the building and transforming them into an architecturally attractive, functional and cost-effective structure. The granite-like façade, neo-classic portals and other architectural finishes are particularly appealing. All this would not have been possible without the close cooperation between the owner, archi-

tect, structural engineer and precaster. This totally precast concrete building is a great example as to where the precast/prestressed concrete industry should be heading.”

ACKNOWLEDGMENTS

The authors would like to express their appreciation to The Weitz Company, especially the efforts and contributions of Orville Hineman, construction manager. Our appreciation and thanks also extend to the technical assistance of John Garlich and Jason

Lien of Rocky Mountain Prestress and Steve Marshall of S. A. Miro, Inc.

CREDITS

Owner: Liberty Media/Starz Encore Group, Englewood, Colorado
Prime Contractor: The Weitz Company, Inc., Denver, Colorado
Project Architect: Barber Architecture, Denver, Colorado
Project Engineer: S. A. Miro, Inc., Denver, Colorado
Precaster: Rocky Mountain Prestress, Denver, Colorado