CONSTRUCTION SUPPORT FOR SUPERSTRUCTURE DEMOLITION AND REHABILITATION OF FOUR I-90 DECK ARCH BRIDGES IN SILVER CREEK, NY

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Project Background

- 2 Twin span thruway bridges: Silver Creek, NY (Region 5)
- Feature Carried: I-90
- Feature Crossed: Silver Creek and Walnut Creek
- Structure Type: Reinforced concrete deck arch with transverse floorbeams, 3 spans: center arch span with 2 approach spans
- Length: 133’-0” clear span (arch), 285’-8” (total)
- Width: 56’-7” out-to-out, 51’-0” curb-to-curb
Project Background

• Year Built: 1954
• 1988: Replaced bridge rail with concrete barrier
• 1993: Concrete repairs, scupper removal, joint replacement
• Traffic: 2 lanes
• Original Design Live Load: HS 20
Project Location
Project Location

Silver Creek Structures

Walnut Creek Structures
Project Team

• Owner:
  New York State Thruway Authority (NYSTA)

• Engineer:
  HNTB

• General Contractor:
  Cold Spring Construction Co.

• Construction Support Engineer:
  Erdman Anthony
Project Background

- Last inspected in July 2011
- Rating performed by HNTB in April 2012
- Existing concrete deck rated poorly (HS 13 - 24.7 tons). Replace concrete deck.
- Existing floorbeams act as true T-beams. Removing deck slab would compromise compression flange. Replace transverse floorbeams (with precast).
- Existing spandrel columns and arch satisfactory. Class D concrete repairs as necessary. Replace center 4 short spandrel columns.
Damaged Deck Slab
Erdman Anthony Scope

- Demolition Calculations
- Erection Procedure with drawings for floorbeams
- Calculations supporting Erection Procedure
- General construction support
- Ensure overall structural integrity
Plan

PHASE 2
I-90 WB

PHASE 1
I-90 EB

I-90 EB
STAGE 2
APPROACH
SPAN

STAGE 1
1 SPAN

STAGE 2
APPROACH
SPAN

Deck slab and floorbeams to be replaced

Existing arch and spandrel columns to remain

SECTION A-A (See Layout Plan)
PROFILE ALONG WEST BOUND ROADWAY
Section – Arch Span

Typical Spandrel Columns
Section – Approach Span

Typical Half Transverse Section thru Approach Spans

Note: Reinforcement not shown except in columns.

Symmetrical about 8 of Knall, except for elevations of foundations.
Construction Equipment

- Walk-behind diamond blade wet saw
- Caterpillar 304C Excavator
- Caterpillar 328D Excavator
- Link-Belt HSL 238 150-ton Crawler Crane (2)
- Liebherr LTM 1200 250-ton Hydraulic Crane
- Grove GMK5275 275-ton Hydraulic Crane
Demolition Procedure

- Transition all traffic onto single bridge
- Remove bridge overlay
- Remove concrete barriers
- Deck slab demolition – arch span (symmetrical)
- Floorbeam demolition – arch span
- Erect 12 new arch span floorbeams
- Approach span demo similar
Restrictions

- No construction live load on overhangs
- Transverse sawcuts in deck 2” in from edge of floorbeam
- No longitudinal sawcuts over floorbeams
- Reactions based on excavator at maximum lift capacity
- Excavator will be located precisely to minimize bending in deck
- Crane mats for crawler cranes, excavator as needed
- Exterior lanes on existing bridge are adequate for 4 lanes of traffic, post-tension floorbeams as required (HNTB)
Existing Floorbeam PT
Tasks

- Determine max pick weight for excavator
- Determine limitations for excavator position
- Determine crane locations
- Design crane mats and outrigger pads
- Design rigging for floorbeams
- Perform surcharge analysis (crane on approaches)
Saw Cut & Slab Demo

LONGITUDINAL SECTION ON THE O.GRADE LINE
Scale: 1" = 1'-0"
Photos – Slab Demo
Excavator Load
Excavator Location

1. EXC. TRACKS LONGITUDINAL - MAX PICK OVER TOES

ENVELOPE

\[ M^+_{\text{MAX}} = 184.05 \text{ K-ft} \quad > \quad 155.42 \text{ K-ft (NG)} \]

\[ M^-_{\text{MAX}} = 110.72 \text{ K-ft} \quad > \quad 81.71 \text{ K-ft (NG)} \]
Excavator Location

STEP 25: EXC. LIFT OVER TOES

MAX

CL Floorbeam

8’-0”

CG Excavator

\[ M = 8.48 \text{ kFt} < 155.42 \text{ kFt} \text{ (OK)} \]

\[ -M = 38.73 \text{ kFt} < 81.21 \text{ kFt} \text{ (OK)} \]
Demolition

Barrier and Slab – Arch Span

2 Lanes West Bound

2 Lanes East Bound
Demolition

Floorbeams – Arch Span

2 Lanes West Bound

2 Lanes East Bound
Floorbeam Removal
Erection Procedure

Arch Span:

• Deliver precast floorbeams on adjacent bridge.

• Lift floorbeams:
  – Center 4 Arch span floorbeams: 2 Hydraulic Cranes in tandem
  – Floorbeams 5 and 6: Single pick with Hydraulic Crane
  – Remaining 6 arch span floorbeams: Single pick with Crawler Crane
Erection

Floorbeams – Arch Span: Dual Crane Picks

EB Lane 1 - Temp. closure during erection (1-2 min)
EB Lane 2 - Fully closed for delivery

2 Lanes West Bound

250-ton Hydraulic Crane

275-ton Hydraulic Crane
Erection

Floorbeams – Arch Span: Single Crane Picks

EB Lane 1 - Temp. closure during erection (1-2 min)

2 Lanes West Bound

EB Lane 2 - Fully closed for delivery

250-ton Hydraulic Crane

275-ton Hydraulic Crane
Floorbeams – Arch Span: Single Crane Picks

EB Lane 1 - Temp. closure during erection (1-2 min)

EB Lane 2 - Fully closed for delivery

2 Lanes West Bound

150-ton Crawler Crane

150-ton Crawler Crane
Floorbeam Erection
Demolition

Slab and Floorbeams – Approach Spans

2 Lanes West Bound

2 Lanes East Bound

Crane mats on column lines
Slab and Floorbeams – Approach Spans

2 Lanes West Bound

2 Lanes East Bound

Crane mats on column lines
Floorbeam Removal
Q: Why was special attention paid to the method of demolition for the deck and transverse floorbeams?

A: A majority of the spandrel columns and the entire arch were to remain in place and were required to be undamaged.
Q: Why were the slab sections that were being removed limited to a certain size?

A1: Tipping capacity of the excavator.

A2: Reaction under excavator tracks cannot cause a failure in the deck slab or floorbeams.

(2 parts)
Q: Why were the floorbeams and slab analyzed for the maximum lift load for the excavator and not just the weight of the slab section being removed?

A: To be conservative in the analysis and to avoid overstressing the deck floorbeams.
Q: Why was the Crawler Crane placed on the column lines for the approach span work?
A: To reduce bending forces in the floorbeams. (Transfers reaction right to columns)
Q: Why were crane mats used under the tracks of the crawler cranes?

A: To span between the floorbeams and avoid overstressing the deck slab.
“You don’t wanna know.”

- Cold Spring PM Jeff Younger when asked exactly how they plan to remove the deck slab sections from the bridge.
Thank You

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