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A Daybreak's work

Little is wasted at bridge site in South Jordan, Utah

From the beginning, Rio Tinto Kennecott envisioned Daybreak, a 4,125-acre master-planned community in South Jordan, Utah, differently.

Whether you call it sustainable development, smart growth, green building or just common sense, it is Daybreak's foundation. It is the knowledge that the decisions they make today will be felt by their children and their children. What they intended to create is a community that will enrich their lives, keep them healthy and equip them for future success.

One approach to sustainable development at Daybreak is the amount of open space planned for the development. This open space is programmed as both parks and useable open space for the community. One of the next major parks and open spaces being constructed is Brookside Park, located north of Daybreak's Oquirrh Lake. Brookside Park, which includes trails, landscaping and a water feature, is envisioned as a north-to-south connecting feature, bringing one of the major residential community's to Oquirrh Lake. However, a major arterial crosses the park. Rather than bisecting the park, a plan was laid to span the park with a vehicle bridge connecting a residential roadway and the Brookside Park underneath.

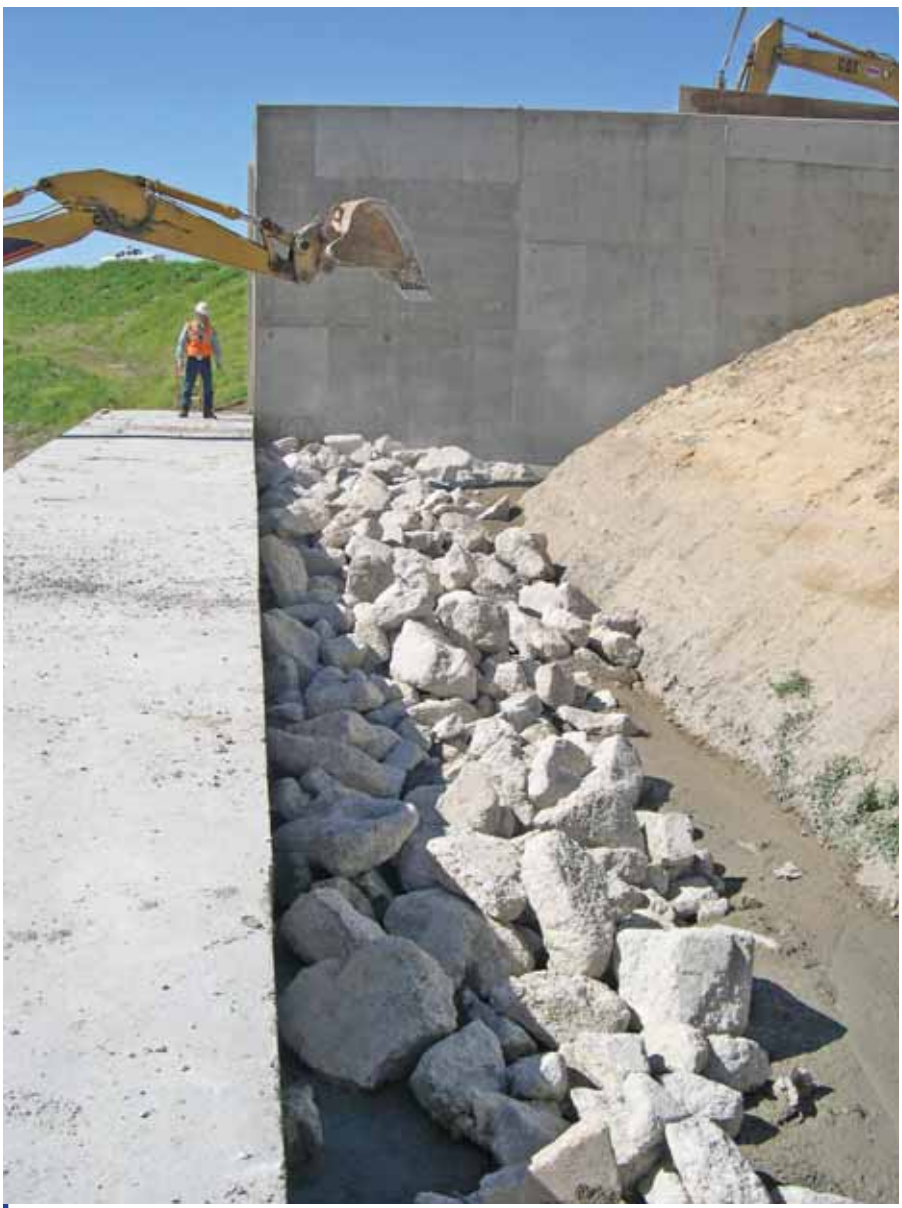
This was to be no ordinary vehicular bridge. It not only needed to serve as the major arterial—designed as an extension of South Jordan Parkway—over the park, it needed to be elegant, beautiful and open, and result in the least impact on the environment. When evaluating the various bridge types, the Daybreak planners and engineers, and Nolte Associates Inc., their structural engineer and project manager, considered the architectural features of the surrounding community and the visual impact of the bridge, the potential cost and time to build the bridge and the considerable temperature swing, which can be as much as 60° in a 24-hour time period.

Having had great success with precast concrete arch bridge types at Daybreak, the Daybreak/Nolte team decided to use a low-profile and long-span arch bridge style. Thus was born the arch at Brookside.

A golden arch

Brookside Bridge is an 82-ft-wide, four-lane arterial bridge designed to accommodate vehicular, bicycle and pedestrian traffic with an 84-ft span. Its low profile provided only a 10-ft rise at the midspan, so the bridge abutments were elevated an additional 10 ft to provide sufficient vehicle clearances for the residential roadway going underneath. The elevated abutments provided the added benefit of a more "open" feel and less of a tunnel effect.

Nolte selected the precast concrete bridge type because it would be provided locally by Contech Construction Products Inc. The Brookside Bridge's 84-ft span precast concrete arches are made with some locally available recycled materials. Developed in 1966 in Switzerland, the arch system is a precast concrete version of the arches used in Roman aqueducts built over 2,000 years ago. The third arch system bridge at Daybreak, Brookside Bridge is the largest of the three. Additionally, the modular bridge system provided for fast erection of such a large span. It took only two days to set the 20 precast arches; each arch was formed by two 4-ft-wide, 42-ft-long, 2-ft-thick precast units that joined together in the midspan. The midspan connection of the arches, which is formed by gravity, was held together during erection by a steel pin until the crown joint concrete sections were installed and arches as a structural unit were completed. Its smooth lines and elegant style allow it to blend with its surroundings.



In an effort to save costs, fulfill Kennecott's commitment to sustainable development at Daybreak, increase strength and shorten the time to place flowable fill material, the Daybreak/Nolte team used the 4,000-psi concrete slab waste material to help fill some of the void/area where the flowable fill thrust blocks were to be placed.

The mission of Kennecott, the Daybreak developer, is to raise the bar for community design. Their vision centers on bringing everything in close, right into the neighborhoods, so that residents are within a five-minute walk of a park or trail, a school or a community center, or the village center's shops and restaurants. And their dedication to design includes rigorous review of all architectural elements in the community, including roadways, bridges, lighting elements and landscaping. A concrete arch was a natural selection, as it would blend in seamlessly with the natural elements of the surrounding community. The arch segments have a thin profile, as compared with steel or concrete girders, and its smooth lines and thin, elegant style blend well with the park. The slim design also provides more opportunities for enhanced architectural finishes, which will be added before construction is completed. Additionally, the flat rise-to-run look eliminates the rectangular opening tunnel effect most roadway bridges create.

As the Brookside Bridge is a new facility, the concrete arch provided a significant cost advantage to Kennecott. Selection of the arch structure eliminated the need to prepare design specifications for multiple products, effectively eliminating design of conventional abutment walls, girders and the bridge deck. Construction of conventional bridge structures with these types of bridge elements typically run significantly higher in cost than the all-in-one arch bridge that was selected.

As on-time completion of the new roadway was a key consideration, speed of erection was factored into bridge-type selection. In June 2010, the main arch segments were erected in two days, with the crown joint completed in just 5 days, allowing the parapet walls to be completed much sooner than conventional bridge structures. This speed supported the need to complete the main structural

It took only two days to set the 20 precast arches; each arch was formed by two 4-ft-wide, 42-ft-long, 2-ft-thick precast units that joined together in the midspan.

components before winter. This will allow the necessary time for the architectural finishes to be installed in the spring, enabling the Brookside Bridge to be completed in time for roadway access to the new Daybreak light-rail station opening in late summer 2011.

The Brookside Bridge includes no expansion joints in the main roadway deck, which is critical to accommodating the high temperature variations that occur in South Jordan. As the roadway sits atop the arch (there is a 4-ft soil buffer between the arch and the roadway), concerns regarding creep and shrinkage due to temperature variation are limited exclusively to the roadway. And with no expansion joints, maintenance costs are minimized and life-cycle costs are lowered as there is no bridge deck or joints at the bridge deck/roadway interface.

Every bit is good

Weighing in at 8.5 million lb, the Brookside Bridge is no lightweight concrete structure. This includes the precast segments (500 cu yd), the abutment footings (850 cu yd) and large mass thrust blocks (1,200 cu yd) for load-carrying strength. A rough calculation indicates approximately 190,000 lb of reinforcing steel was required. All of the reinforcing steel in the bridge is recycled steel, locally produced in Utah.

Kennecott's commitment to sustainable development translates into high-performing commercial buildings. All commercial buildings built by Kennecott within Daybreak will seek to achieve some level of Leadership in Energy and Environmental Design (LEED). It only seemed natural that the Brookside Bridge adhere to similar sustainable development standards as well. The LEED criterion awards one to two points when at least 10% of building materials are made of recycled materials. Similarly, one to two additional points are awarded if at least 10% of materials are manufactured within 500 miles. According to the U.S. Department of Energy, man-made buildings account for nearly 18% of total U.S. carbon emissions, with a portion of that related to the manufacture of building materials and the required transport of the materials to the construction site. As such, Kennecott has sought building materials and products that are extracted and manufactured locally to the Daybreak jobsite with the intent of reducing the environmental impact that would result from transporting these goods. Sourcing the bridge locally—Contech is located within 50 miles of Daybreak—supported both Kennecott's goals and the sustainable elements of the Brookside Bridge. Additional sustainable elements included the use of recycled concrete for the precast arch abutment thrust blocks, recycled rebar and oil with low levels of volatile organic compounds used for the cast-in-place retaining and parapet walls.

As Kennecott requires all builders and contractors to recycle at least 75% of their construction waste, Daybreak had an on-site stockpile of concrete sidewalk material—damaged and replaced throughout the course of construction activities—that needed to be recycled. With this concrete slab material readily available within a short distance on-site, a plan was proposed by the Daybreak team to use this material as in-fill for the large main arch thrust blocks (1,166 cu yd) that were to consist of a 500-psi flowable fill material.

In an effort to save costs, fulfill Kennecott's commitment to sustainable development at Daybreak, increase strength and shorten the time it would take to place the 500-psi flowable fill material, the Daybreak/Nolte team used the 4,000-psi concrete slab waste material to help fill some of the void/area where the flowable fill thrust blocks were to be placed. This was accomplished in the following manner:

- The waste concrete pieces were screened so that all pieces used were at least 12 in. in size or greater;
- The waste concrete pieces were placed, not dumped, into the area to be filled, in order to keep a consistent void size; and
- The 500-psi flowable fill design was set at a slump of 8 to 10 in. so it would flow easily into the open/void areas around the concrete pieces to create a solid mass.

Reusing the concrete slab waste material saved at least half of the volume and subsequent cost of the total flowable fill required by the design while significantly reducing the amount of concrete material that would have otherwise been recycled off-site. The time required for placement of the flowable fill was shortened, thereby shortening the cure time. Additionally, the presence of these higher-strength concrete pieces increased the overall strength of the mass, improving performance of the bridge structural components at a reduced cost.

In total, the Brookside Bridge used approximately 3.2 million lb of recycled concrete and recycled rebar and did it with style. The bridge will be open to vehicular traffic in the spring of 2011. For additional information on the Daybreak community, visit www.daybreakutah.com. **R&B**

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