Exposed Structural Systems Enhance Sustainability

Las Vegas Springs, Las Vegas, NV

By Benjamin M. Cornelius, P.E.

The Las Vegas Springs Visitor Center features sustainable, regional, durable, recyclable and low-maintenance materials.

Listed on the National Register of Historic Places since 1978, the Springs Preserve is a 180-acre plot of land located approximately three miles west of downtown Las Vegas. The site represents one of the richest and most unique cultural and biological resources in Southern Nevada. As the Las Vegas Springs owner and steward, the Las Vegas Valley Water District working with the Springs Preserve Foundation set out to protect the area and create a community gathering place – a gateway through time where people can learn about the valley's rich history and explore methods to ensure sustainability for our future.

Designed by Tate Snyder Kimsey Architects (TSK) of Las Vegas and New York City-based structural engineer, Leslie E. Robertson Associates, R.L.L.P. (LERA), to meet LEED® Platinum standards, the Las Vegas Springs Visitor Center consists of two buildings – an exhibit building, containing exciting and interactive exhibitry dedicated to the cultural and natural history of the Las Vegas Valley, and an administrative building, containing offices, guest services and a restaurant. It features sustainable, regional, durable, recyclable and low-maintenance materials, including native stone walls, weathered steel siding and energy efficient glass. The totally exposed steel, masonry and concrete structural systems contributed to the project's overall sustainability, and to achieving TSK's vision and the Las Vegas Valley Water District's goal to create a world class attraction.

First Use of Self-Consolidating Concrete in Nevada

With all of the structure exposed, the concrete had to be spectacular. The use of Self-Consolidating Concrete (SCC) was key to the success of this project. The structural engineer's suggestion to use this material originally met with resistance. Unfamiliar with self-consolidating concrete, the contractor was concerned that the learning curve involved in mastering how to mix and place SCC would be too great.

More widely used in Europe, SCC is more flowable than conventional concrete, but can be just as cohesive and achieve the same durability and strength. The increased flowability of SCC allows the concrete to fill formwork more completely, without segregation and with fewer voids and a better surface finish. And SCC can be placed faster than conventional concrete, with little or no vibration, which can damage form surfaces, requiring time-consuming and painstaking remedial work.

Together with industry professionals pioneering the use of SCC in the United States, LERA wrote a specification and took the lead in communicating the value of self-consolidating concrete. The contractor was persuaded to give SCC a try. The resulting concrete surfaces were so spectacular that self-consolidating concrete was used for the Desert Living Center, a neighboring project being constructed by the same contractor.

Complexities

Las Vegas native caliche, the extensive use of exposed structure and the complex geometry of TSK's edgy, architectural design comprised the primary challenges for the structural design. Ingenuity, teamwork and careful detailing resulted in an efficient solution, overcoming these complex challenges.

Caliche

A soil condition found in some areas of the arid Southwest, caliche is a deposit of calcium carbonate (lime) beneath the soil surface. This condition is more commonly called "hardpan" and creates an impervious layer in lower levels of soil. The site for the Las Vegas Springs Visitor Center consisted of multiple caliche layers, whose elevation varied across the site, sometimes quite abruptly. This created the potential for several distinct bearing conditions, each with different bearing surface

The use of Self-Consolidating Concrete (SCC) resulted in a superior finish and cost savings due to the significant reduction in the need for cosmetic repairs typically necessary when using traditional cast-in-place concrete.

preparation procedures, allowable bearing pressures and stiffnesses. Footing elevations were generally chosen with the goal of having all footings in a given building bear either upon caliche (in the case of the exhibit building) or on structural fill above the caliche (in the case of the administrative building). In some cases, however, architectural considerations or variations in the depth or thickness of the available caliche levels required transitions from caliche to structural fill. LERA, working together with the geotechnical engineer, Converse Consultants, developed four different typical procedures and details for excavation and bearing surface preparation, to allow the contractor to address the four different anticipated conditions and mitigate the challenges of the variable bearing materials. In one case, a pit that extends 18 feet below grade and catches 7,500 gallons of water rushing out of the flash flood experience exhibit, was constructed in a hole dug through the caliche and hung from a footing ringing the pit that bears upon the caliche.

A built example of the sustainability it promotes, the Las Vegas Springs Visitor Center features totally exposed steel and concrete structural systems.

Sculptured Detailing

The extensive use of exposed structure required a higher level of detailing than most projects with architectural finishes. The structural steel, interior screens, exterior shade structures, stairways and awnings all required details that were sculptural in quality. The 72-foot diameter rotunda also featured a richly detailed, long-span roof system.

Structural Steel

Nearly all of the elevated floor and roof framing in both buildings is architecturally exposed. Framing was organized and designed to create a handsome and efficient layout that is respectful of headroom requirements, particularly for architectural elements suspended from the roof. The result is a system that appears quite light and neat, and allows for the complex integration of architectural, mechanical and exhibit systems below.

Shade Structure

Shade structures, with a total area of approximately 20,000 square feet, surround various portions of each building, controlling solar radiation and providing an exciting and dramatic architectural feature. The screens are variously supported from the building structure, the ground, or both. The screen panels consist of perforated gauge metal and expanded metal, and are set into a light steel framework of layered plates. The metal panels themselves are both architectural and structural, affording the screen great stiffness over spans of as much as 30 feet between supports. Details for the layered plates and their connections to one another, to the building and to the foundation were sculptural and in keeping with the TSK's vision for the shade structures. All components of the shade structures were treated with a special weathering finish compound, which yielded an attractive weathered appearance and texture, with color ranging from chocolate brown to orange. A similar shade structure is supported from the inside face of the circular rotunda wall.

Cantilevered Awning

An elliptical steel awning, measuring 33 feet from front to back and cantilevering more than 27 feet past its forward supports, forms the centerpiece of the main entry to the exhibit building. With a structure formed entirely of steel plates, the awning consists of three elliptical plates and a circular plate – each with a different center-point along the front-to-back axis of symmetry – and a series of radial plates that create the appearance of a rising sun. Glass panels were cut to match the shapes formed by the intersecting elliptical, circular and radial plates. The awning tapers from back to front, and connections were designed with partial penetration welds to minimize deformations due to welding operations.

Rotunda Roof System

The rotunda consists of a 72-foot diameter circular area and column-free zone. A stream of water below the walking surface, together with the linear organization of materials, directs the visitor to the center of the rotunda. A shade structure, suspended from the inside face of the rotunda wall and adorned with weathered, perforated steel panels, serves as an internal solar control device, punctuated with colored glass panels that introduce a unique spectrum of light into the interior. The rotunda roof framing converges at the center of the rotunda at the "crown node." This seven-sided, prefabricated intersection was erected onto a central shoring tower, and then framing beams spanning between the perimeter and the node were installed with relatively simple connections.

Complex Geometry

The unusual geometry of the Visitor Center presented challenges to the goal of creating an efficient and constructible design. LERA was proactive in facilitating simpler coordination between the steel, concrete and masonry components. Although steel erection columns embedded in concrete bearing walls were considered early in the design phase, the concept was abandoned in response to longer steel lead times.

continued on next page

Exposed railings and interior screens required high level of detailing.

An elliptical steel awning, measuring 33 feet from front to back and cantilevering more than 27 feet past its forward supports, forms the centerpiece of the main entry to the exhibit building.

In search of ways to simplify the coordination required between the concrete, steel and masonry trades, LERA organized the steel framing to minimize the number of connections between steel framing and concrete and masonry walls.

LERA also took steps to make more efficient use of the structural framing, and simplify fabrication and erection. LERA designed girders to pass continuously over the tops of columns, taking advantage of the negative bending capacity and stiffness of the girders. Girders were also set up from the tops of roof beams by an amount equal to the thickness of the metal roof deck to allow for a shallower ceiling package and far fewer beam copes.

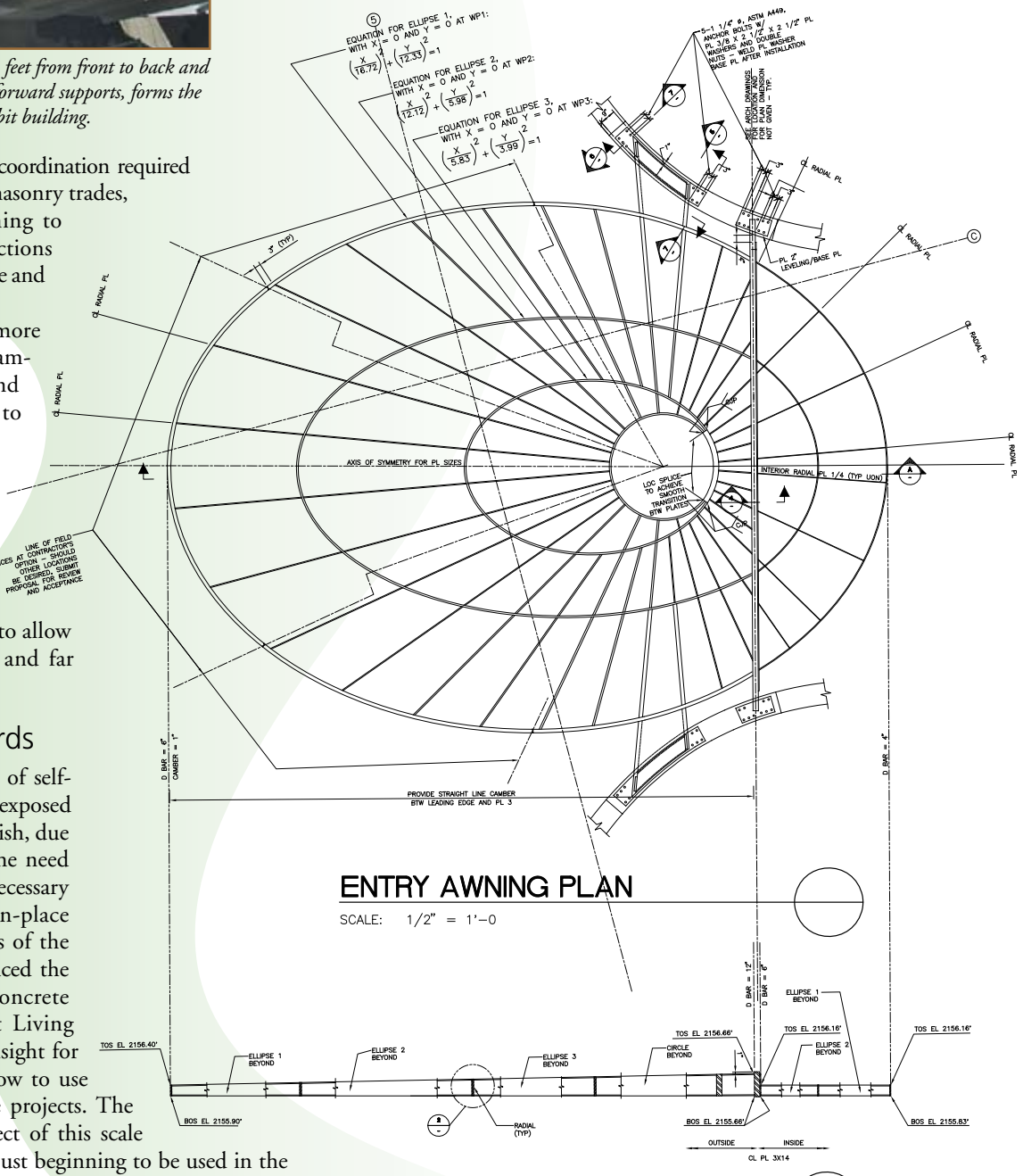
Setting New Standards

The decision to specify the use of self-consolidating concrete for the exposed concrete resulted in a superior finish, due to the significant reduction in the need for cosmetic repairs typically necessary when using traditional cast-in-place concrete. The spectacular results of the completed Visitor Center influenced the choice of self-consolidating concrete (SCC) for the adjacent Desert Living Center, and provided valuable insight for all involved in the project on how to use SCC to the advantage of future projects. The successful completion of a project of this scale and quality with SCC, which is just beginning to be used in the United States, increased the understanding of SCC by the entire team, and raised the potential for future use of this technology in this country.

The Las Vegas Valley Water District, working with the Springs Preserve Foundation, set out to protect the area and create a community gathering place. "The Springs Preserve was developed to create a sense of place, a sense of identity for Las Vegas," said director Francis N. Béland. The Visitor Center, where guests begin their tour of this unique facility, achieves that goal.

The first attraction of its kind, the Preserve is designed to set new standards in "green building." A built example of the sustainability it promotes, the totally exposed steel and concrete structural systems contributed to the project's overall sustainability and to achieving the architect's vision and the client's goal to create a world class attraction.▪

Benjamin M. Cornelius, P.E. is a Senior Associate at Leslie E. Robertson Associates, R.L.L.P. (LERA) and was Project Manager of the Las Vegas Springs Visitor Center. With the firm since 1994, Mr. Cornelius has been involved in the design of a wide range of building types. Benjamin is currently LERA's project manager for the design of a high-rise office tower in Boston, which is being designed to meet USGBC LEED® criteria.



Some dimensions and call-outs have been removed for printing purposes.