



Concrete poured for the parking structure is integrally colored to blend in with the surrounding canyon rock.

# Concrete cliffhanger

Monroc Inc. and Silver State Concrete behove Hoover Dam visitor facilities

by Bill Blaha

A new visitor center at Hoover Dam, this country's foremost concrete icon, is shaped up as an exciting sideshow to the main attraction. The center together with a multi-level parking structure a short distance away are being constructed primarily of concrete. And while the quantity involved is nowhere close to what was required for the famous old dam, the amount of effort needed to complete this project is nonetheless equally challenging.

The drum-shaped center is perched on a narrow ledge of Black canyon on the Nevada side of the Colorado River. It literally is hung on the canyon wall as it rises dramatically from a deep V-cut excavated from the face of the cliff. There are three levels within the 110-ft. diameter structure plus an elevator shaft that runs 530 ft. down through the canyon wall to the dam's powerhouse. The exterior of the center, which matches the design and color of the dam's art-deco style intake towers, is clad with architectural precast panels produced by Monroc Inc., Salt Lake City. Many of these attractive concrete units are even shaped to fit the contour of the rock they abut.

Construction of the parking garage likewise has been a demanding task. The cast-in-place concrete frame structure is shoehorned into a ravine which during the 1930's held the batch plant that supplied all the concrete for Hoover Dam. To make room for its new occupant, an additional 100,000 yd. of volcanic rock had to be blasted from the site—a job that took nearly a year to complete.

## Larger facilities

The visitor center and parking structure are being built by PCL Construction Services Inc. under a contract awarded by the Bureau of Reclamation. Both are due to be opened by this month.

The new visitor center will replace a much smaller facility built over 60 years ago. For example, the twin 25-passenger elevators now taking visitors to the base of the dam are only half the capacity of those to be put in service in the new shaft.

Just as important, the parking structure will help ease growing concerns about traffic and safety. Visitors must now cross a busy two-lane highway (U.S. 93) that runs across the top of the



**N**ew visitor facility has a concrete-lined elevator shaft that descends through 540 ft. of solid rock. It will contain two, 50-passenger high-speed elevators.

center to the four elevators. In addition, there is little parking space available. Many have to park a mile or more away, then take a shuttle bus or go by foot along the highway to reach the dam. The five-story parking structure will provide covered space for 420 cars and up to 30 buses and motor homes. Visitors will have direct access to the center via a passage way beneath the highway.

Construction of the new visitor facilities began in 1986 with the relocation of electric transmission towers on the Nevada wall of Black Canyon downstream from the dam, said Donald Baker, a BuRec civil engineer on the site. In 1988 and 1989, Highway 93 on the Nevada side of the dam was realigned and a new bridge built to carry traffic over the pedestrian walkway that will link the parking garage and the visitor center.

The two-span, cast-in-place, segmental bridge is 540 ft. long and 42 ft. wide. A 4.8 ft. wide walkway extends along one side. The bridge contains 3,900 yd. of concrete produced from an on-site plant operated by Frehner Construction Co., the general contractor. A Schwing pump was used to place the concrete in 16 ft. incremental segments by the balanced cantilever method, Bader said. The next phase of work involved construction of the 23 ft. diameter and 530 ft. deep shaft housing the new four elevators. Bored through solid rock, the shaft is lined with 1.5 ft. of concrete supplied from the same on-site Johnson plant. Frontier-Kemper Constructors hand that contract.

#### Breathtaking Center

The new visitor center consists of three indoor levels and an observation deck. Among other things, it will contain a revolving theater divided into three 158-seat sections. Three consecutive 12-minute programs are presented. They tell the history of the dam and provide information on water management and the critical nature of water in the Southwest.

Approximately 20,000 sq. ft. of architectural precast concrete clads the circular structure as it emerges from a giant V-shaped opening carved



from the rim of the nearly vertical canyon wall. The

off-white panels, 132 in total are typically 8.6 ft. wide and 20 ft. tall. To keep the units within the specified weight limit of 115 lb. pcf, they were manufactured by Monroc using a mix design that included Ute-Lite expanded shale aggregate, said George Armstrong, production manager.

About half the panels are one of a kind units that follow the profile of the jagged rock they fit against. To make certain the interface would be accurate (3 in. Maximum tolerance), PCL had a topographical survey made of the entire work area. This data was passed on to Monroc and fed into the pre-caster's in-house computer to plot out graphic representations of each irregular panel to be cast.

Using these CAD model drawings, Monroc proceeded to build templates out of both Styrofoam and Masonite which duplicated the size and shape of these panels. They were then hauled 350 miles from Salt Lake City to the project and like a huge jig-saw puzzle matched against the exact section of canyon wall the finished concrete units would border. After all was checked out and validated, the company started actual production.

All the panels were shipped to a staging area about a mile from the dam. As needed, the pieces were brought to the site just one trailer load at time, because of the lack of working space between the highway and job. Monroc's erection crew, under the supervision of Neal Collings, installed the curved concrete panels from the bottom of the wall on up. The men worked from a swing stage, similar to that used by window washers, suspended from the center's observation deck. A tower crane lowered the units to the work deck. After being maneuvered into position, the panels were weld



Front end of the parking structure is founded on huge concrete caissons sunk to depths of 90 ft. Here workers assemble a steel cage for one of them.

Monroc also supplied precast box girders for a 92 ft. long pedestrian bridge constructed under the highway between the visitor center and parking structure. Each of the bridge's two spans are formed by 12 components measuring 46 ft. long, 48 in. wide and 36 in. deep. Other concrete elements furnished by the company include column caps installed at the center's escalator landing and on all three floors inside the facility.

#### Jobsite Batch Plant

Approximately 25,000 yd. of ready-mix was required to construct both the visitor center and parking structure, said Bill McNaughton, a BuRec material engineering technician who oversaw concrete quality control on the project.

This volume was supplied to PCL from a batch plant operated by Las Vegas-based Silver State Concrete at a temporary site one mile from the dam. The Con-E-Co Lo Pro plant, controlled by a PCI/Command Data Eagle Junior batching system, services three mixer trucks assigned to the project. To cope with the hot, dry weather common to that part of the Southwest, the plant's stockpiles of coarse aggregates were wetted regularly to hold down their temperature. Similarly, the temperature of the mix water was automatically controlled by an American Geothermal water cooling and heating pump.

As a further measure to make sure concrete temperatures did not exceed 80 deg. at the time of pouring, in compliance with BuRec specs, water mist spray bars were mounted on the

sides of Silver State's truck mixer drums.

Eighty percent of the total concrete volume going to the dam project was for the parking structure, 90 percent of which was pumped.

The parking facility is a cast-in-place structure using pan slab forming. It is tucked inside a steep ravine that has been partially blasted out to provide enough room for the structural footprint. Stretching 540 ft. in length in a stepped down configuration, the facility is 165 ft. wide and three levels high at the rear, 215 ft. wide and five levels high in front.

Footings at the rear of the building are socketed into solid rock while the front end, which stands atop a fill deposit formed when the dam was under construction, is founded on concrete caissons. There are 29 caissons in all. Each is 3.6 ft. to 9 ft. in diameter and embedded to depths of 90 ft.

Except for the caissons and other structural elements not visible, the parking structure's concrete is integrally colored to blend in with the surroundings canyon rock. Silver State Concrete is matching this natural russet tone by adding dry color pigment to each delivery batch. Supplied by Davis Colors, the pigment, tradenamed Omaha Tan, is packaged in 25 lb. Mix Ready™ bags that are dumped manually into the truck mixers before they leave the plant.

As an added step to achieve the proper color blending, the structural concrete was subsequently sandblasted by PCL to etch its surface and reduce the sheen.

Pouring operations commenced any time from midnight to 6 a.m. in order to avoid morning traffic slowdowns as well as the scorching summer heat that registered up to 140 deg. inside the cutout ravine.



New visitor center rises from a deep V-cut in the canyon wall. Drum-shaped structure is clad with precast panels, some of which follow the profile of rocks and abut.

#### Major tourist attraction

The total estimated cost of the new visitor center and parking structure, including the rebuilt highway section and realignment of transmission towers in the vicinity of the dam, is \$106 million. The new facilities are expected to enable more than one million people a year to tour Hoover Dam, the most frequently visited dam in the U.S. About 750,000 currently visit the dam each year, and more than 29 million people have taken the dam's guided tour since its initiation in 1936.



Hoover Dam is the highest concrete dam in the Western Hemisphere. It is 660 ft. thick at its base, 45 ft. thick at its crest and stretches 1,244 ft. across the Black Canyon. The immense dam contains 3.25 million cu. yard. of concrete, all of which were poured continuously during a two-year period.

Views of New visitor center, Segmental bridge and parking garage constructed at Hoover Dam.