National Steel Bridge Alliance

# 2007 PRIZE BRIDGE *Competition*

The NSBA Prize Bridge Competition honors significant and innovative steel bridges constructed in the United States. Awards are presented in a variety of categories, including long span, medium span, short span, movable span, major span, reconstructed, and special purpose.

The National Steel Bridge Alliance thanks the submitters of all of the outstanding entries for their participation in the 2007 Prize Bridge Competition. The projects were judged on:

- Innovation
- Aesthetics
- Design and engineering solutions

Designers of the winning Prize Bridge projects will receive award plaques during a dinner banquet at the 2007 World Steel Bridge Symposium in New Orleans, December 4–7, 2007. Owners of winning bridges will receive award plaques at a dinner banquet during the 2008 AASHTO Bridge Subcommittee meeting.

Jurors for this year's competition were:

- Thomas Lulay
  CH2M Hill, Salem, Ore.
- Matthew Farrar, State Bridge Engineer
  Idaho Department of Transportation, Boise
- Myint Lwin, Director
  FHWA Office of Bridge Technology, Washington, D.C.
- Andrew Herrmann, Managing Partner
  Hardesty and Hanover, New York

# NATIONAL AWARD

SPECIAL PURPOSE

## Highland Bridge

Denver


The new Highland Bridge restores a vital link between downtown Denver and the revitalized Highland neighborhood to the northwest. It replaces the 16th Street viaduct, a reinforced concrete viaduct that was failing when it was demolished in 1993, with a user-friendly pedway. It is the third in a family of three signature pedestrian bridges extending the city's downtown 16th Street Pedestrian Mall alignment across the Central Platte Valley.

Similar to the first two crossings, the Highland Bridge utilizes structural steel tubing and a cable-stay system for a dramatic structure. Rising 70 ft above the ground, the triple-rib steel arch spans 320 ft over Interstate 25. The flared cross-hanger arrangement provides a sweeping support system for the suspended bridge deck.

### Design Vision

During the project's design, many structural steel options were evaluated, ranging from 200 ft to 350 ft long: single-rib arches, trussed arches, and bifurcated arches. Renderings were used during the design process by the architects, urban designers, and structural designers to share design concepts and solicit input from stakeholders and the public. Input from businesses, residents, and special interests, such as bicyclist groups, helped steer the project design. Critical to the urban design concept was the creation of a vertical circulation area to traverse a 13-ft change in grade from the structure deck down to the existing Platte Street elevation on the east side of I-25. The need for both long ramp access and stair access drove the design toward an architecturally sophisticated and urban solution. A circular ramp solution minimized impact on surrounding property while creating a plaza area with theater seating and direct access to nearby shops and a park.

The west end of the triple-rib arch anchors into a single-thrust block foundation. As pedestrians and bicyclists travel east across the bridge, the arch rib spacing increases, opening up and framing the downtown skyline, with each arch rib anchoring into a separate foundation.

Input from fabricators and contractors was solicited during the design to provide efficient and economic details. To facilitate construction over I-25, the arch fabrication was broken into four sections. Temporary splice plate connections between the arch pieces were designed for ease of erection and were removed once the arch steel pipe welds were completed.

### Innovative Construction

To facilitate fabrication, the arch sections were fabricated upside down and fitted up to adjacent pieces for geometry control. The pieces were painted in the shop and shipped to the field, where each section was reassembled in a staging area north of the bridge site in preparation for erection. The arch sections were erected by crane during two consecutive night closures of I-25. The contractor's step-by-step sequence included a rolling procedure to orient the arch section upright and provide temporary falsework support for the end sections.

Design allowances during construction included sleeving the individual anchor bolts for each arch piece in the foundation, allowing up to one inch of adjustment in any direction. The sleeves and under-the-arch base plates were grouted after placement.

After the arch erection, the steel deck girders

**Owner**
City and County of Denver

**Sturctural Engineer**
Hartwig & Associates, Inc., Englewood, Colo.

**Designer**
Carter & Burgess, Denver

**Fabricator**
King Fabrication, Houston (AISC Member)

**Construction and Erection Engineering**
GES Tech Group - Consulting Engineers, Calhan, Colo. (AISC Member)

**General Contractor**
Hamon Constructors, Inc., Denver

were suspended with temporary cables prior to installation of the permanent 1.5-in.- to 1.75- in.-diameter cables. Because of the asymmetric layout and varying lengths and angles of the permanent cables, the deck girder geometry was set with a cambered twist, so that once the deck was poured it would match the proper geometry. The cable forces were monitored during the construction by measuring the cable vibration frequency. With the use of an accelerometer, the cable forces were calculated from the cable frequency, length, and weight. This method of measuring the cable forces was non-intrusive and can be used to conduct future routine inspections of the bridge. MSC