Bridge Design Alternatives
for the Joint Transportation Committee
Washington State Legislature

December 11, 2014

Linda Figg
President/CEO
FIGG Bridge Companies

FIGG

CREATING BRIDGES AS ART®

FIGG

CREATING BRIDGES AS ART®

Exclusively Specializing in Bridges for 36 Years United States of America and International

FIGG Bridges in 42 states and 6 countries

FLORIDA

Family of Bridge Companies:

FIGG Bridge Engineers
FIGG Bridge Inspection
FIGG Bridge Developers
FIGG Bridge Managers

FIGG BRIDGE BUILDERS

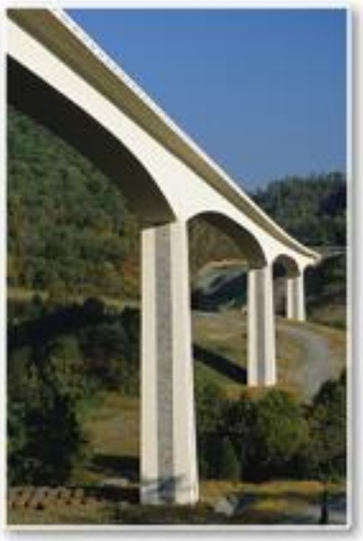
Building Bridge Landmarks™

WASHINGTON

COLORADO

VIRGINIA

BOSTON



355 Bridge Design Awards for Our Customers

All Bridges Built Because They Were Lowest Cost

Sunshine Skyway Bridge, FL

Blue Ridge Parkway Viaduct, NC
National Park Service

Natchez Trace Parkway Arches, TN
National Park Service

3 Presidential Awards

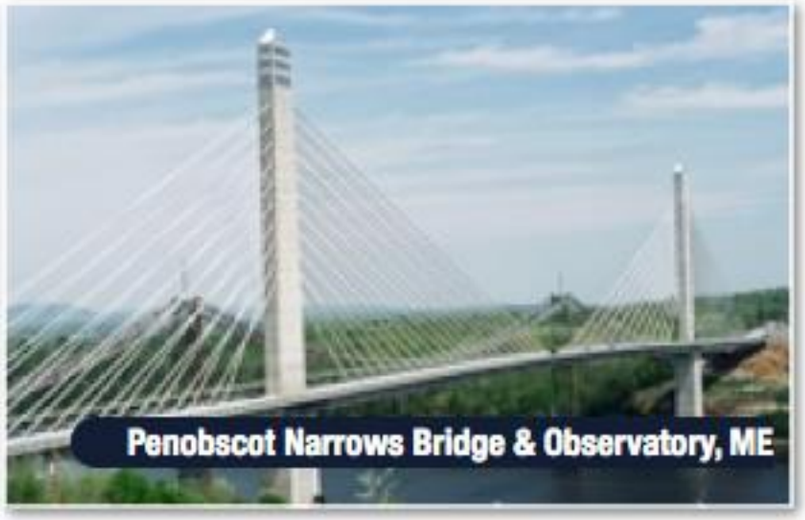
through the National Endowment for the Arts

-Only 5 ever for Bridges-

FIGG

CREATING BRIDGES AS ART®

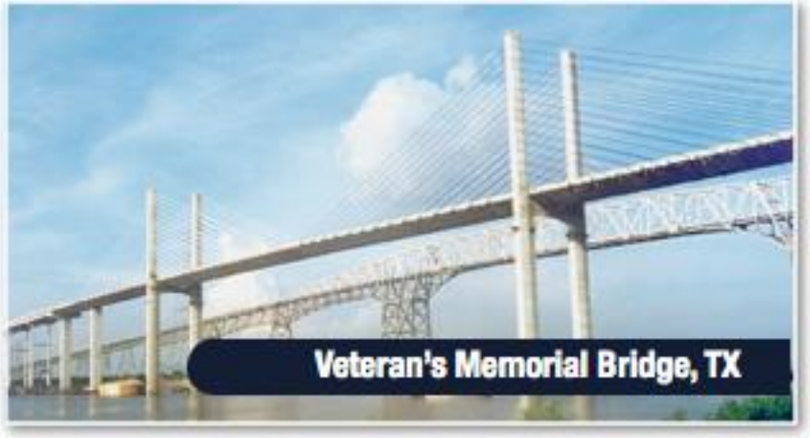
FIGG Has Delivered the Most Long Span Concrete Cable-Stayed Bridges in America


Penobscot Narrows Bridge & Observatory, ME

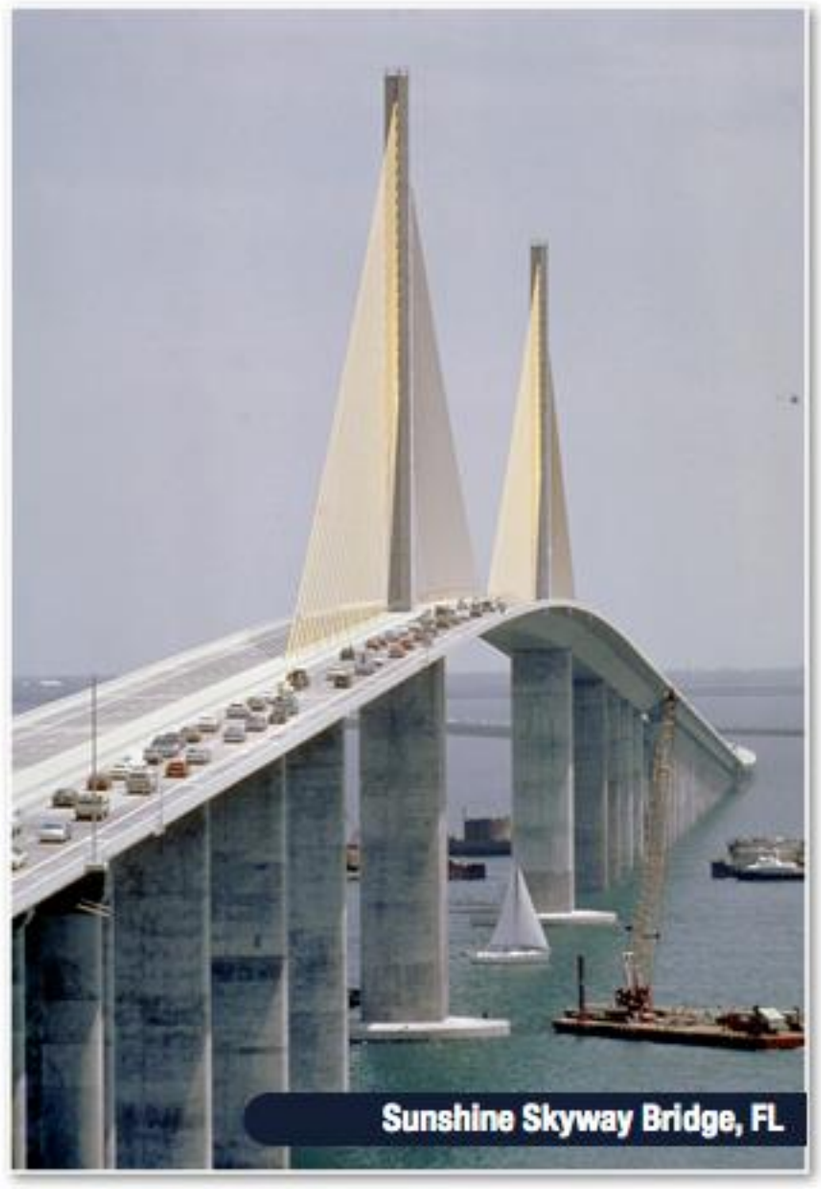
13 built concrete cable-stays in U.S.
11 FIGG responsible charge
7 Engineer of Record - A first for each state
5 Precast concrete - Engineer of Record
For All of them


Leonard Zakim Bridge, MA


I-280 Veterans' Glass City Skyway, OH


Veteran's Memorial Bridge, TX

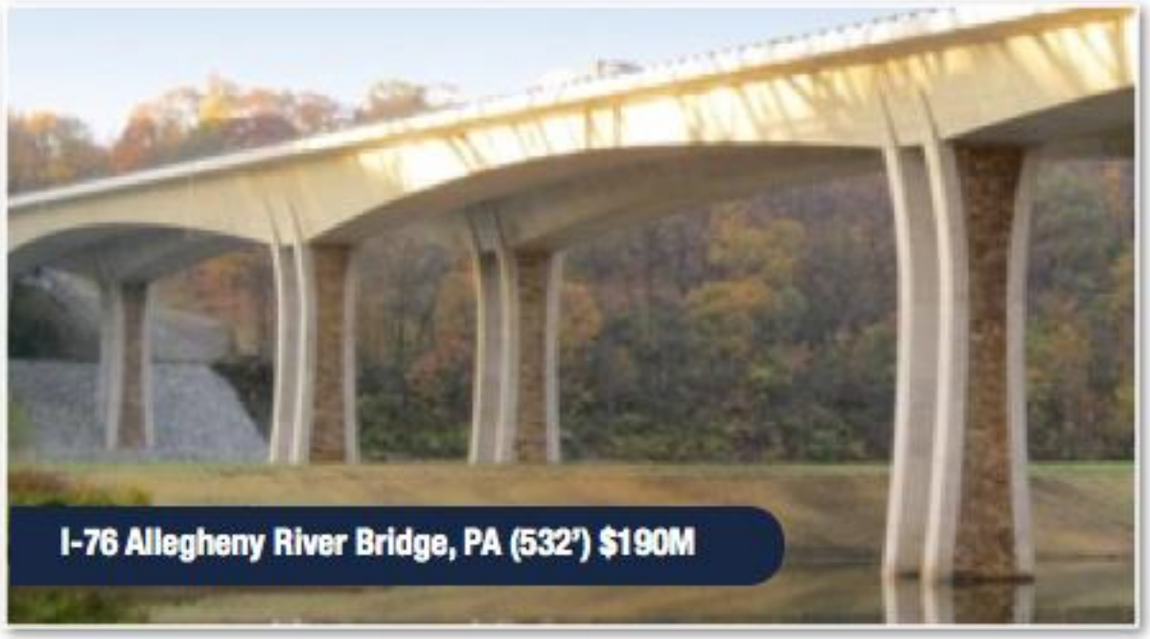

C&D Canal Bridge, DE

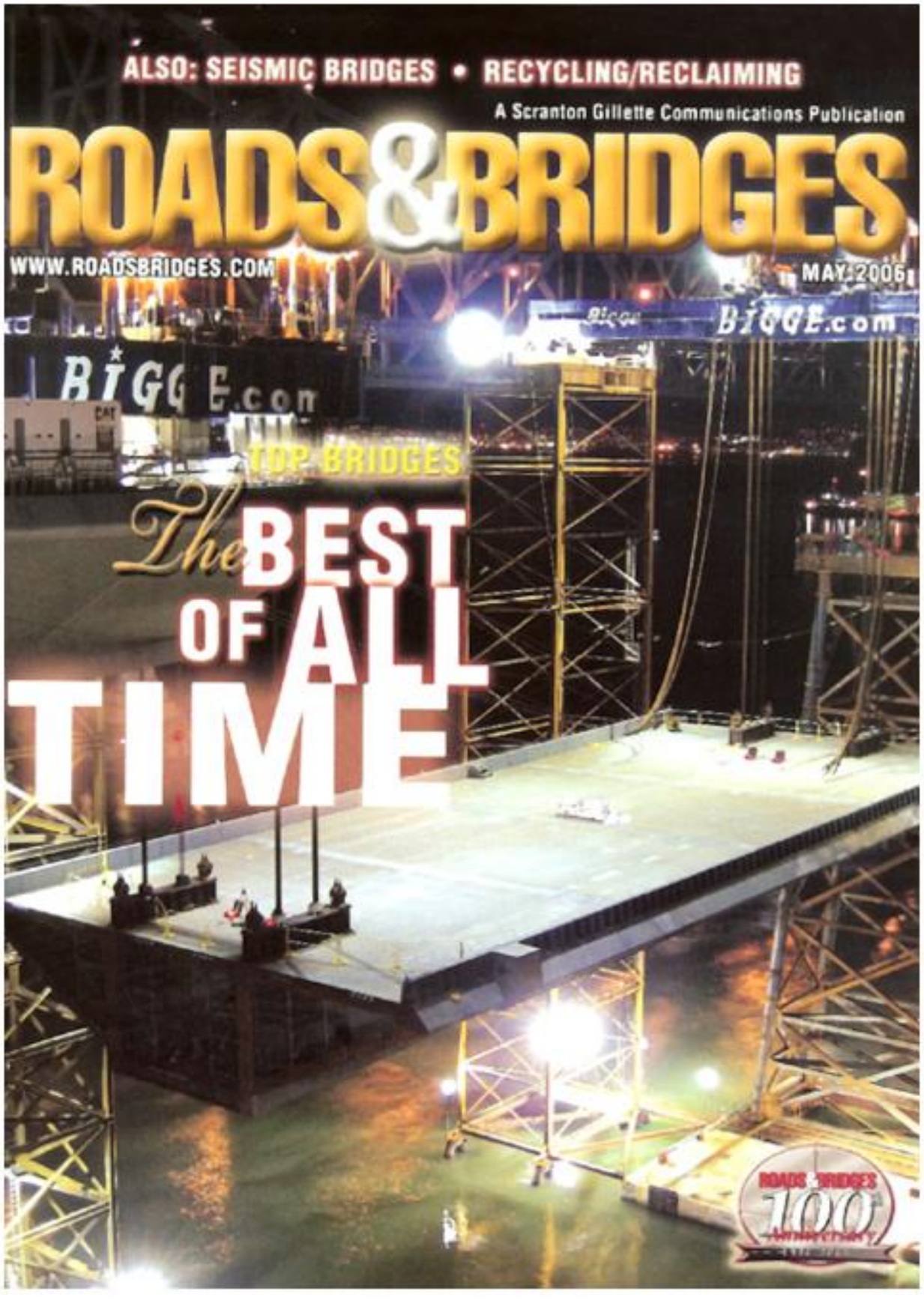

Sunshine Skyway Bridge, FL

FIGG Has Delivered the Most Long Span Concrete Bridges in America

54 built long-span concrete bridges from 300’ to 1200’ spans as Engineer of Record

An unsurpassed record of success in closing long spans concrete bridges





FIGG

6 of the Top 25 Bridges of all time

FIGG Bridges showcased on 7 television shows in the last 14 years

THE HISTORY CHANNEL
WHERE THE PAST COMES ALIVE

MODERN MARVELS

History of Concrete 2000 - Modern Marvels
(All major bridges designed by FIGG)

Overseas Highway 2003 - Modern Marvels
(Seven Mile Bridge, FL Keys)

Sunshine Skyway Bridge 2004 - Modern Marvels
(Skyway Bridge, Tampa FL)

PBS

NOVA

History of Arches 2004 - Modern Marvels
(Natchez Trace Parkway Arches, TN)

Mountain Roads 2007 - Modern Marvels
(Blue Ridge Parkway, NC)

Super Bridge 2003 - 2 hour PBS/NOVA Special
Clark Bridge, IL

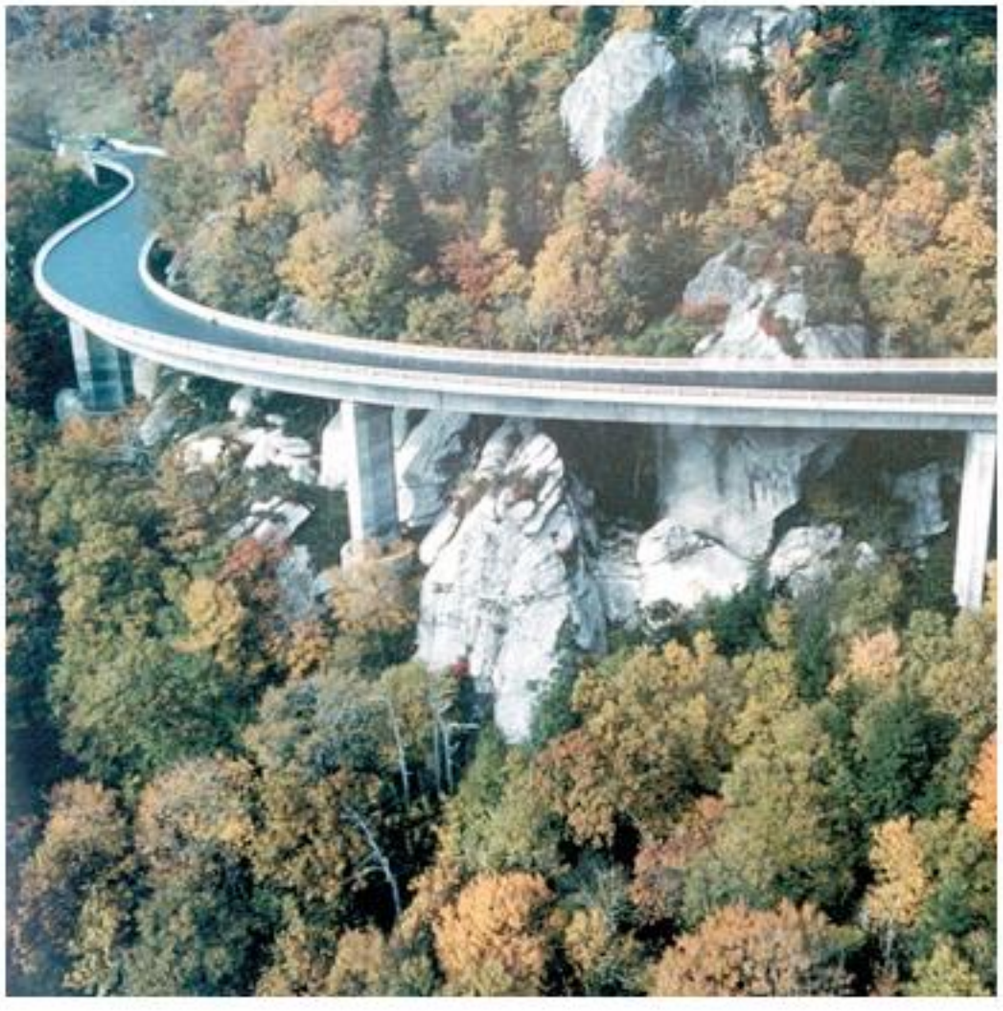
NATIONAL GEOGRAPHIC

Twin City Bridge: After the Collapse 2009 - Nat Geo
(New I-35W Bridge, Minnesota)

RAIL BRIDGES

ARCHES

CABLE STAYED BRIDGES



ENVIRONMENTAL BRIDGES

URBAN BRIDGES

LONG BRIDGES OVER WATER

LONG SPAN BRIDGES

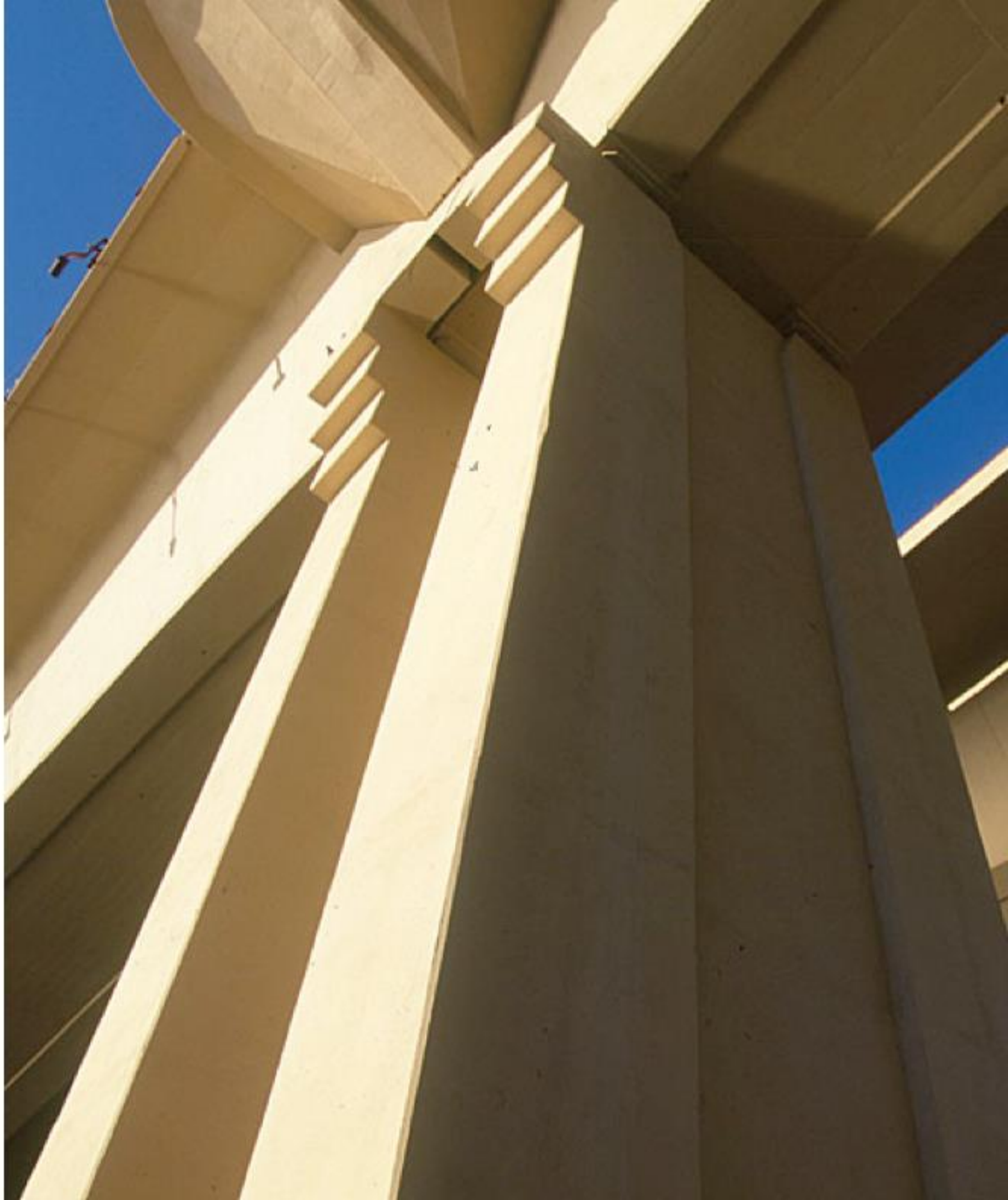
Every bridge has a story.
It begins with
a **Vision**

I - 275 Sunshine Skyway Bridge | Tampa Bay, Florida

Community Vision

Signature Design

Functional Sculpture



Constructibility

Environmental Sensitivity

Harmony with Environment

Context Sensitive Design

Technical Innovation

Spirit of People

Timeless

Sustainability is the Capacity to Endure

CREATING BRIDGES AS ART®

Applying FIGG Archetypal Design Principals to Concrete Bridges

Establish a Theme

Blend Shapes

Create Shadows

Select Appropriate Textures

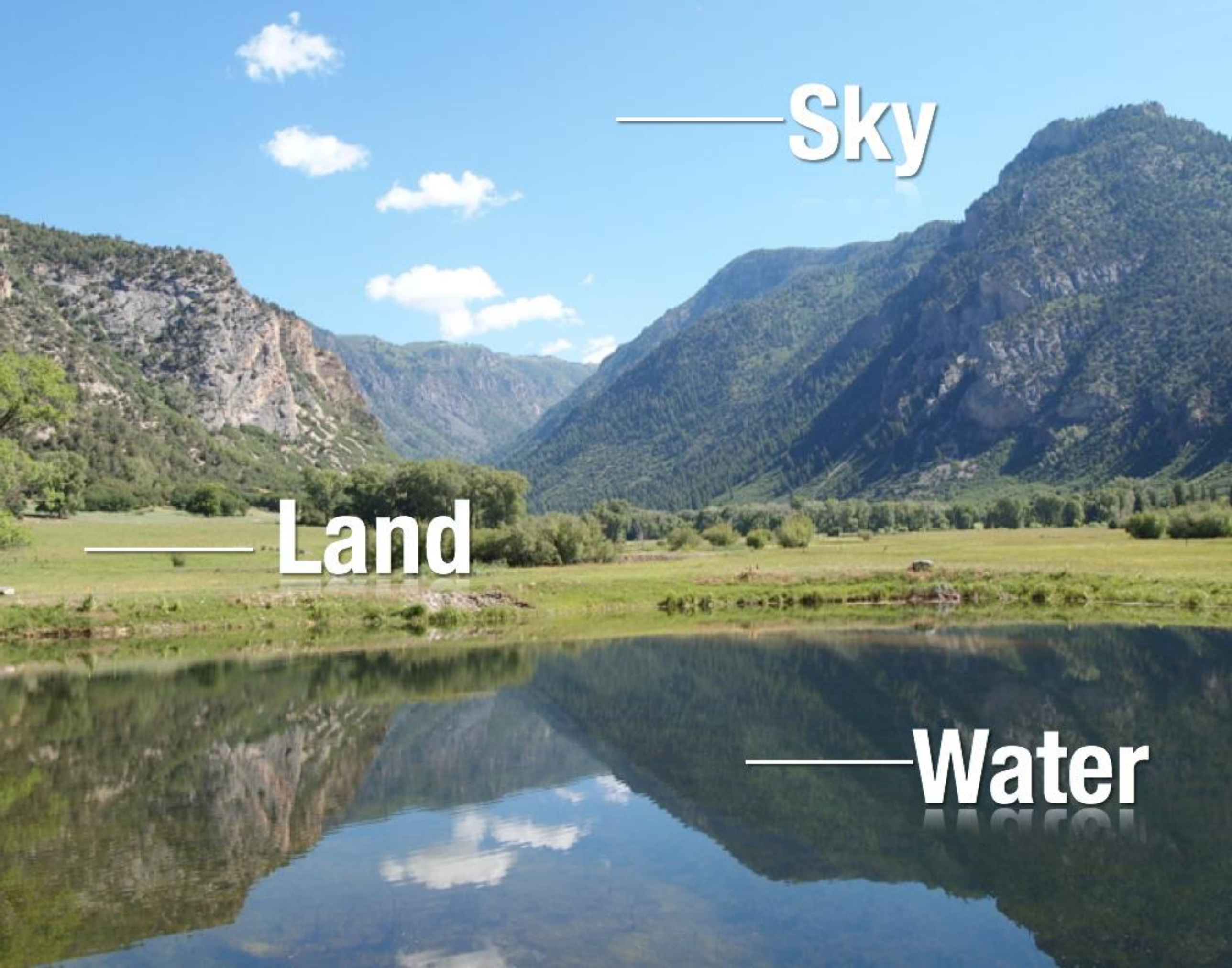
Choose Pleasing Colors

Open New Vistas

Use Native Materials

Create Feature Lighting

Incorporate Landscaping


Sky
Land
Water

Concrete Segmental Bridges are a Sustainable Solution

ENVIRONMENTAL

Concrete Segmental Bridges are COOL

Protect air, water and land

Protect ecosystem

Reduce green house gases

carbon footprint

Low energy use

Blue Ridge Parkway Viaduct
Grandfather Mountain, NC

FHWA
Owner - National Park Service

Blue Ridge Parkway Viaduct
Grandfather Mountain, NC

Blue Ridge Parkway Viaduct
Grandfather Mountain, NC

Blue Ridge Parkway Viaduct
Grandfather Mountain, NC

Blue Ridge Parkway Viaduct
Grandfather Mountain, NC

Built from Above

Blue Ridge Parkway Viaduct
Grandfather Mountain, NC

Blue Ridge Parkway Viaduct
Grandfather Mountain, NC

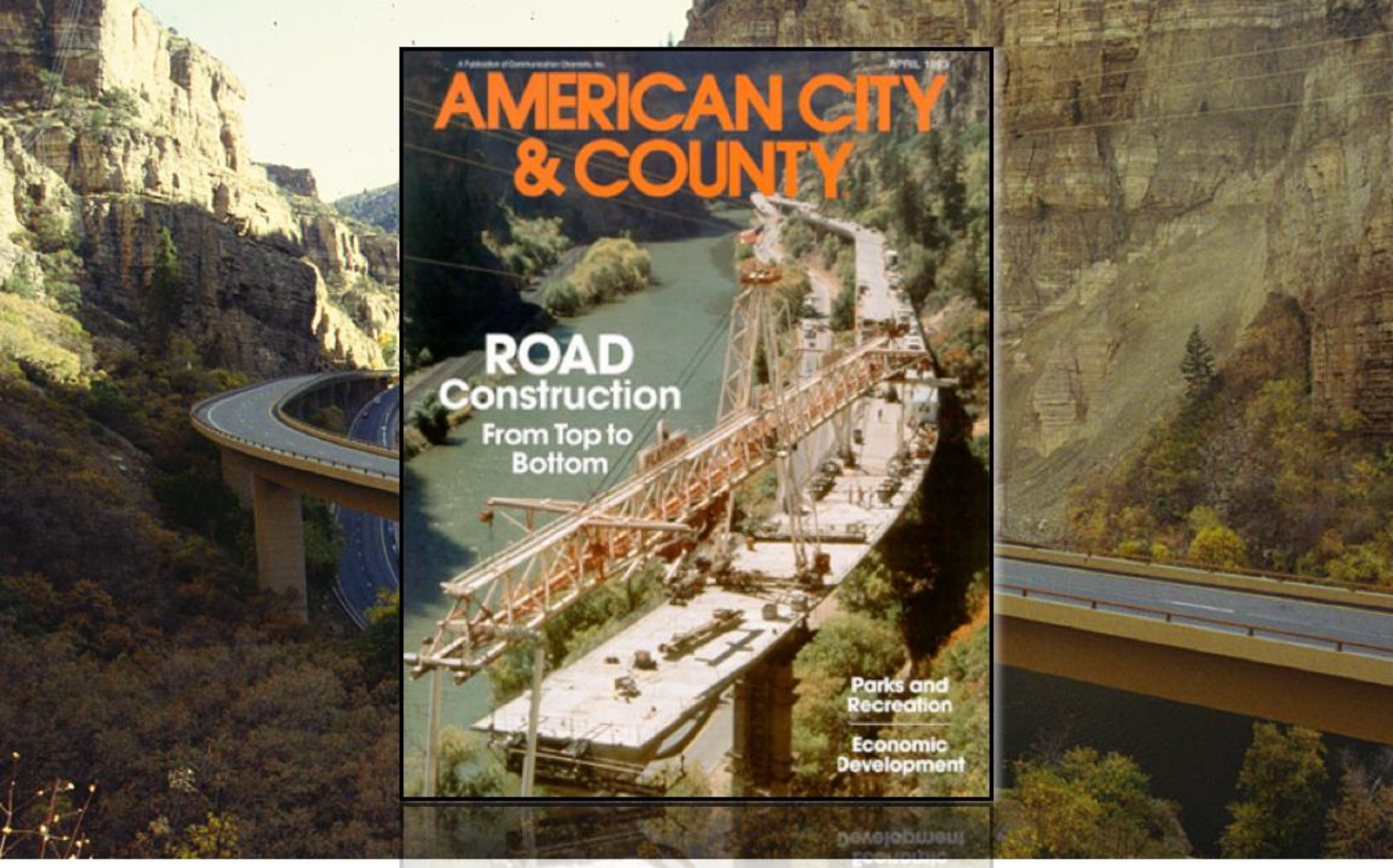
Black Iron Oxide Matches Boulders

Blue Ridge Parkway Viaduct
Grandfather Mountain, NC

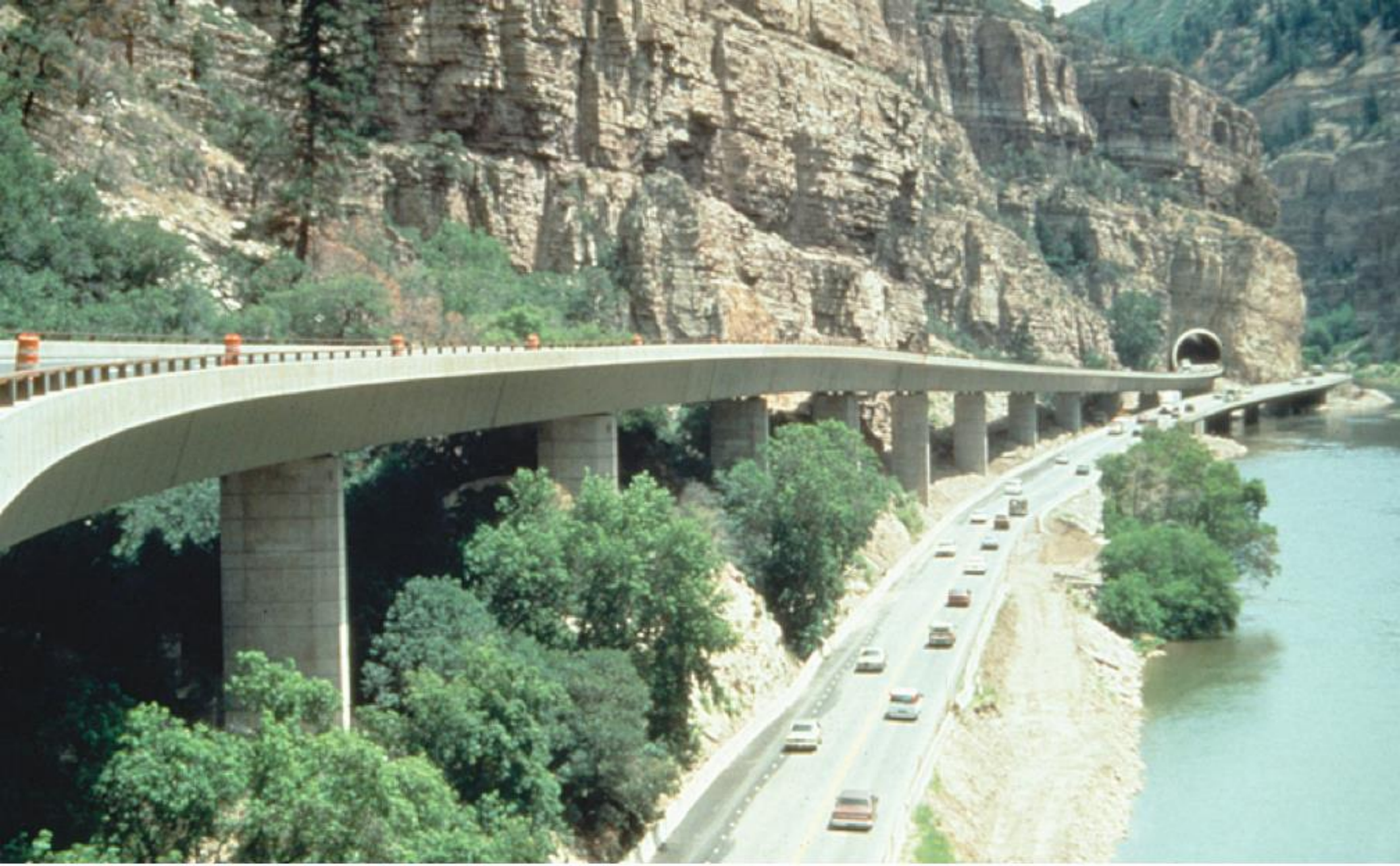
Complements the Physical Setting While Preserving Scenic, Aesthetic and Environmental Resources

I-70 Hanging Lake Viaduct
Between Vail & Aspen, Colorado

9 bridges through canyon
Built by Flatiron



I-70 Hanging Lake Viaduct Between Vail & Aspen, Colorado

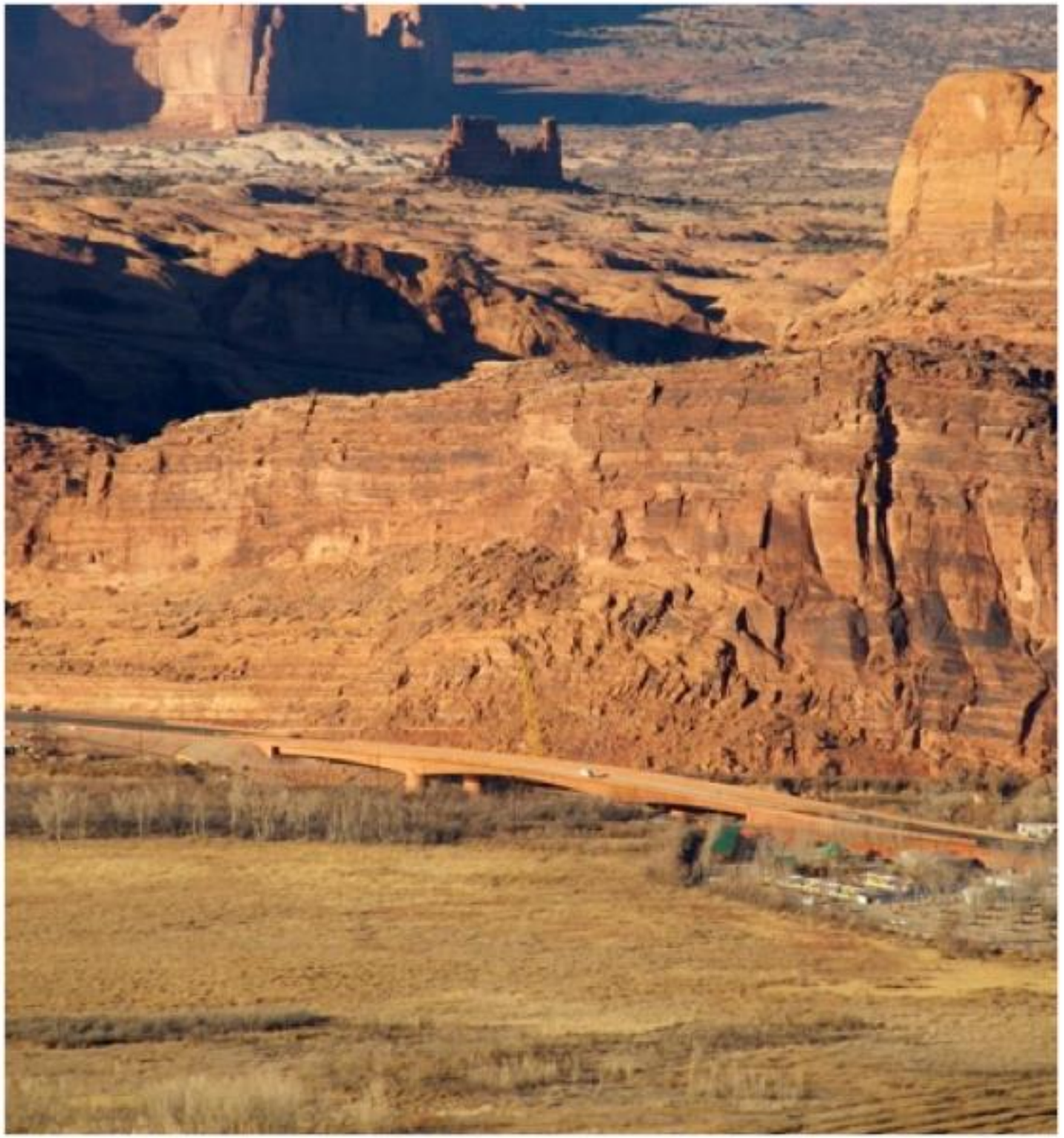


I-70 Hanging Lake Viaduct Between Vail & Aspen, Colorado

Angular piers compliment rocky terrain

US 191 Colorado River Bridge
Moab, Utah

Near Arches National Park



Bridge Born of the Earth

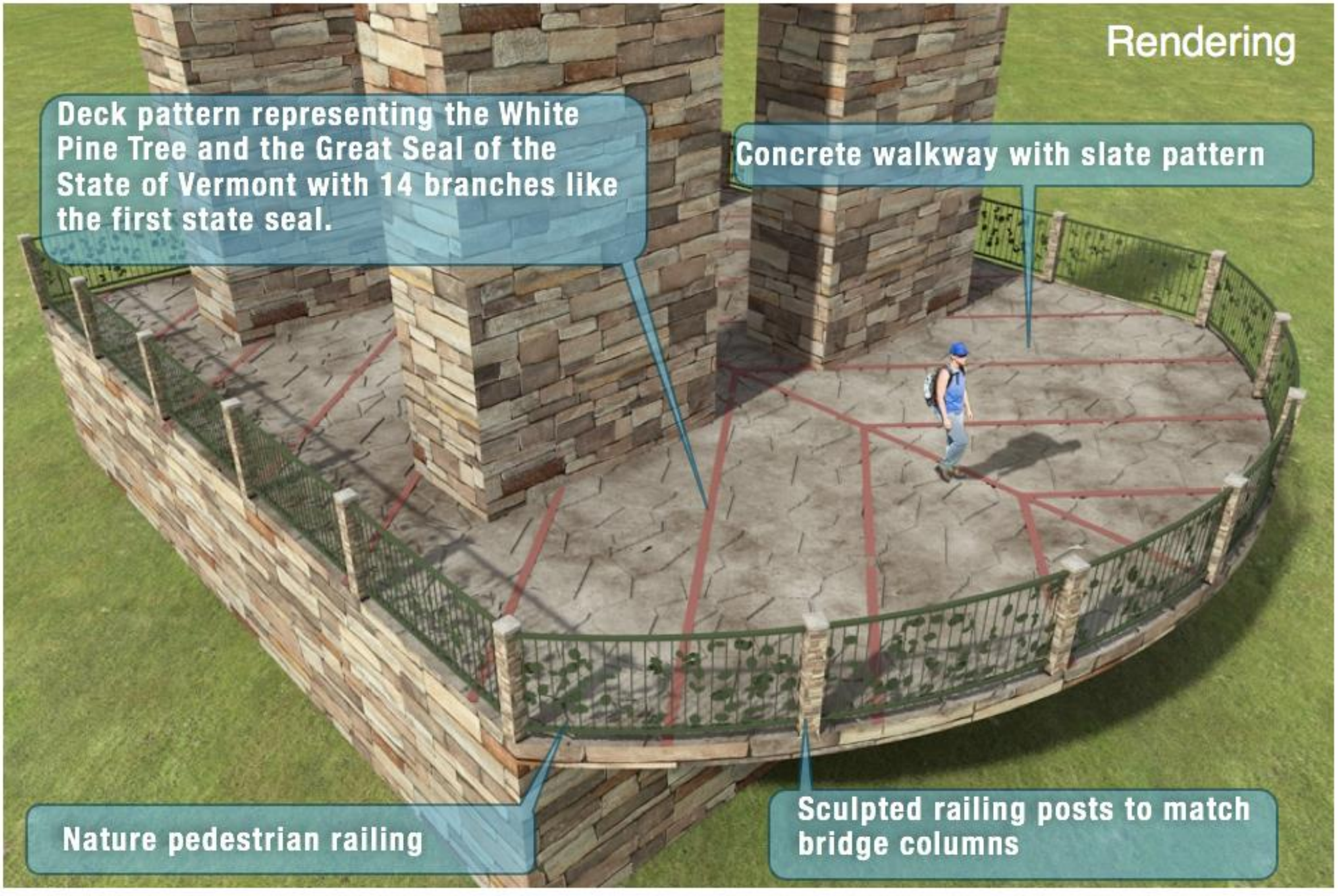
Bridge Color and stone texture on piers selected by the community blend the bridge with canyon surroundings

Vermont: A Bridge To Nature

I-91 Brattleboro Bridge
Brattleboro,Vermont

$60 Million,
Design Build - PCL/FIGG Team
Construction Complete Spring 2016

Viewing Platforms - Gallery of the Natural Habitat

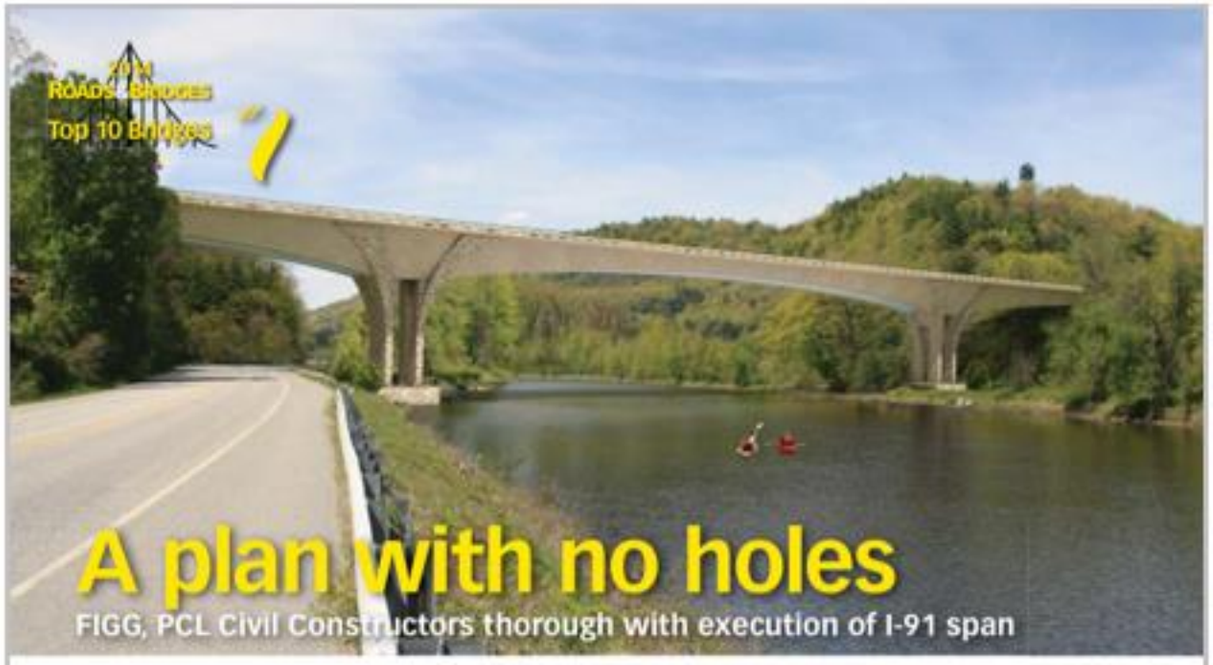


Rendering

I-91 Brattleboro Bridge
Brattleboro, Vermont

I-91 Brattleboro Bridge
Brattleboro,Vermont

Future Pedestrian Bridge



A plan with no holes

FIGG, PCL Civil Constructors thorough with execution of I-91 span

By Bill Wilson
Editorial Director

When putting together a complicated 3-D puzzle, you really cannot build around a missing piece.

As FIGG and PCL Civil Constructors were attempting to mold together the first pier table of the I-91 Brattleboro Bridge in Vermont in late October, extreme measures were being taken to make sure there was not a void in the process.

"As you extend up from those piers that are curving in two different directions at the same time, we are putting [what amounts to] a three-story building of concrete right on top of those four piers," Garrett Hoffman, project manager for FIGG, told Roads & Bridges, "so having the diaphragms to distribute that load from the bridge down into the piers like that, it's requiring a lot of steel and that complexity is taking a while to complete.

"There's a lot of reinforcement and a lot of congestion, and it becomes a very big 3-D puzzle."

Those double-acting piers Hoffman referred to are the centerpiece of a whole gallery of engineering innovation, which made the I-91 Brattleboro Bridge the obvious choice for No. 1 on this year's Roads & Bridges' Top 10 Bridges list. It's actually called a quad wall pier system. An opening sits between two walls so that there are actually four legs of the column, which is supposed to have the look of a giant tree.

In late October, construction of pier No. 1 on the south side of the West River was complete, ushering in the complex handling of the diaphragm and its 300-yd concrete pour, and crews were already on lift two (which is about 70 ft off the ground) of pier No. 2 on the north end. The goal: to have the pier table on No. 1 complete by Christmas, so form travelers could be installed and the first segment could be cast before cold weather settled in.

"They want to get one segment done and a cycle behind them before the hard winter sets in, so they are not dealing with learning a cycle time for a segment as well as dealing with the hardships of winter," said Hoffman.

After last winter it's no wonder tensions were running high heading into November. During the polar vortex of 2014, Mother Nature gave Vermont a reprieve in January with a couple days of mild winter. The spike in temperature, however, unleashed a huge rush of water that was plugged farther upstream, and when frigid conditions returned the next day PCL Civil Constructors found its equipment literally frozen in the West River.

Hoffman said they are now out of that danger zone because no machines are in the water, but winter will still be a challenge due to the amount of concrete curing that is set to take place. Additional insulation in the form of tenting, burlap and blankets will be used to create an ideal environment for strengthening

PROJECT: I-91 Brattleboro Bridge
LOCATION: Brattleboro, Vt.
OWNER: Vermont Agency of Transportation
DESIGNER: FIGG
CONTRACTOR: PCL Civil Constructors
COST: $60 million
START DATE: September 2013
COMPLETION DATE: April 2016

Roads & Bridges Magazine #1 Bridge of 2014

70' Tall Piers

Cascades Connector Pedestrian Bridge, Tallahassee, Florida

Eco-Friendly Park Bridge Construction Starts in 2015

East County Bridge Project

Between Clark County, Washington & Multnomah County, Oregon
Crossing the Columbia River

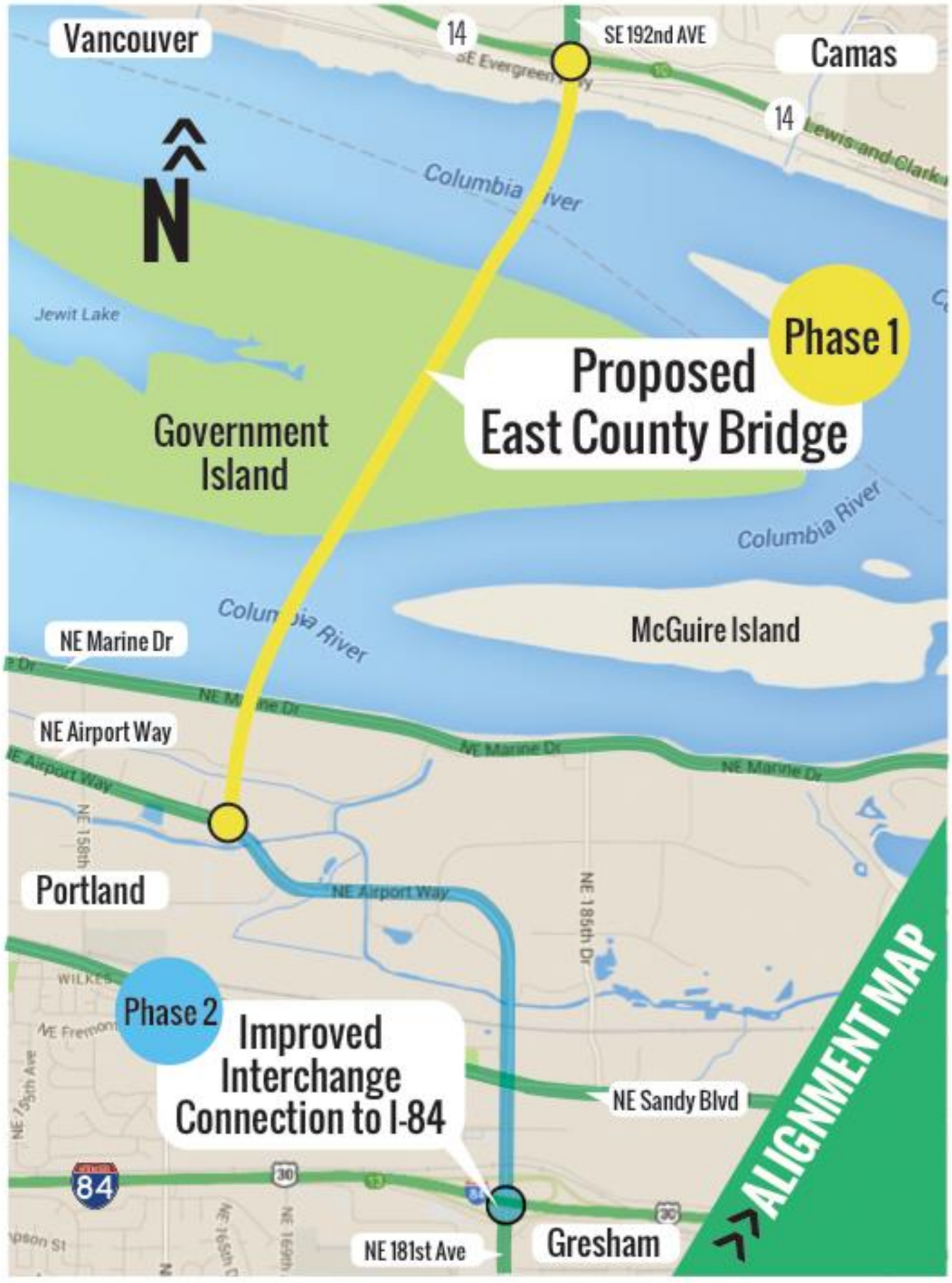
Overall Bridge Layout

10,995’ long

4 lane bridge

Design Build / Turnkey

PCL/FIGG



East End Bridge Rendering

Alignment is away from homes. Convenient connection to commercial areas

410’ - 480’ span lenths

Example Theme of Nature inspired by Washington and Oregon Trees

Ponderosa Pine

Sitka Spruce

Quaking Aspen

East End Bridge Rendering

East County Bridge Project Between Clark County, Washington & Multnomah County, Oregon

Connecting Communities

ECONOMICAL

Cost and Time Savings

Local Economic Benefits

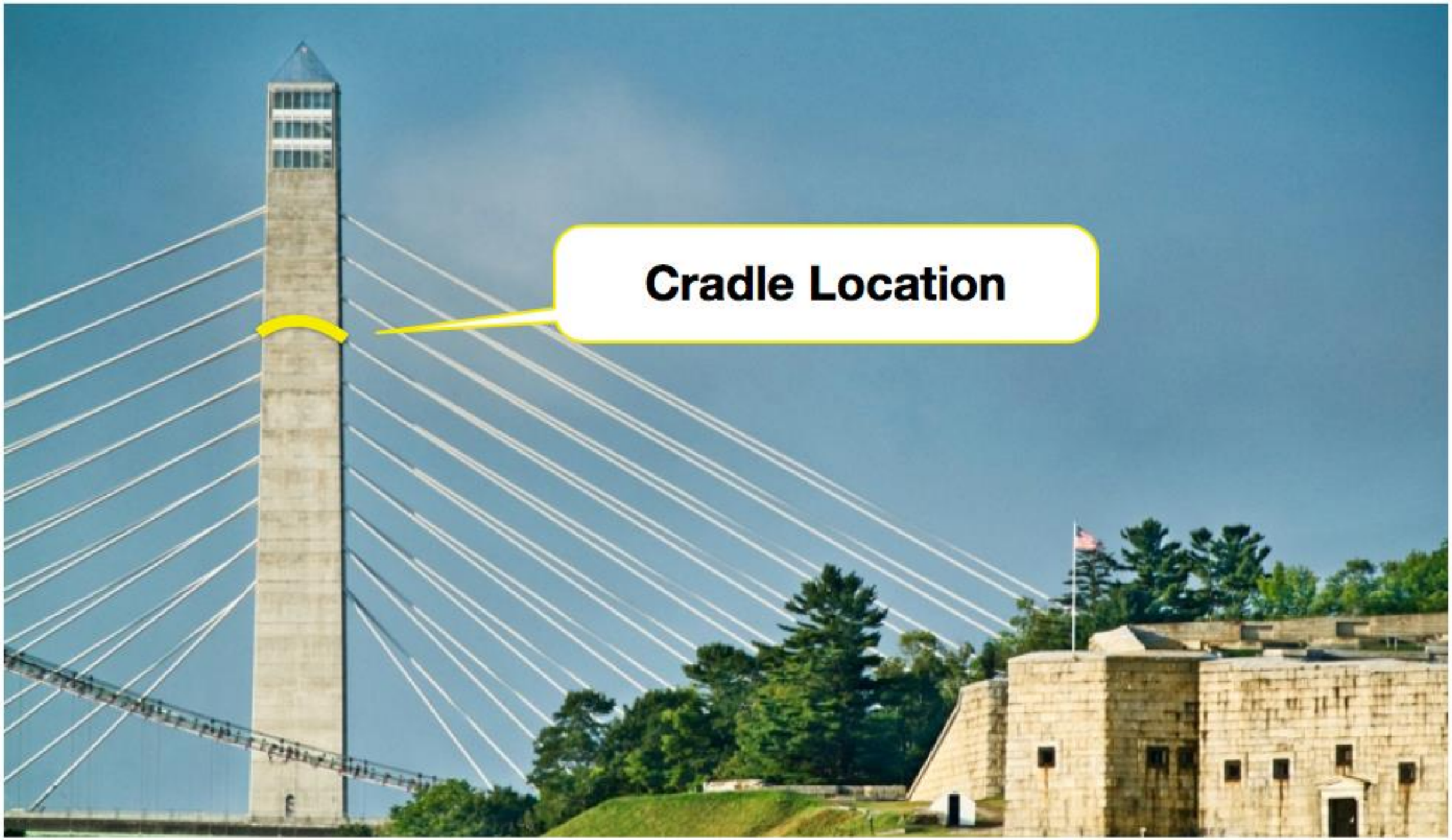
Resource Efficiency

Life Cycle Cost Benefits

Penobscot Narrows Bridge & Observatory, Maine

Local economic development
$ 74 million cable stayed bridge

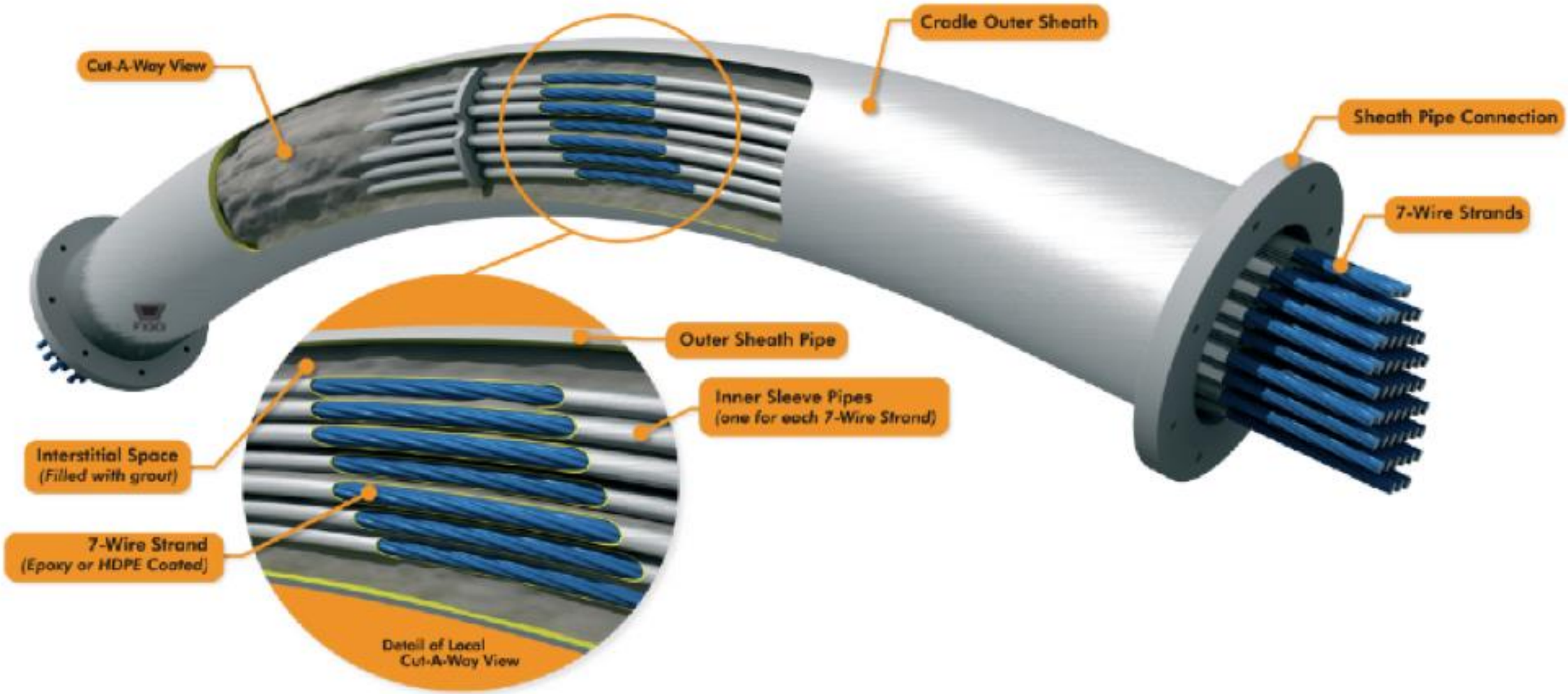
Innovative Cable Stay Cradle



Ft. Knox State Park in Maine

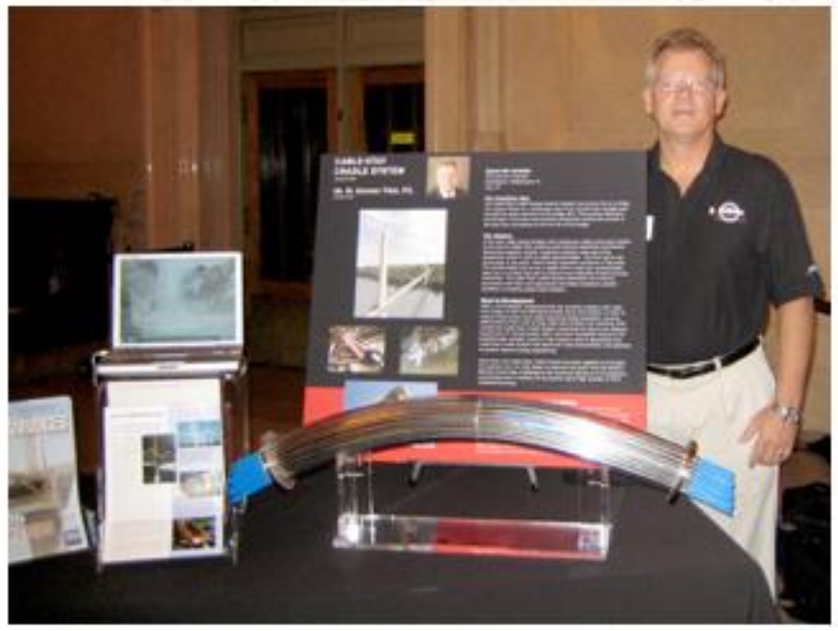
FIGG Patented Cable Stay Cradle

Lowest maintenance cable-stayed solution creating over 100 year life



Removes 50% of the anchors, 50% of the operations

MODERN MARVELS
invent now
CHALLENGE

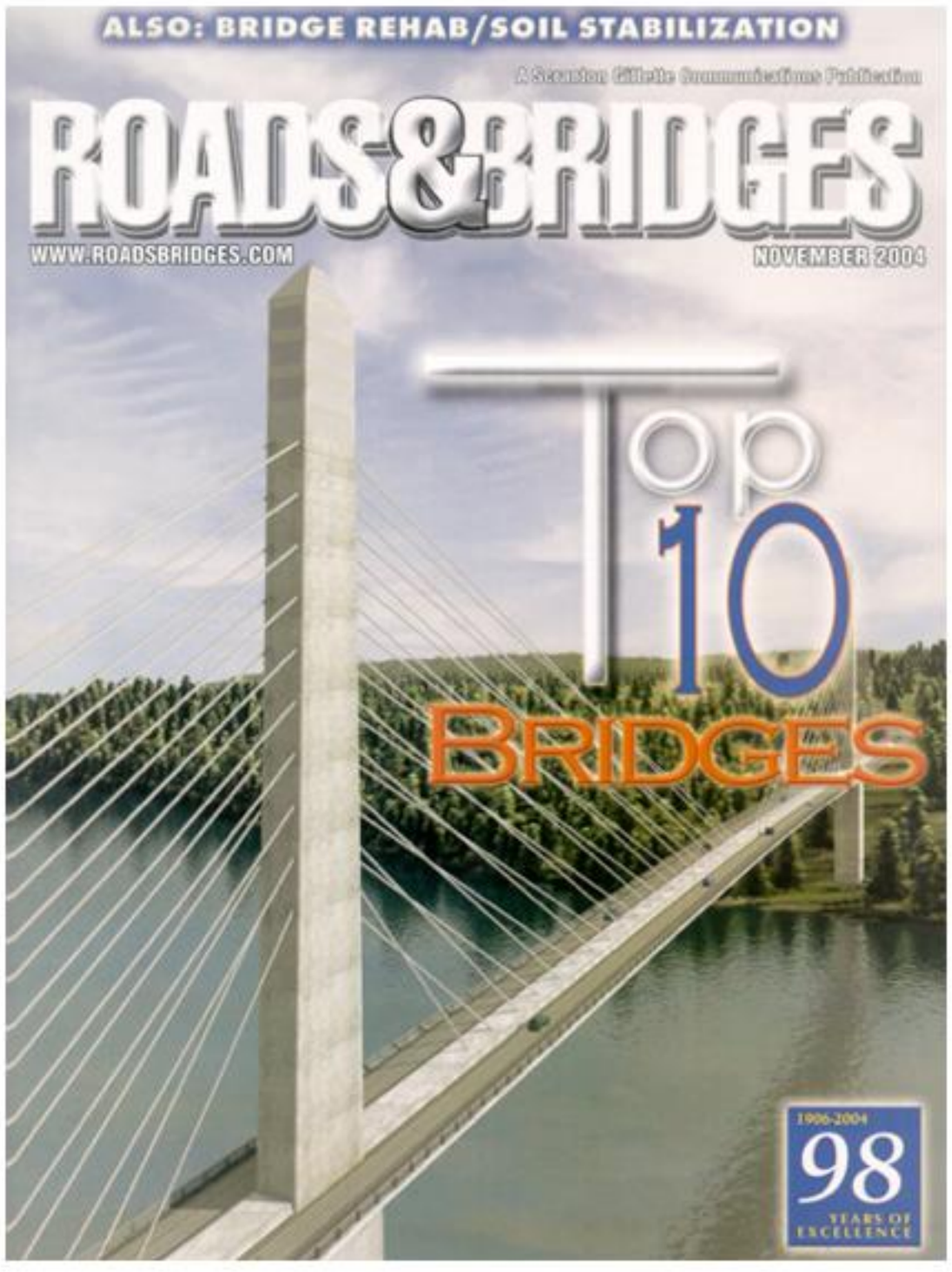


Grand Central Station, New York

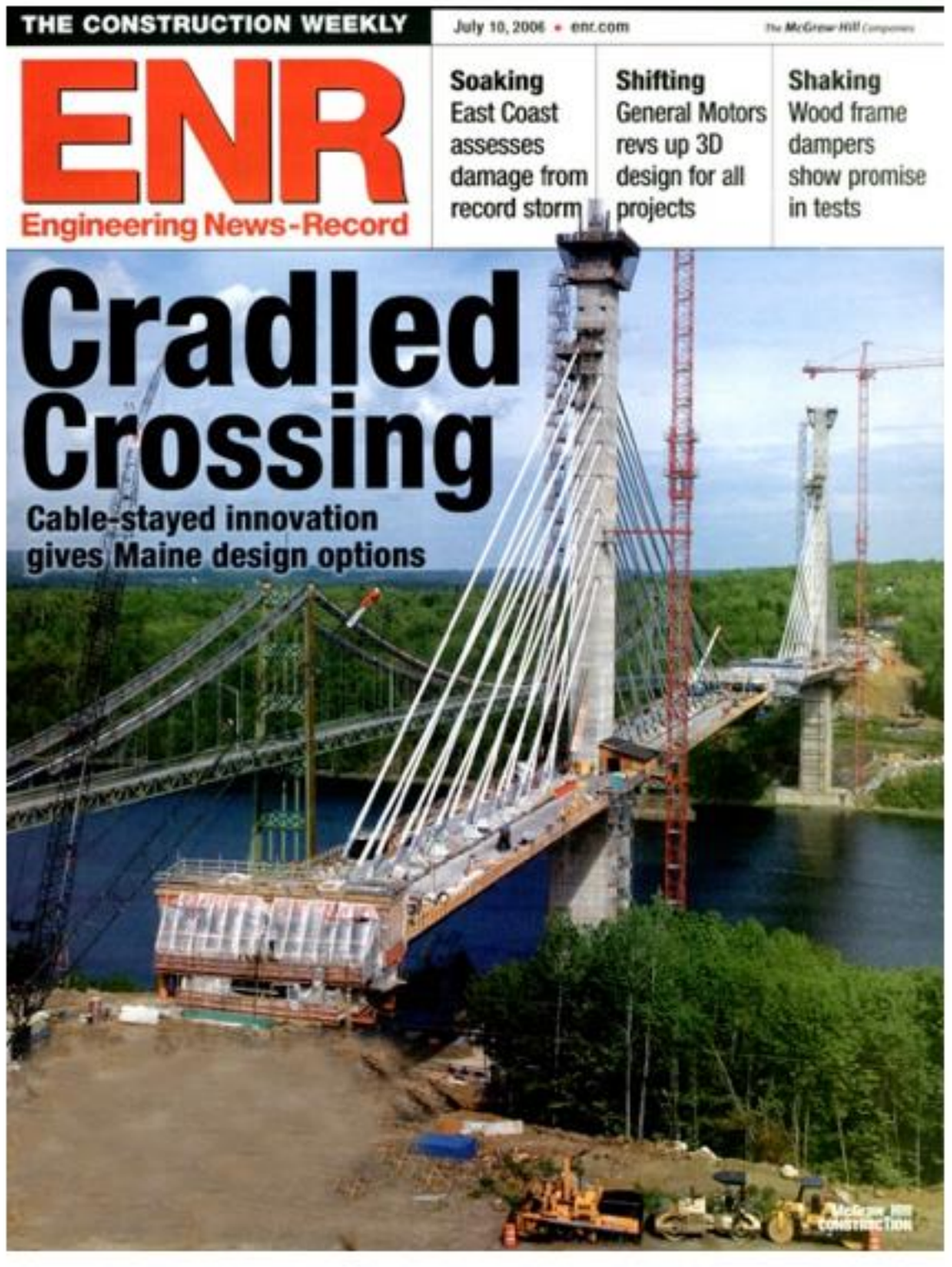
Modern Marvels Invent Now Challenge

One of Top 25 Inventions of 2006 from over 4000 entries

Winner of 20 Design Awards including FHWA “Innovation Award”



2004 #1 BRIDGE IN AMERICA



JULY 10, 2006 ENR COVER

Penobscot Narrows Bridge & Observatory, Maine

The observation pylon stay 2, 10 and 17 reference strands have been replaced with carbon fiber composite cable

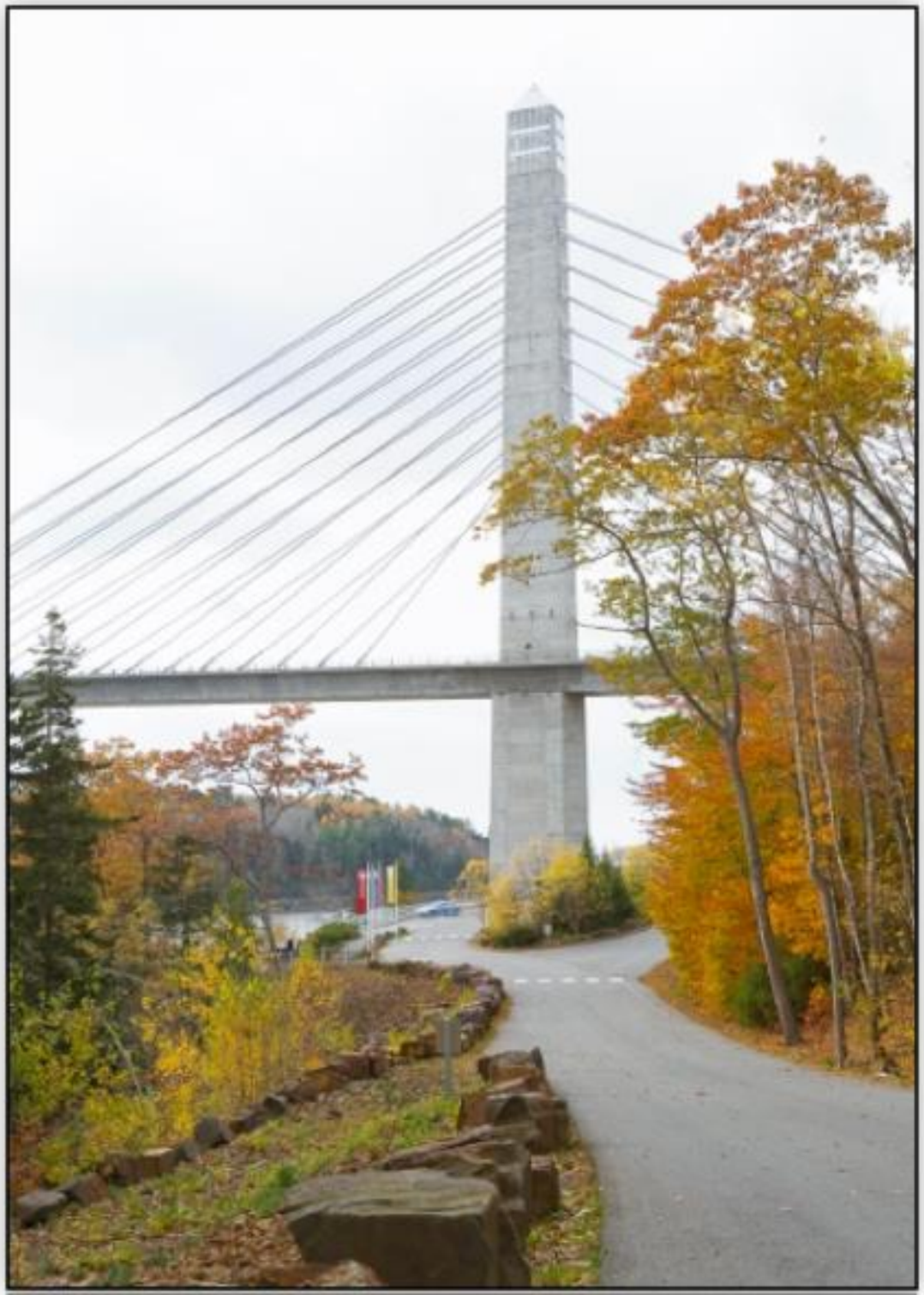
First time in United States

All operations took place while bridge open to traffic, inside the box and without opening exterior stay sheathing

Transportation and Economic Development
Penobscot Narrows Bridge & Observatory, Maine

Vertical Park Public Observatory

Tallest public observatory on a bridge - 420’ atop one pylon



Penobscot Narrows Bridge & Observatory, Maine

I-280 Veteran's Glass City Skyway, Toledo Ohio

Largest bridge in Ohio history
612'-6" main span

I-280 Veteran's Glass City Skyway, Toledo Ohio

Theme: Glass

I-280 Veteran's Glass City Skyway, Toledo Ohio

SOCIAL

Context Sensitive Solutions

Involve Community
Better Quality of Life
Safer
Better Land Use

I-35W Bridge
Minneapolis, Minnesota

August 1, 2007, 40 year old Bridge in Minneapolis, MN collapsed.

The bridge had been rated as structurally deficient and raised concerns throughout the US for the condition of bridges

New I-35W Bridge

Designed and Built in 11 Months

$234 Million

FIGG

Welcome to
MARCY·HOLMES
The City's First Neighborhood

Marcy-Holmes Neighborhood

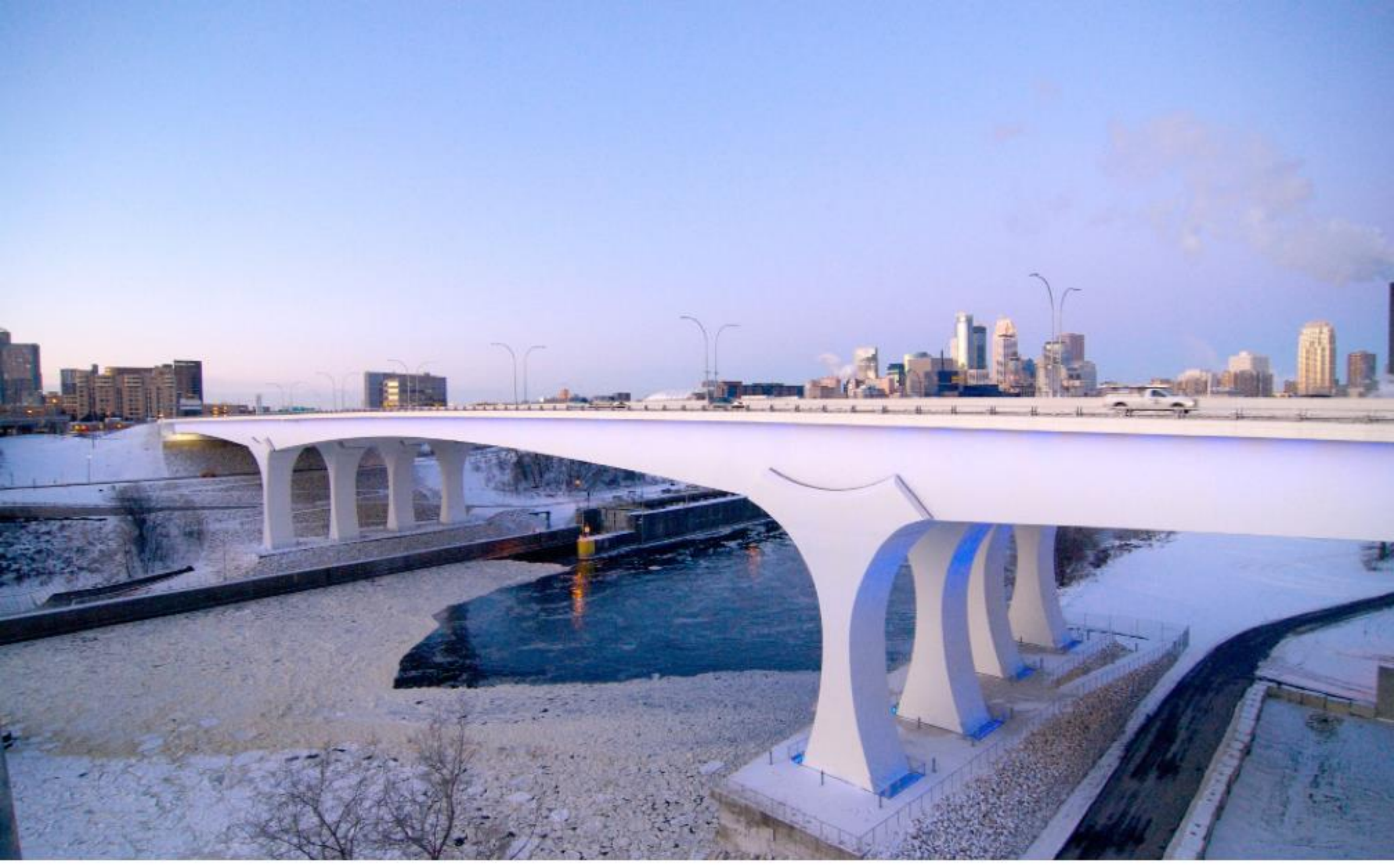
Metrodome

Guthrie Theater

Lower St. Anthony Falls Lock & Dam

The Urban Neighborhood in downtown Minneapolis

35W



New I-35W Bridge
Minneapolis, Minnesota

504’ Mainspan
Built by Flatiron with FIGG

October 24, 2007
7:30 AM – 5:00 PM

88 People
Residents, Businesses,
Cultural/Arts,
University of Minnesota,
Government Officials

Voted on Bridge Features

FIGG Bridge Design Charette™

Community Involvement in the Art of Design

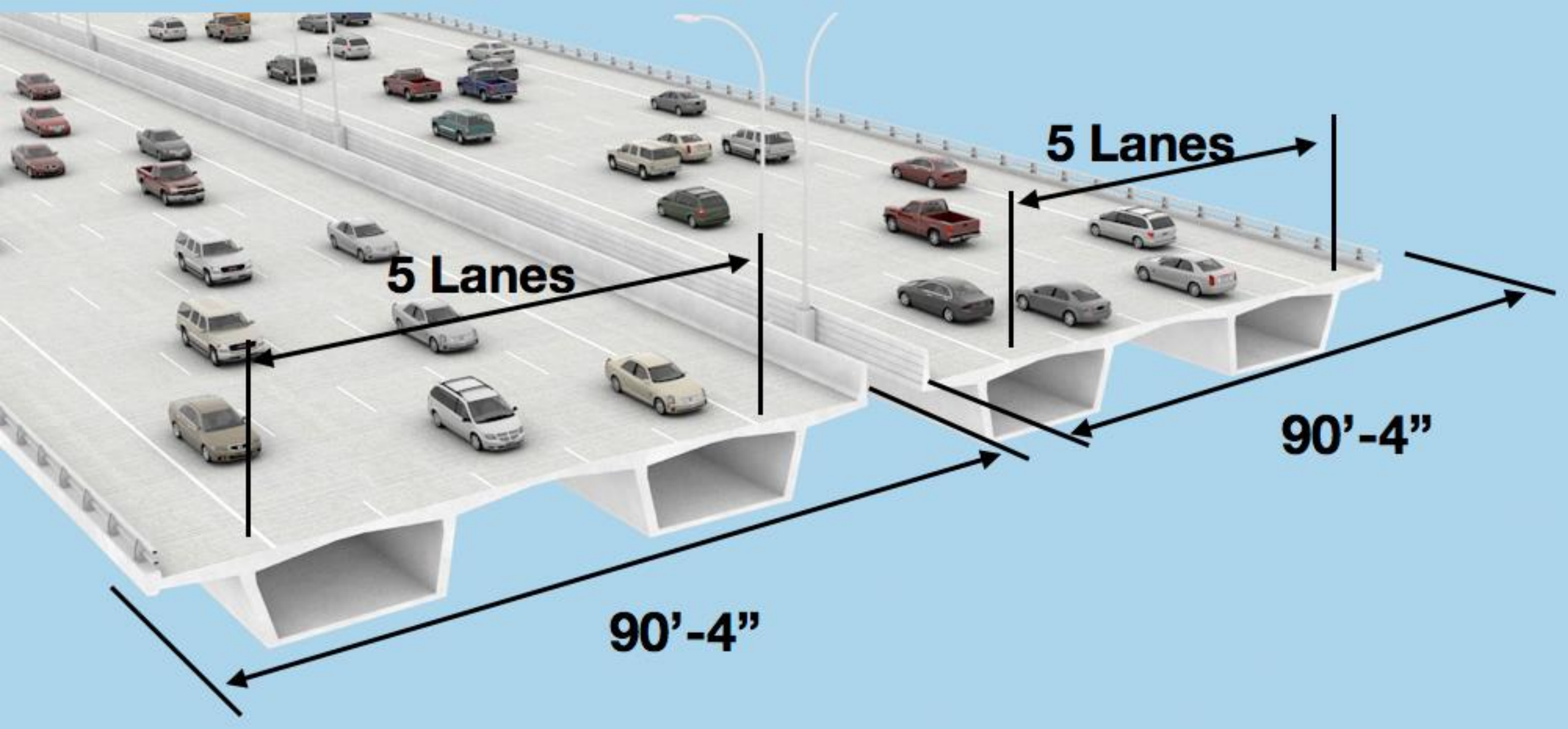
Sculpted Pier Shape

Bridge Color

Open Railing

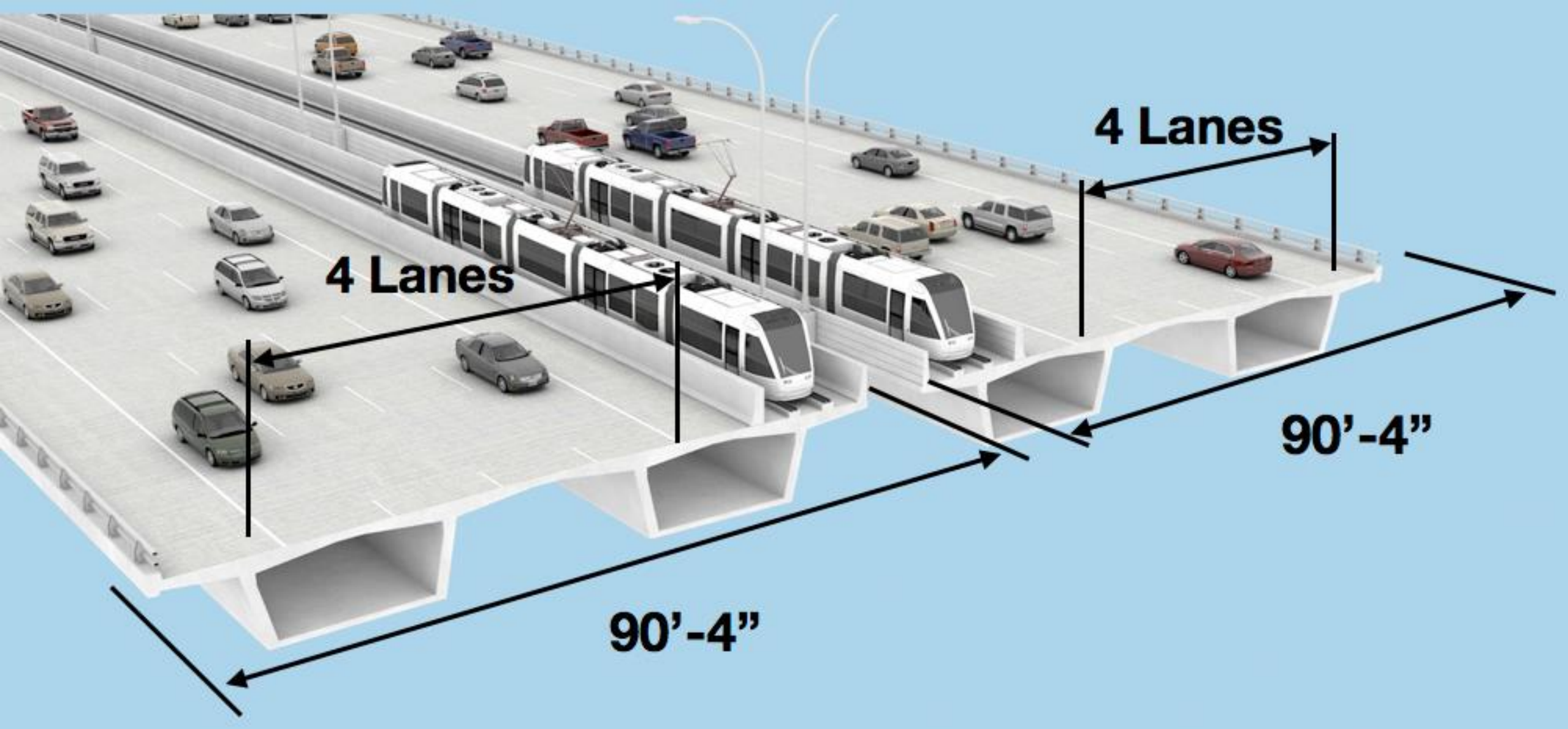
Feature Lighting

Stone Abutments



Current Configuration

Twin Box Girder - 5 Lanes Each.
Inside shoulder/lane designed to convert to light rail in future



Future Transit Ready

4 Lanes with LRT

Economy of Longline Precasting in Spaces Near Site

Local materials, Local labor
Warming house maintains constant temperature for curing

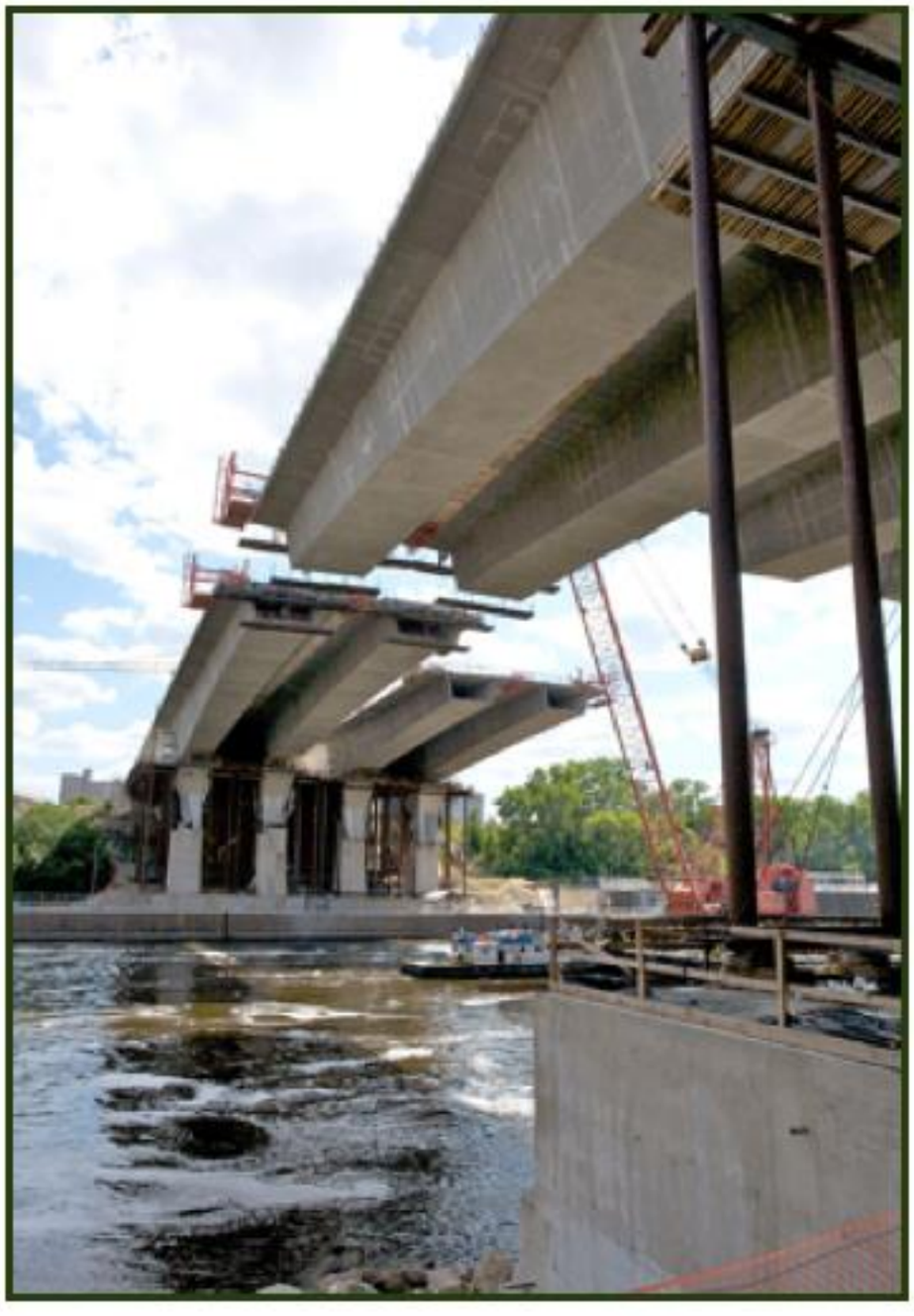
Up to 4 segments/day

Time Savings

Accelerated Bridge Construction

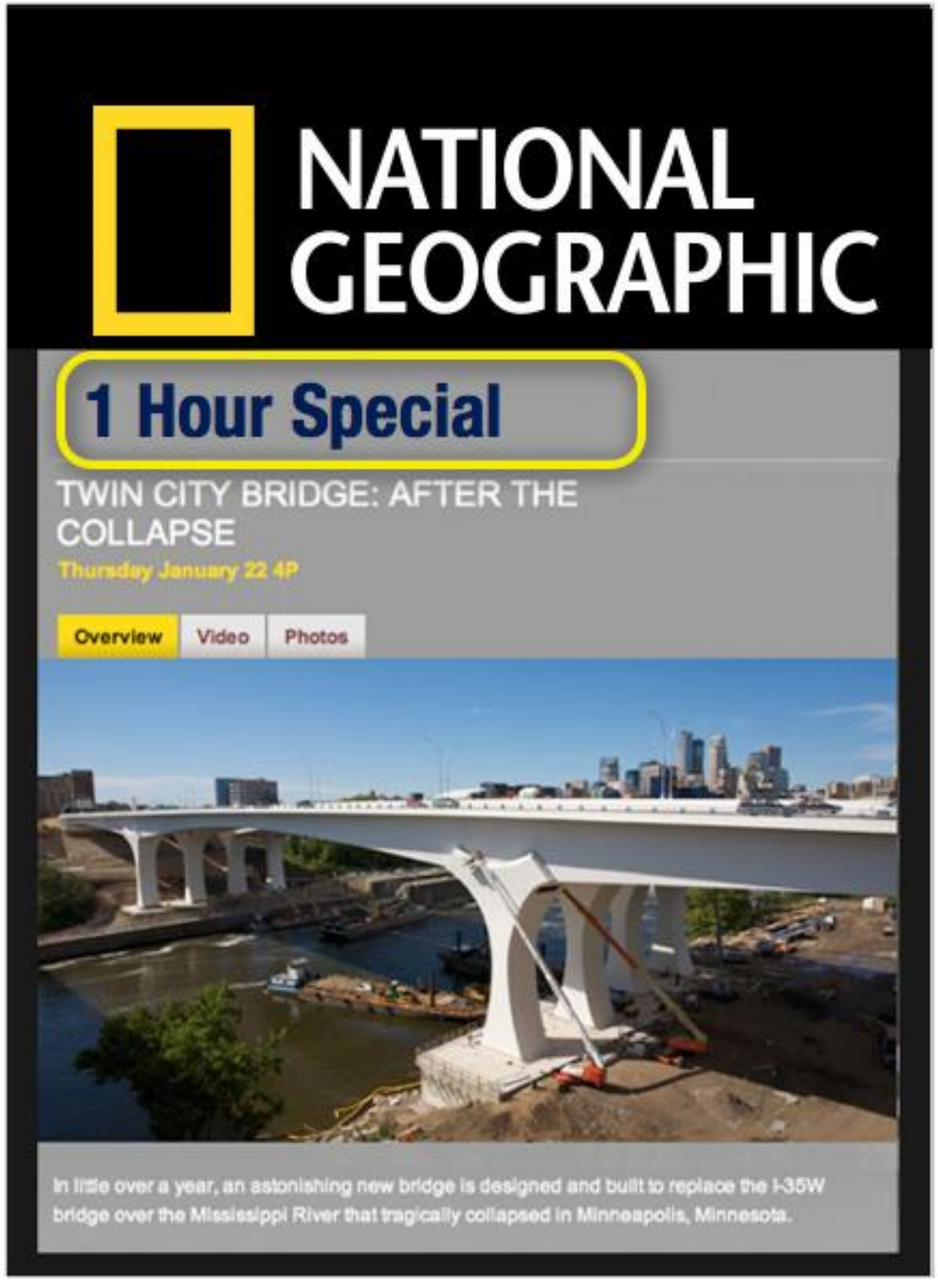
120 segments placed in 47 days over Mississippi River

“Construction As A Spectator Sport” - New York Times



Community Involvement

New I-35W Bridge
Minneapolis, Minnesota



New I-35W Bridge Minneapolis, Minnesota

70’ Tall Piers with LED Lights

Eco-friendly Concrete

30’ Precast Gateway Sculptures

Inspired by the ancient symbol for water, the gateway design consists of three rippling forms that recall the river and the flow of life.

Nanotechnology self-cleaning and pollution-eating cement

When UV light hits surface of concrete it creates a photocatalytic reaction that cleans pollution out of the air

LED Highway Lighting for Interstate - A first.
Worked with US Dept. of Energy

New I-35W Bridge
Minneapolis, Minnesota

Opened Sept. 18, 2008
at 5 a.m., 3 months ahead of schedule

Urban Bridges - All views are important

17th Street Bridge
Ft. Lauderdale, Florida

205’ spans
1908’ length
8’ - 3” wide piers

Underneath creates usable space that is quiet

17th Street Bridge
Ft. Lauderdale, Florida

A Usable Space for Parks

17th Street Bridge
Ft. Lauderdale, Florida

A Usable Space for Parks

17th Street Bridge
Ft. Lauderdale, Florida

Maximizing Connectivity in Urban Environment

17th Street Bridge
Ft. Lauderdale, Florida

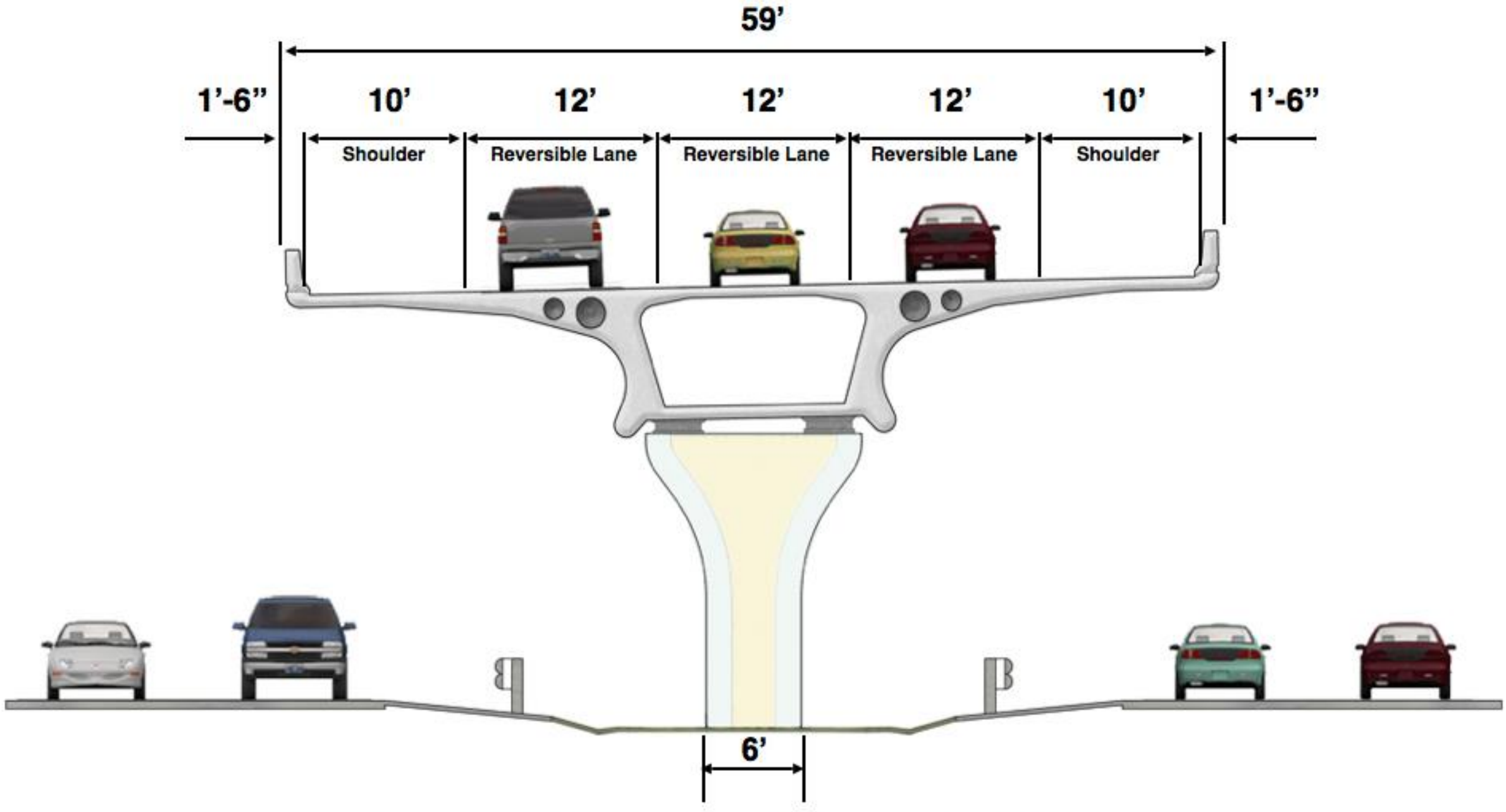
Selmon Expressway, Tampa, Florida
Doubling Capacity In Existing Right-of-Way

2007 #1 Toll Facility in World by International Bridge, Tunnel & Turnpike Association

Tampa Hillsborough Expressway Authority - A Vision For The Future

14 mile long toll road connecting Brandon & Tampa

SPACE SAVER – The future answer to expanding highways in existing right-of-way



6 LANES IN 6 FEET

Piers built in median concurrent with segment casting

Local Casting Yard at Port of Tampa

Selmon Expressway
Tampa, Florida

Storage Yard at Port of Tampa

3032 Precast Segments

Segment (9’-4” wide) is loaded on segment hauler truck

Bridge built by PCL

Building from The Top While Keeping Traffic Moving

2400’ built in one month

All Electronic Tolling

Selmon Expressway - Tampa, Florida

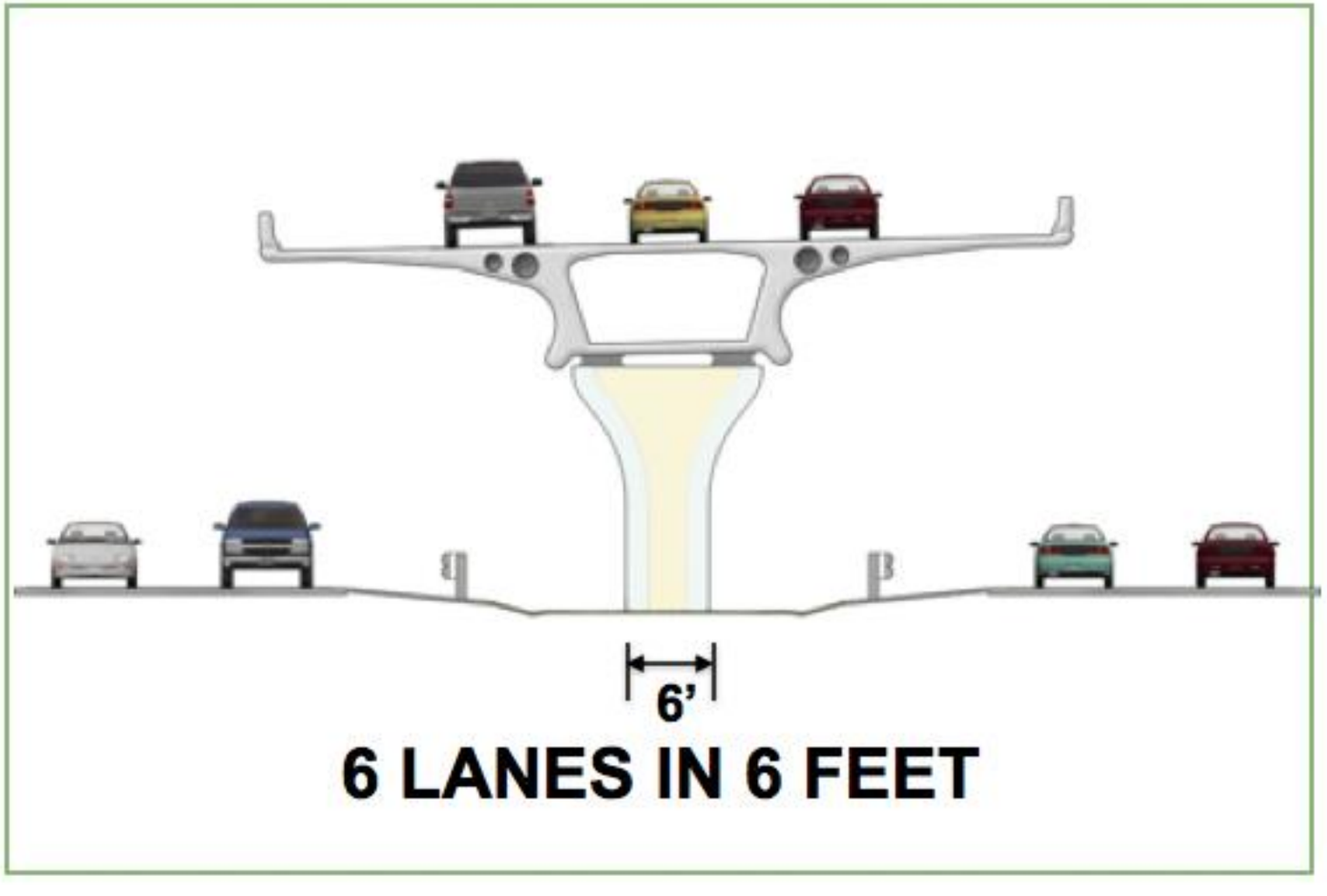
5 miles (40 minute trip cut to 10 minutes)

$1.87 toll

Opened June 2006

Over 20 million trips, no accidents

$65 Square Foot



Positive Effect on Property Values

Property values adjacent to elevated roadways designed by FIGG since 1988 have shown that average property values increased during and after construction

Selmon Expressway (2006)

43% the year after it opened

Regionally – 10% per year

BAYLIFE

SUNDAY, JULY 1, 2007 • THE TAMPA TRIBUNE • TBO.com

unexpected beauty

Most of us see too many each day to stop and marvel at the beauty around us, the historical architecture, icons and motifs that reflect Tampa's history.

A stroll downtown or to Ybor City reveals a wealth of sights and symbols of past generations and clues that enliven the future. Some merge art and engineering, others are purely whimsical. All lead our eyes over the expressive lines that are distinctively Tampa.

You may be familiar with many of the images on this page, which form a mosaic of life in the city. But do you know what and where they are? Test your local knowledge.

Bret Loft

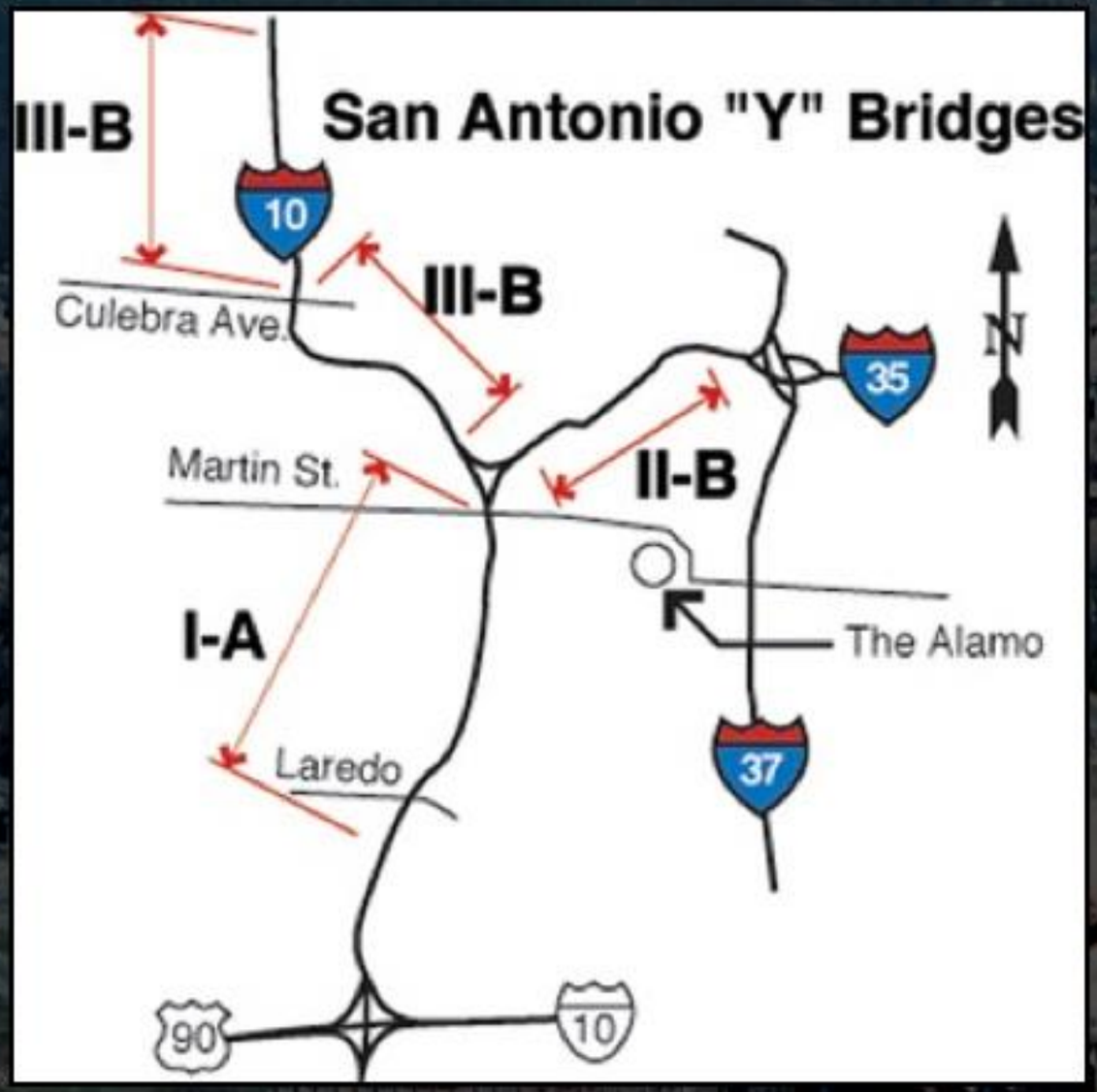
Find the answers on Page 7

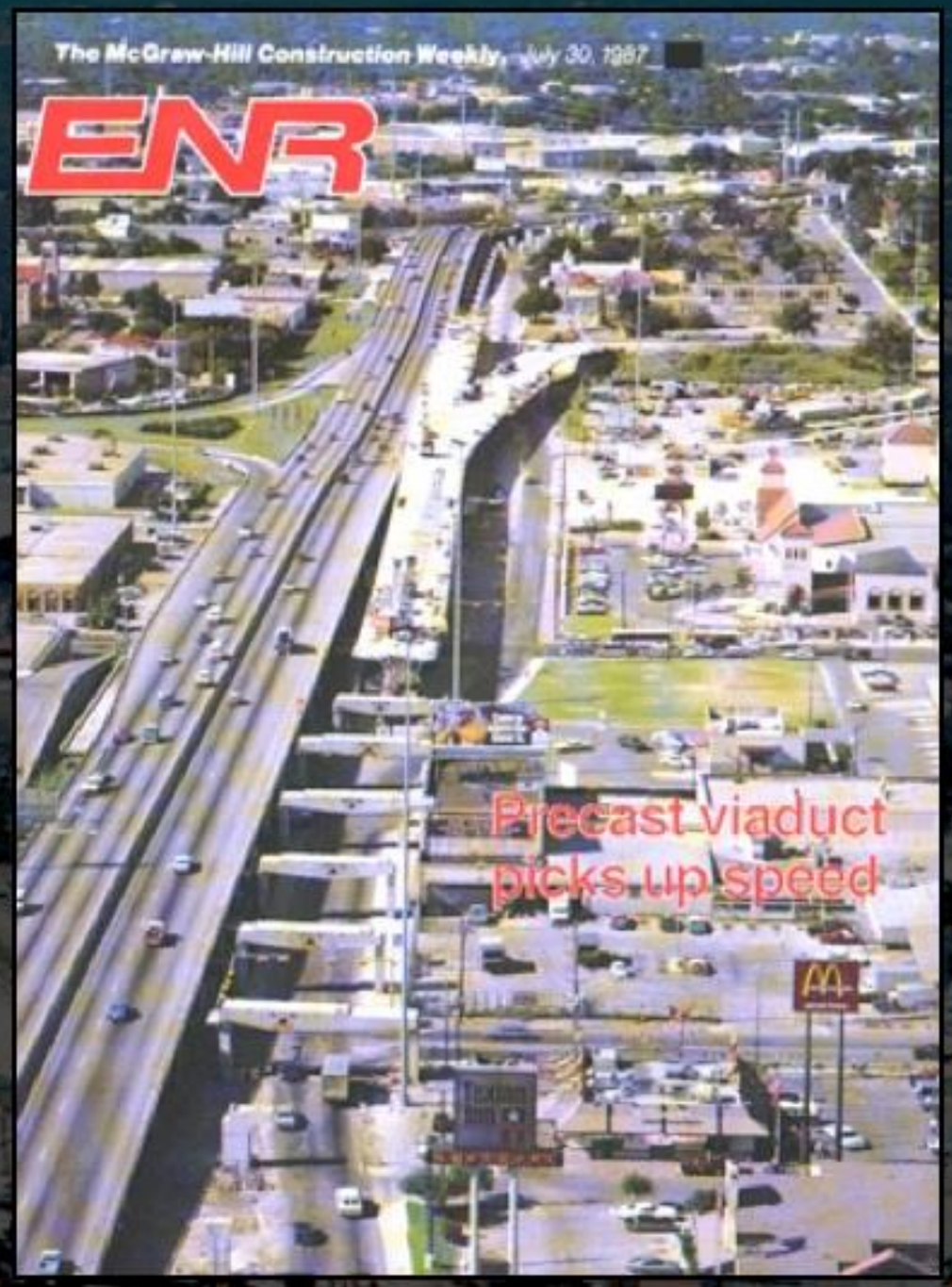
July 1, 2007 Tampa Tribune

Selmon Expressway
Tampa, Florida

San Antonio "Y"
San Antonio, Texas

Doubling the Capacity in the Existing Right of Way



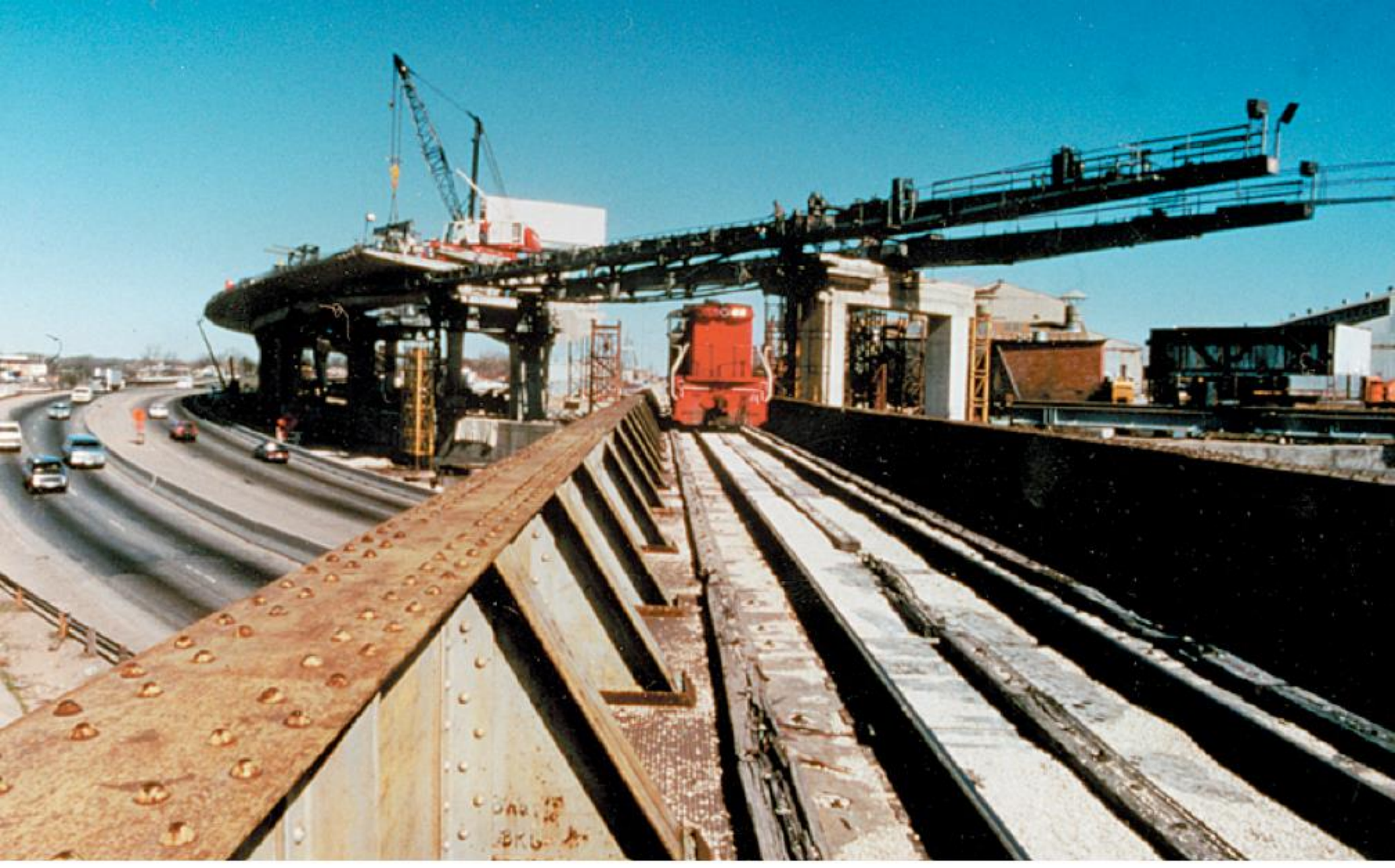


San Antonio "Y"
San Antonio, Texas

Doubling the Capacity in the Existing Right of Way
I-10 and I-35 Meet

San Antonio "Y"
San Antonio, Texas

Expanding Capacity using existing shoulders



San Antonio "Y"
San Antonio, Texas

Built over railroad

San Antonio "Y"
San Antonio, Texas

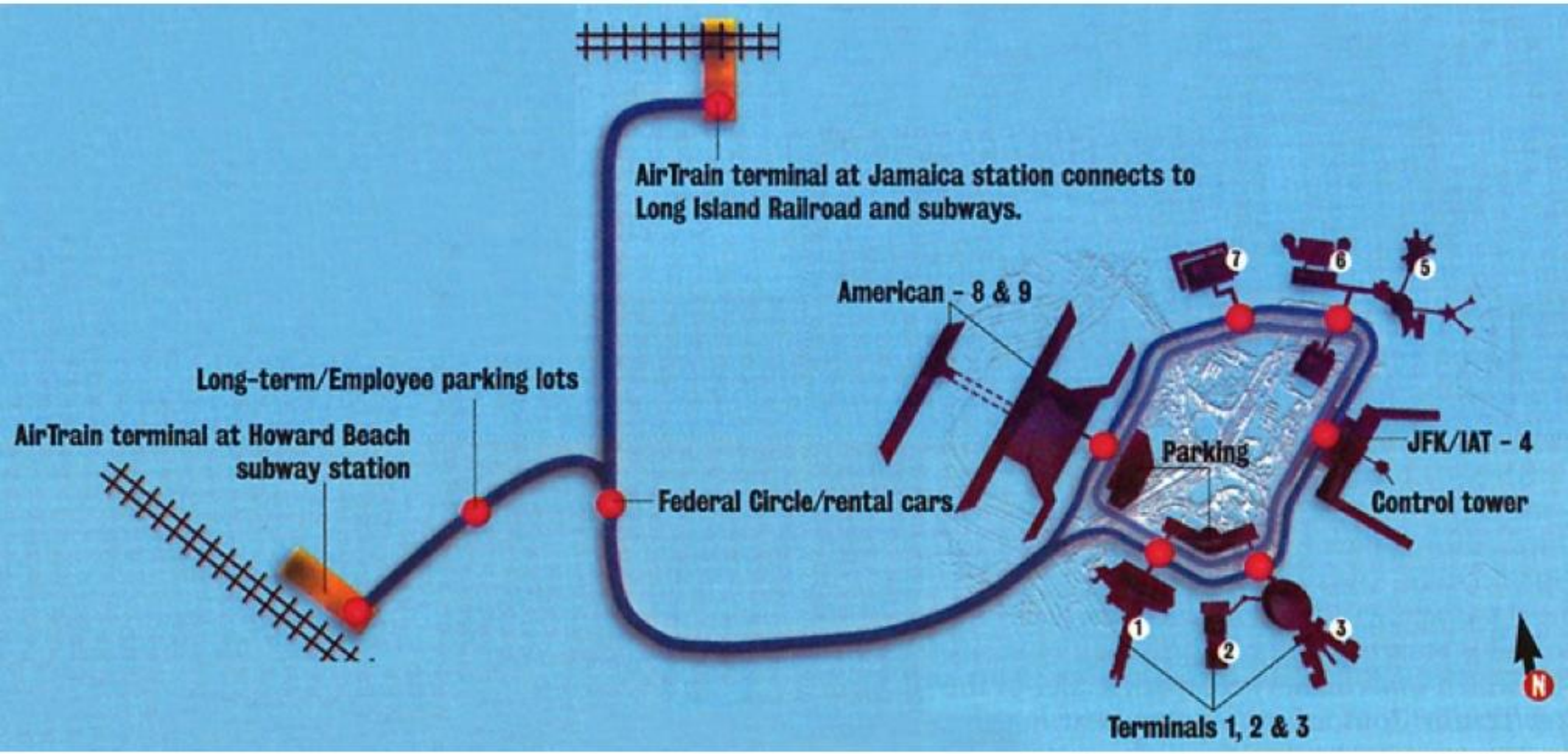
Only 7' of space used in existing shoulder

San Antonio "Y"
San Antonio, Texas

Only 7' of space used in existing shoulder

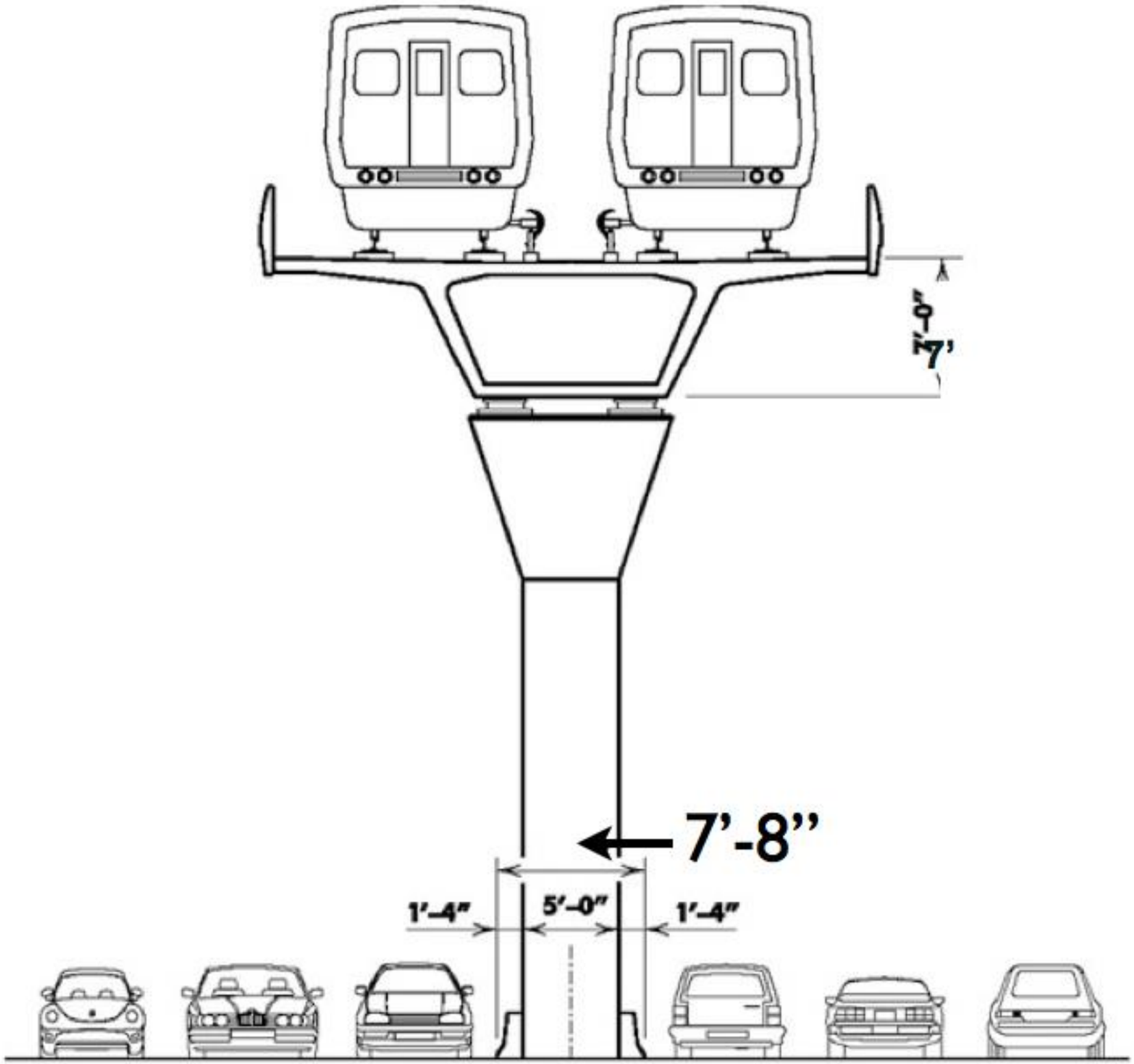
AirTrain JFK, New York

Port Authority New York/New Jersey
9 Miles - Built in 21 months



AirTrain JFK, New York

Port Authority New York/New Jersey
9 Miles - Built in 21 months

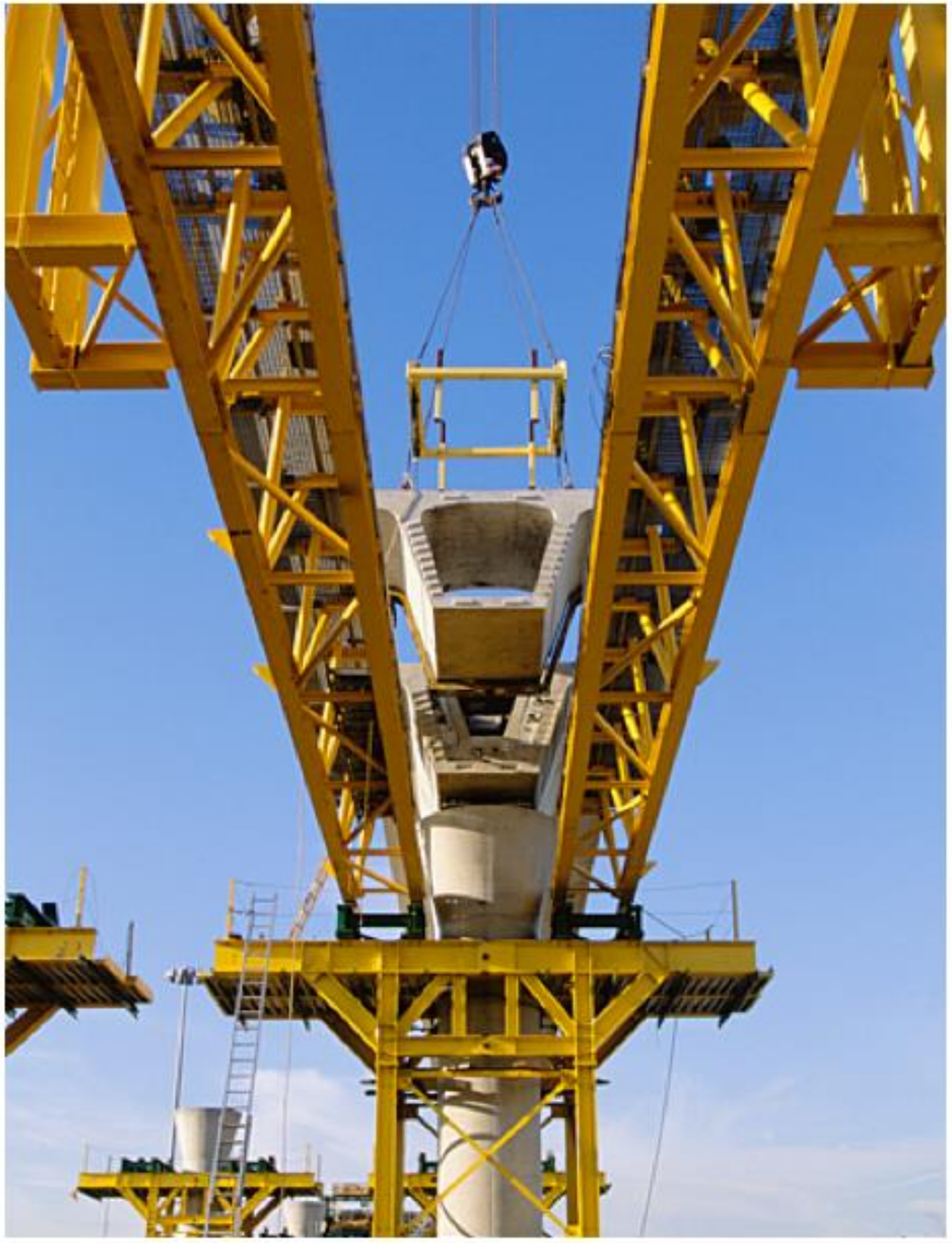


AirTrain JFK, New York

Create median for elevated structure in existing right-of-way

AirTrain JFK, New York

Van Wyke Expressway
160,000 vehicles per day



AirTrain JFK, New York

Built over existing bridges and down the median

AirTrain JFK, New York

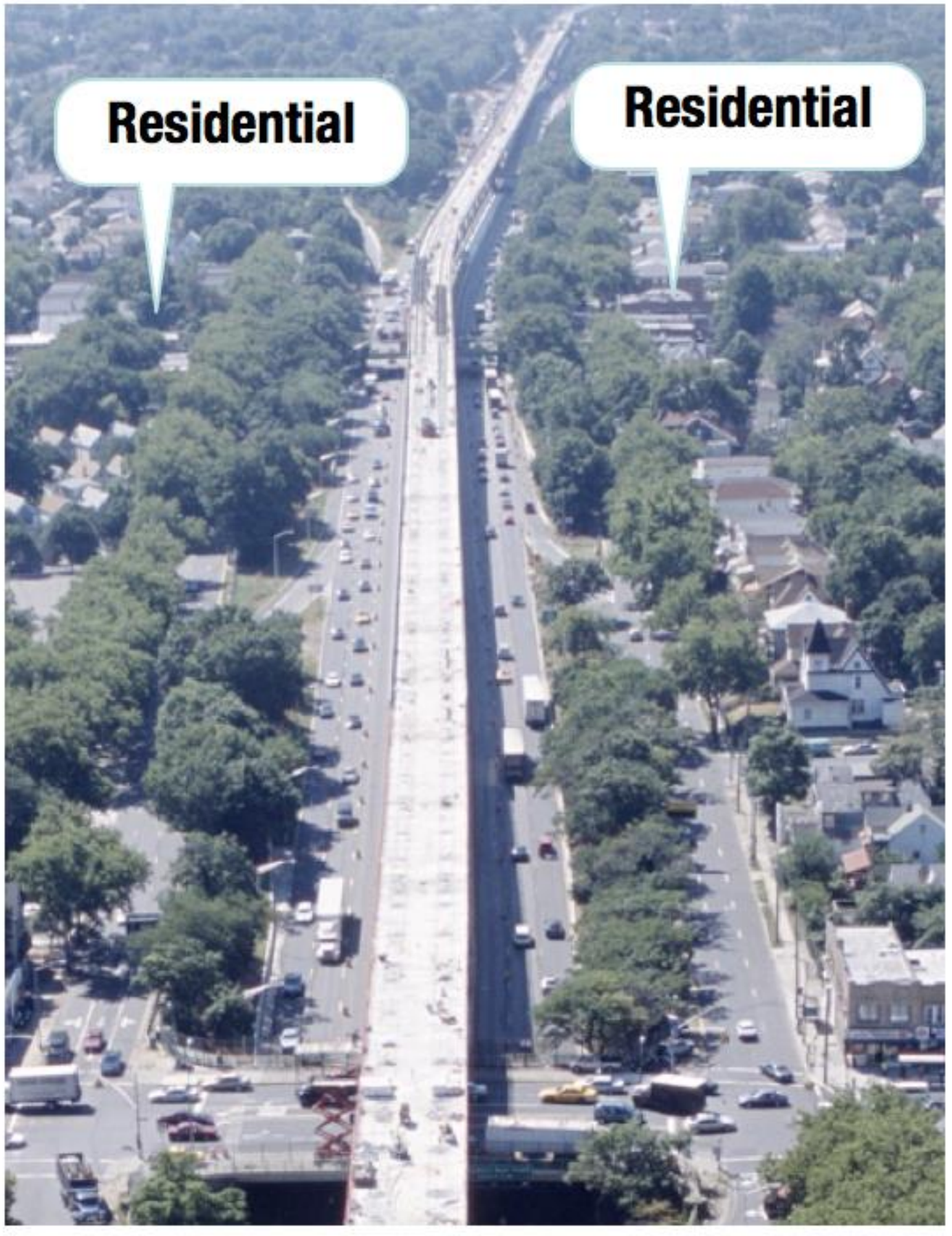
Long open spans

Positive Effect on Property Values

Property values adjacent to elevated roadways designed by FIGG since 1988 have shown that average property values increased during and after construction

AirTrain JFK (2001) - 32.5% per year

Regionally – 13% per year

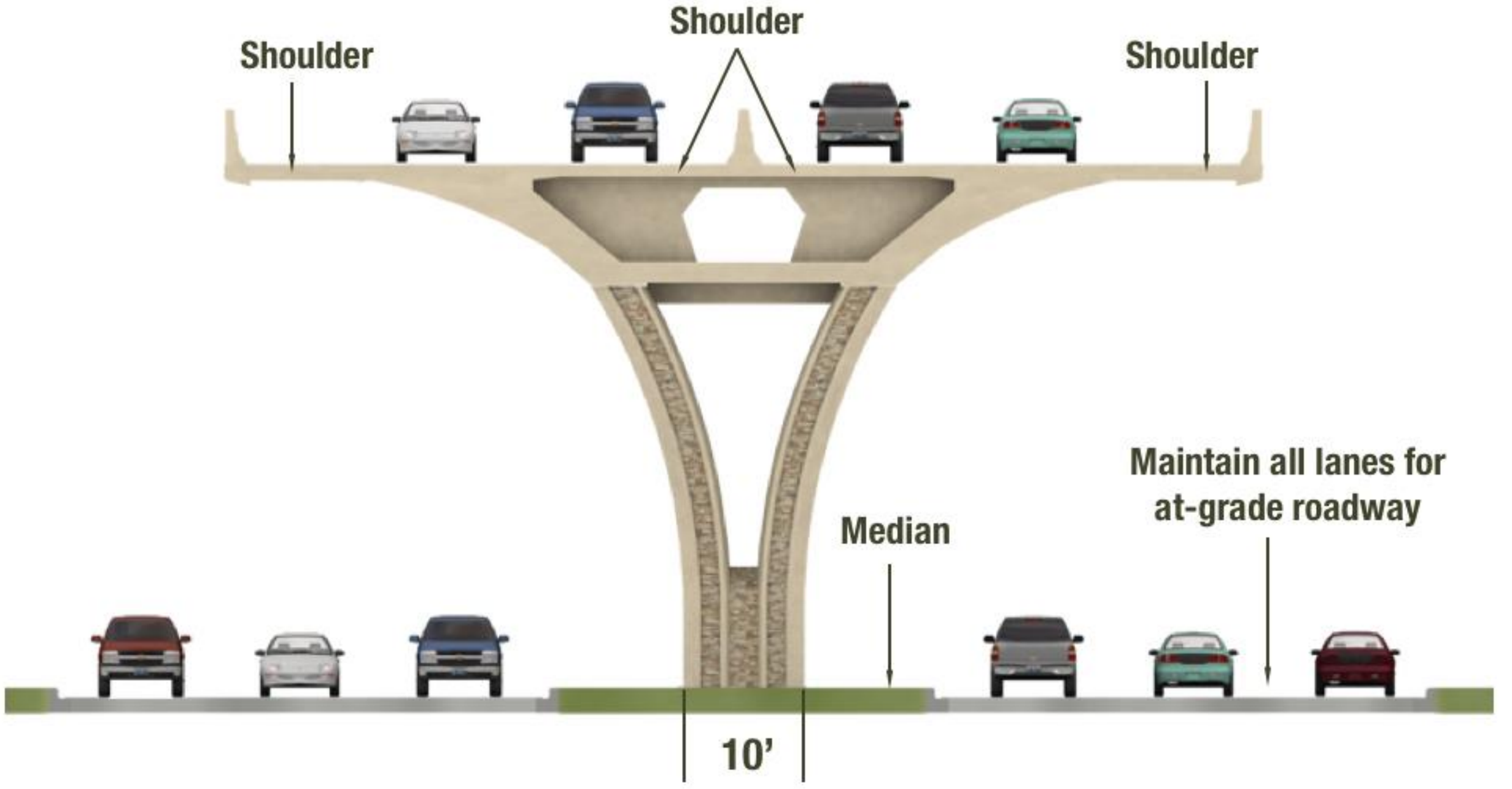


AirTrain JFK, New York

Rendering ©FIGG

U.S. 280 Elevated Roadway Birmingham Alabama

Garden Parkway - A Tribute to Nature: Trees and Native Stone



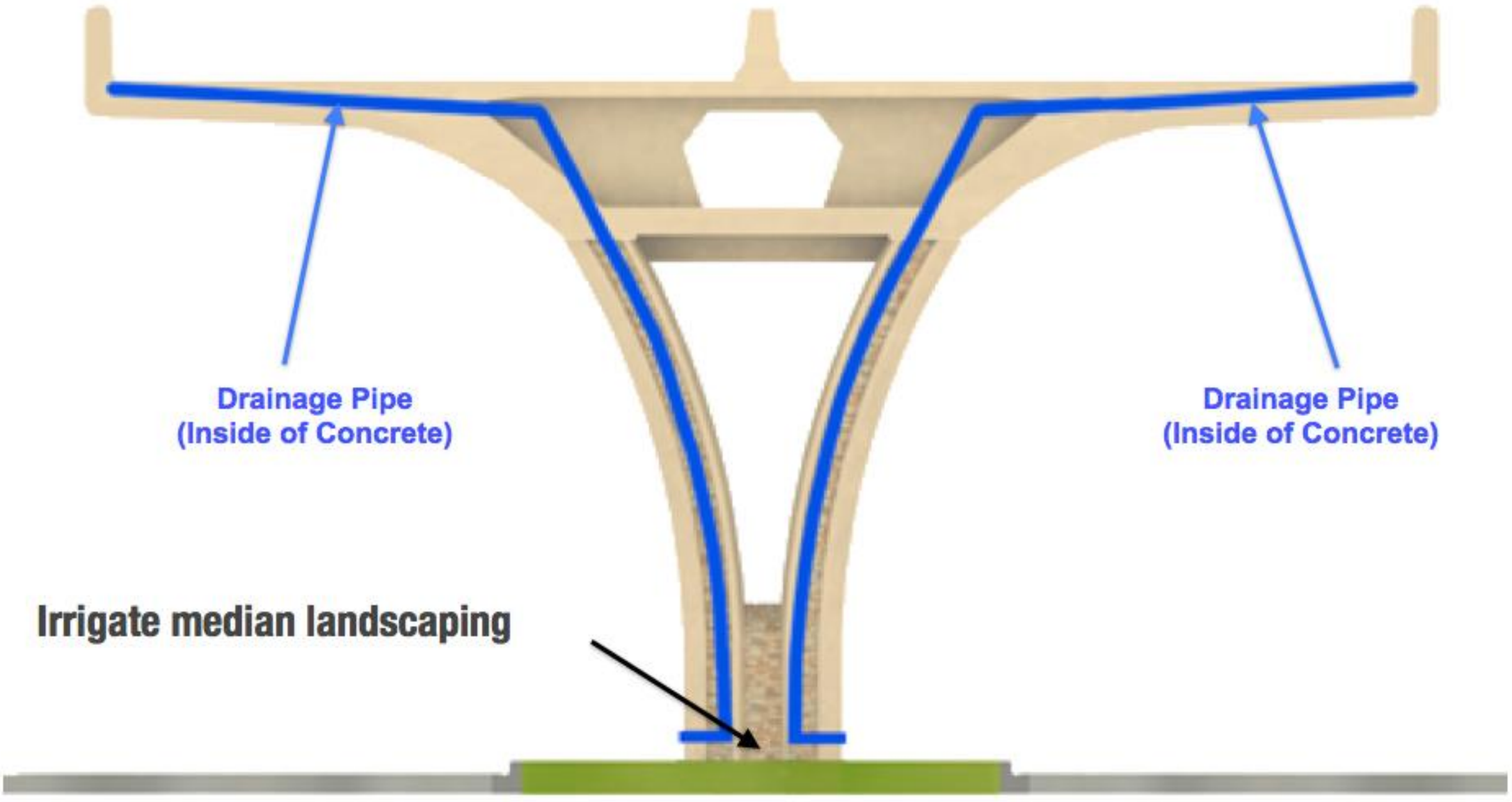
U.S. 280 Elevated Roadway
Birmingham Alabama

Garden Parkway - A Tribute to Nature: Trees and Native Stone

U.S. 280 Elevated Roadway Birmingham Alabama

Construction Method to Keep Traffic Flowing at All Times over intersections

Stormwater collected at deck level, piped through the bridge and used to irrigate landscaping



U.S. 280 Elevated Roadway
Birmingham Alabama

Garden Parkway
A Tribute to Nature:
Trees and Native Stone

SR-21 Corridor Study
Savannah, Georgia

6 Miles of Elevated Structure
Corridor Study for MPO

SR-21 Corridor Study
Savannah, Georgia

6 Miles of Elevated Structure
Corridor Study for MPO

SR-204 Corridor Study
Savannah, Georgia

3 Miles of Elevated Structure
Corridor Study for MPO

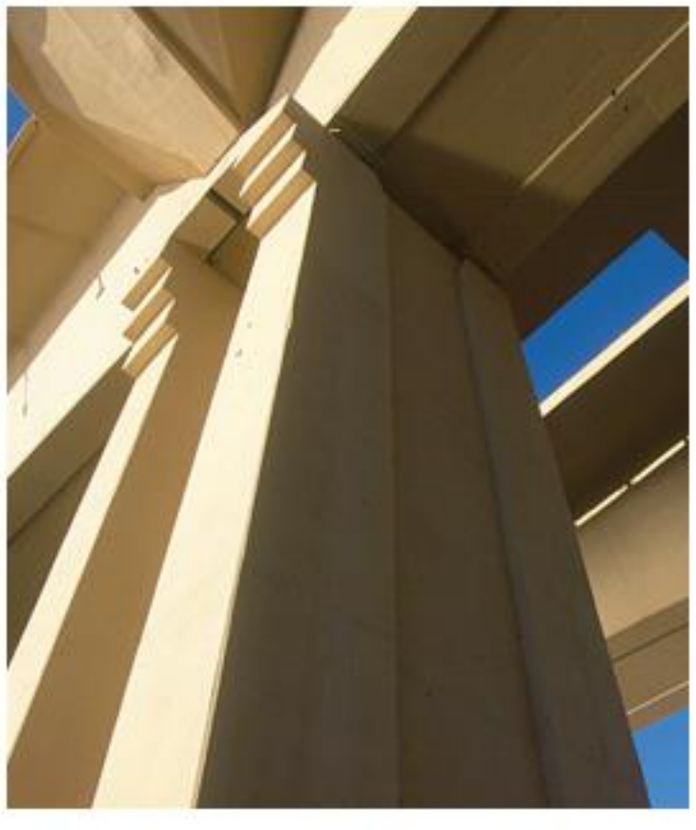
Rendering ©FIGG

Concept Rendering

Concept Rendering

Concept Rendering

Functional Bridge Sculpture™



Sustainable Solutions