BRIDGE OVER SWINGLEY RIDGE ROAD

by Kevin Eisenbeis, Harrington & Cortelyou Inc.

The bridge spans Swingley Ridge Road and provides access to the parking garage.

Cast-in-place concrete provides the answer

A cast-in-place concrete bridge provided the aesthetic solution when Sachs Properties Inc., owners of the Chesterfield Ridge Center office development complex in Chesterfield, Mo., needed a bridge for access to their new parking structure and six-story building. The complex site geometrics called for a bridge to span Swingley Ridge Road, while also providing access to the rooftop level of a new parking structure.

A new, 322-ft-long bridge spanning Swingley Ridge Road was desired to allow easy access to Chesterfield Ridge Center from the nearby North Outer 40 parallel connector road and I-64. A 100-ft-long upper level drive extension, projecting from the bridge, was also needed for access to a new parking structure. A cast-in-place, reinforced concrete bridge, T-shaped in plan view, provided the elegant solution desired. The monolithic concrete structure,

profile

SWINGLEY RIDGE ROAD BRIDGE / CHESTERFIELD, MO.

BRIDGE DESIGNER: Harrington & Cortelyou Inc., Kansas City, Mo.

CIVIL ENGINEER: Volz Inc., St. Louis, Mo.

GEOTECHNICAL ENGINEER: Geotechnology Inc., St. Louis, Mo.

BUILDING ARCHITECT: Mackey Mitchell Associates, St. Louis, Mo.

A cast-in-place reinforced concrete bridge provided the elegant solution needed.

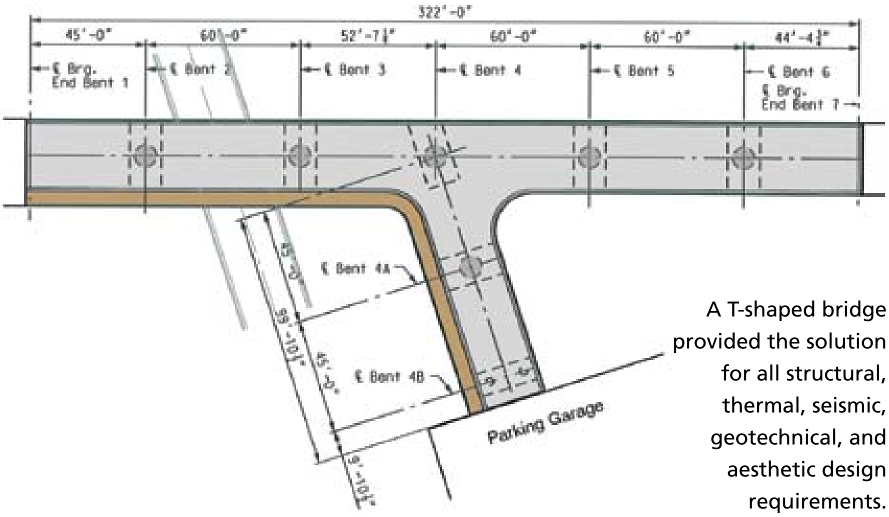
supported on single-column, "golf tee" concrete piers, provided the ideal solution to meet all structural, thermal, seismic, geotechnical, and aesthetic design requirements.

Several structural options were initially considered for the bridge. Framing issues and thermal movement requirements for steel and concrete girder spans proved to be undesirable where the upper level drive entrance connected to the main structure. Use of a monolithic concrete slab bridge eliminated structural discontinuities and complex superstructure framing details where the elevated structure arms converged. Pier caps supporting girders were no longer needed. Expansion joints on the structure could also be eliminated, with joints being used only at abutments and where the entrance drive joined the parking structure.

Eric Neprud, project engineer for Harrington & Cortelyou, summarized the choice: "Selection of the voided slab bridge drastically simplified the detailing requirements where the access drive meets the main bridge." The use of 16-in.-diameter voids embedded within the 2-ft 3-in.-thick slab reduced weight and material requirements, allowing the thin superstructure to span up to 60 ft between pier support points. Drop panels varying from 6-in. to 10-in.-thick were required to distribute loads to the narrow columns. A 28-day concrete compressive strength of 4000 psi was used with the Missouri Class B2 mix design, allowing the bridge to carry AASHTO HS-20 live loading. A 5-ft-wide sidewalk was also cantilevered from the bridge.

Chesterfield, located just west of St. Louis, Mo., is subject to Category B seismic requirements. The complex T-shape of the structure dictated that a three-dimensional analysis would be required for seismic considerations with a ground acceleration of 0.12g. Structural analysis utilizing a response spectrum analysis with mTAB Stress (SAP 386) software indicated displacements and loadings would be acceptable. The tall, slender piers supported on single drilled shafts performed well when analyzed for seismic loading. Conventional analysis of the bridge was made utilizing the Brass program.

Field exploration consisted of four borings extending through the 41-ft to 46-ft-thick overburden and 25 ft into the rock below. Due to the geology of the site, a potential for slope instability in the earth fill required special analysis.



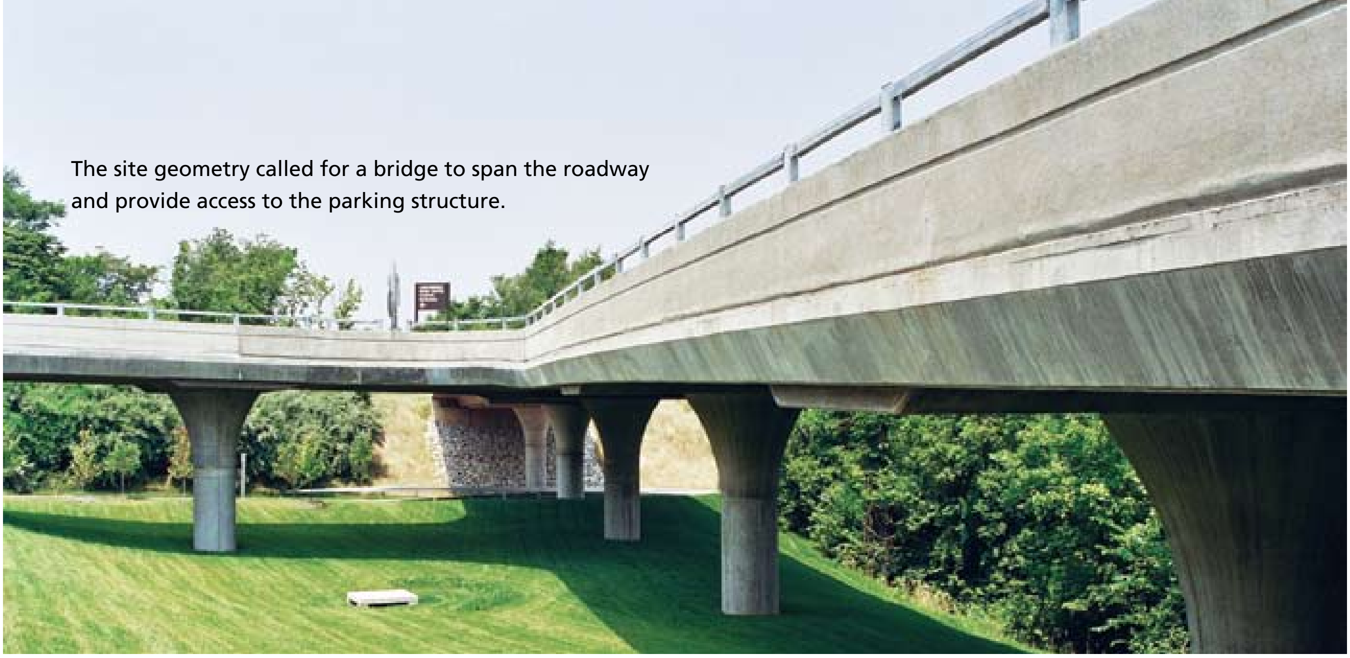
A T-shaped bridge provided the solution for all structural, thermal, seismic, geotechnical, and aesthetic design requirements.

CAST-IN-PLACE REINFORCED CONCRETE / SACHS PROPERTIES INC., ST. LOUIS, MO., OWNER

BRIDGE CONTRACTOR: St. Louis Bridge, St. Louis, Mo.

FIELD OBSERVATION: Alper-Ladd, St. Louis, Mo.

BRIDGE DESCRIPTION: A cast-in-place reinforced concrete bridge, T-shaped in plan view consisting of eight spans supported on six columns and three end bents

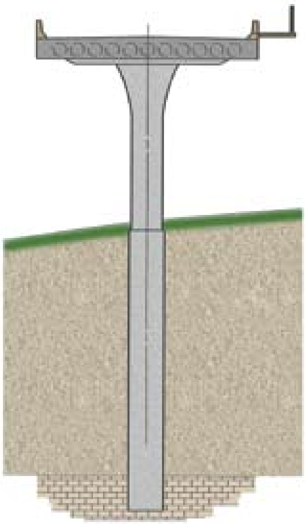

The site geometry called for a bridge to span the roadway and provide access to the parking structure.

The tall, slender piers supported on single drilled shafts performed well when analyzed for seismic loading.

Any change in natural conditions of the highly plastic shaley clays could lead to instability. Drilled shaft foundations were designed for an additional 40 kips of lateral load, in addition to other lateral loads on the piers, as a result of potential slope creep in the 45-ft-thick soil mass overlying the limestone bedrock. Drilled shafts were socketed 2.5 diameters into the limestone below the fill to provide additional lateral resistance. Since falsework and shoring were used to build the new structure, recommendations were also provided for allowable bearing pressures for falsework support footings.

The bridge was built over a 10-month period. Following installation of the drilled shafts and pier columns, the voided slab superstructure was constructed on falsework with concrete placed in a sequential manner. Positive moment sections were placed first, followed by 30-ft-long segments over the pier supports. Forms were cambered to account for dead load deflections and removed when the concrete strength reached 3000 psi.

The cast-in-place concrete bridge provided an economical and attractive solution in this combined commercial and residential setting while the complex geometry of the site and shallow structure requirements made the cast-in-place option ideally suited for this application.


The substructure consists of single piers on single drilled shafts.

Kevin Eisenbeis is a principal with Harrington & Cortelyou Inc., Kansas City, Mo.

For more information on this or other projects, visit www.aspirebridge.org.

AESTHETICS COMMENTARY

by Frederick Gottemoeller

This structure is an excellent resolution of a complicated structural and aesthetic problem: the bridge with a branch. Designing a bridge like this with typical steel or concrete I-beams always results in a confusion of beam layouts and awkward connections. The cast-in-place voided slab, on the other hand, adapts readily. All of the connections and points of force transfer are inside the slab. The exterior shows only a smooth continuous surface along the main lines of the structure. The bridge seems to be all one piece. The eye effortlessly follows its edges from abutment to abutment.

The cross section of the superstructure also has enough torsional stiffness to allow single column supports. This minimizes the number of columns and allows streets, planting areas, and views to flow through under the bridge. The space under the bridge remains a pleasant place to be. Finally, the flares at the top of the columns make clear the flow of forces from the superstructure to the ground. They make this small but complex structure memorable.

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Spikes in Worldwide Steel Prices Impact Bridge Construction

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These increases pose major challenges for owners, contractors, and industry suppliers. Out-of-date estimates can result in funding shortfalls. Fixed price bids, which have not anticipated these sky-rocketing prices, threaten the financial viability of contractors and suppliers alike. Owners, contractors, and suppliers are urged to work together to meet this challenge and reasonably manage risk for all involved in bridge construction.

On a positive note, as material prices continue to rise, the use of high-strength materials generally becomes more cost competitive. Prestressed concrete bridges that proportionally use less steel are even more economical when compared to other structural systems.

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