

MIDDLEBURY'S CROSS STREET

An innovative approach from funding through design

Middlebury is in the heart of Vermont and home to Middlebury College, one of the country's elite liberal arts schools. The college and the quaint town have a rich history. The Cross Street Bridge is an infrastructure wonder. From funding through design, it's a project that can serve as an example to many others desiring to integrate infrastructure improvements into the fabric of the community.

The three-span Cross Street Bridge is the first major design-build transportation project in the state of Vermont, and with a center span of 240 ft, it boasts

the longest simple-span precast, post-tensioned, spliced concrete girder bridge known in the United States.

Otter Creek bisects the town, separating the downtown shopping district and the college from emergency services and Route 7, the major north-south highway in the region. The lone existing crossing is a narrow stone arch bridge built in the late 1800s. The need for a second bridge to alleviate traffic for residents and visitors and provide additional pedestrian and bicycle facilities was becoming more and more urgent.

In addition to being the first design-build project in Vermont and the longest simple-span precast, spliced concrete girder in the country, this project is even more unique because the \$16 million project received no funding from federal or state sources; it was funded entirely by the Town of Middlebury and Middlebury

College. Without the additional federal requirements, the permitting process was streamlined. The fast pace of the project ultimately saved money. Ground breaking was in April 2009 and the bridge opened to the public with great fanfare in October 2010.

Another innovative aspect of the project was the design-build contracting. The town hired a single team for both the construction and design engineering. The decision to use the design-build project delivery method allowed the long-awaited bridge to go from concept to completion quickly upon securing project funding.

Bridge Features

The center span includes five girder lines, 10 ft deep. Each line consists of three individual segments measuring 65 ft, 110 ft, and 65 ft. The span was erected using two temporary towers in the channel.

A photo simulation by VHB of the bridge as envisioned.

profile

CROSS STREET BRIDGE / MIDDLEBURY, VERMONT

BRIDGE DESIGN AND CONSTRUCTION ENGINEER: VHB-Vanasse Hangen Brustlin Inc., North Ferrisburgh, Vt.

SPLICED GIRDER ENGINEER: Corven Engineering Inc., Tallassee, Fla.

GEOTECHNICAL ENGINEER: GeoDesign Inc., Windsor, Vt.

PRIME CONTRACTOR: Kubricky Construction Corp., Glen Falls, N.Y.

PRECASTER AND CONCRETE SUPPLIER: J.P. Carrara & Sons Inc., Middlebury, Vt., a PCI-certified producer

ET BRIDGE

by Christopher D. Baker,
VHB-Vanasse Hangen Brustlin Inc.



A view of Middlebury, Vt., and the new Cross Street Bridge under construction over Otter Creek. All photos: VHB-Vanasse Hangen Brustlin Inc.

The girders were shimmed to the proper elevation, the splices were cast, and the span was post-tensioned and grouted. The post-tensioning needed to span 240 ft required five tendons per girder with each tendon providing approximately 960 kips of jacking force. The precaster was required to produce a 10,000 psi self-consolidating concrete to meet the design demands. Through close coordination with regional admixture representatives and a thorough quality control program, a consistent concrete was produced that met or exceeded the design requirements. The girder segments were erected using a single Manitowoc crane with 160 ft of boom capable of maneuvering the 93-ton segments into place.

The new three-span, 480-ft-long bridge features a 240-ft-long main span that traverses Otter Creek, and is anchored by

a pair of 120-ft-long precast, prestressed concrete adjacent box beam spans, crossing over a local road and a railroad. The box beams are 48 in. wide and 42 in. deep and used concrete with a design compressive strength of 8000 psi with 6000 psi required at transfer. The bridge's 44-ft 8-in.-wide superstructure accommodates two lanes of traffic and two sidewalks providing pedestrian access to the bustling downtown shopping district.

The Cross Street Bridge was designed to be low-maintenance. Prestressed concrete is naturally a very durable type of superstructure. In addition, a corrosion inhibitor was used in the precast concrete fabrication. Epoxy-coated reinforcement was used in the deck, along with a membrane and pavement wearing surface. The fascia beams, sidewalk, abutments, and piers were

also coated with silane water repellent. The deck is 8-in.-thick with 11-in.-thick, 6-ft-wide sidewalks.

The Cross Street Bridge is the first major design-build transportation project in the state of Vermont.

Environmental Concerns

The innovative approach to the design of the bridge came about as the result of environmental concerns. The Agency of Natural Resources did not approve the original bridge design, which included a pier in the middle of Otter Creek. The design team was then challenged to come up with a way to design the bridge to span the entire channel with no supporting structure in the river. Instead of reverting to a steel structure, Middlebury remained committed to a precast, prestressed concrete bridge. VHB met this challenge by partnering with Corven Engineering Inc. for the new design.



THREE-SPAN, 480-FT-LONG, PRECAST, PRESTRESSED CONCRETE, SPLICED GIRDER BRIDGE / TOWN OF MIDDLEBURY, VERMONT, OWNER

POST-TENSIONING CONTRACTOR: VSL, Springfield, Va.

BRIDGE DESCRIPTION: Precast, prestressed concrete bridge with spans of 120 ft, 240 ft, and 120 ft comprising precast, prestressed concrete adjacent box beams in the end spans and 10-ft-deep, spliced New England bulb-tee girders in the center span. The bridge also used cast-in-place concrete foundations, piers, abutments, deck, curbs, and sidewalks.

BRIDGE CONSTRUCTION COST: \$8 million (approximately \$360/ft²)



A 10-ft-deep, 110-ft-long girder segment negotiates city streets in downtown Middlebury. Photo: J. P. Carrara & Sons Inc.

The west abutment consists of a pile cap stub abutment on a single row of H-piles enclosed by a wrap-around mechanically stabilized earth (MSE) wall. The east abutment is a traditional abutment stem supported by a spread footing. Each of the piers is wall-type and is supported by spread footings on H-piles.

The bridge designer collaborated with town officials, a local bridge committee, and the public to develop bridge aesthetics. Maintaining Middlebury's historic, New England charm was a priority for the town. The Cross Street Bridge includes numerous aesthetic features that set it apart from typical highway bridges, such as stepped, hexagonal pier ends with full-height vertical recesses. The bridge also includes decorative street lighting on both fascias, anodized aluminum bridge railings, and pedestrian overlooks at each end of the center span on the ends of the wall piers. Both abutments have an aesthetic finish.

Project Communication

Leadership, teamwork, and a commitment to open communication were keys to this smooth-running design-build project. Given the aggressive schedule and amount of work to be accomplished, due consideration was given early on to defining the process that would guide the project through to completion. The project team agreed upon a hierarchy of communication that would efficiently channel information back to the construction and design project managers as well as other key staff in the office and the field.

The team also worked to establish project timelines and outlined a logical way of packaging the project into manageable "bite-sized" submittals to accommodate contractor and/or fabricator needs. Once the submittal packages were identified, early coordination meetings helped to define anticipated needs during the design

and construction process. The team established a plan review process that generally started with periodic fabricator reviews and meetings followed by final reviews by the fabricator and contractor prior to being reviewed by the town and released for construction. Prior to entering each construction phase, the team inspectors and testing specialists were engaged to review the components to prepare for construction.

With cutting-edge engineering and attention to aesthetic detailing, the Town of Middlebury writes a new page in its storied history with an eye on the future and a nod to its past. The Cross Street Bridge is truly one of a kind in its innovative funding and design-build approach, and it has set engineering records. It is a welcomed addition to this unique New England Town.

Christopher D. Baker is principal/national director—structural engineering at VHB-Vanasse Hangen Brustlin Inc. in Bedford, N.H.

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



The Cross Street Bridge incorporates several aesthetic enhancements such as stepped, hexagonal, wall piers with vertical recesses, pedestrian overlooks on each pier end, anodized bridge railings, and decorative street lighting.



Girder segments were set on falsework in Otter Creek where they were spliced and post-tensioned into a 240-ft-long simple span.