NEW NICE/MIDDLETON BRIDGE Replacement Project

Contract Number: NB-0543-0000
Governor Harry W. Nice/Senator Thomas “Mac” Middleton Bridge Replacement Design-Build Project

AISC Steel Days / High Steel Open House
10-19-2023

NEW NICE MIDDLETON BRIDGE

Maryland Transportation Authority

MDTA

HIGH STEEL STRUCTURES LLC

SKANSKA CORMAN McLean

AECOM

Maryland Transportation Authority

With

General Engineering Consultant (GEC) JV

JOHNSON, MIRMIRAN & THOMPSON
Engineering A Brighter Future®

wsp

Construction Inspection Team

RK&K

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KCI TECHNOLOGIES

WBCM
Designing Infrastructure for Tomorrow®

Gannett Fleming

Design-Build Contractor

SKANSKA CORMAN KOKOSING McLean

In partnership with

AECOM

Designers

AECOM

WALLACE MONTGOMERY
ENGINEERS · PLANNERS · SURVEYORS · CONSTRUCTION MANAGERS

Schnabel ENGINEERING

τβα Tuhin Basu & Associates, Inc.

ACCUMARK Subsurface Utility Services

FLOURA TEETER landscape architects

KLS Engineering

DMW DAFT McCUNE WALKER

CCJM Engineering Infrastructure Solutions

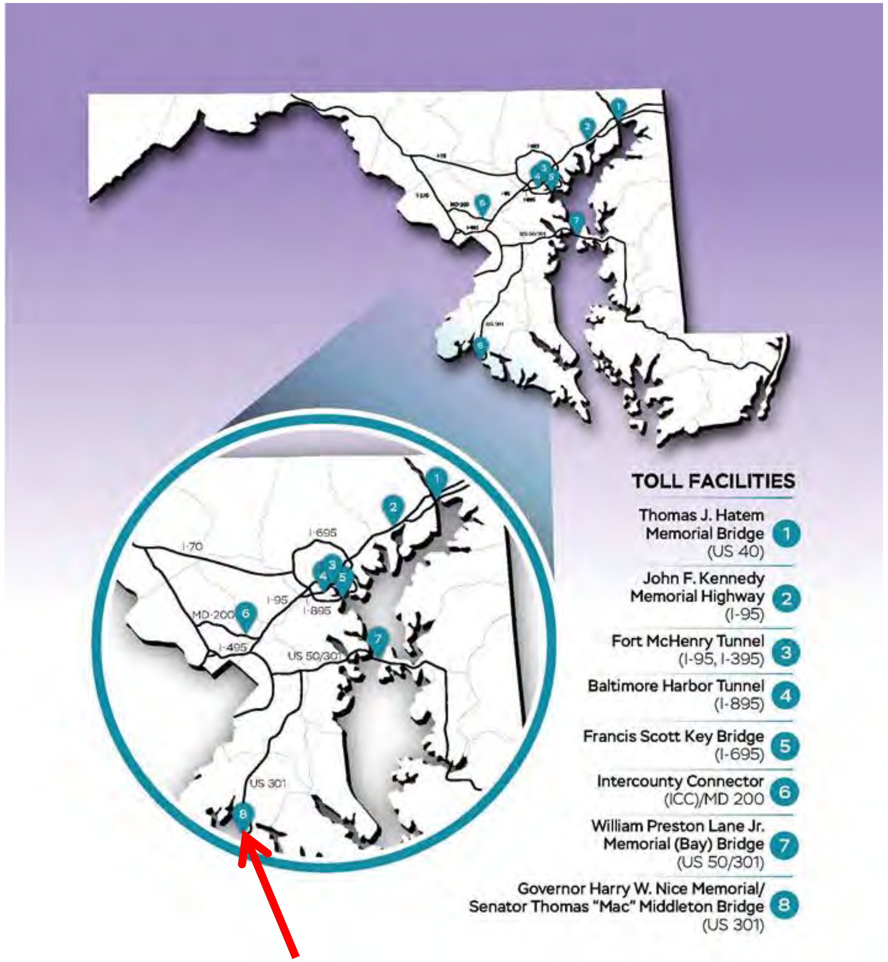
rda RINKER DESIGN ASSOCIATES

HSA, Inc.

Independent Design Quality Manager - IDQM

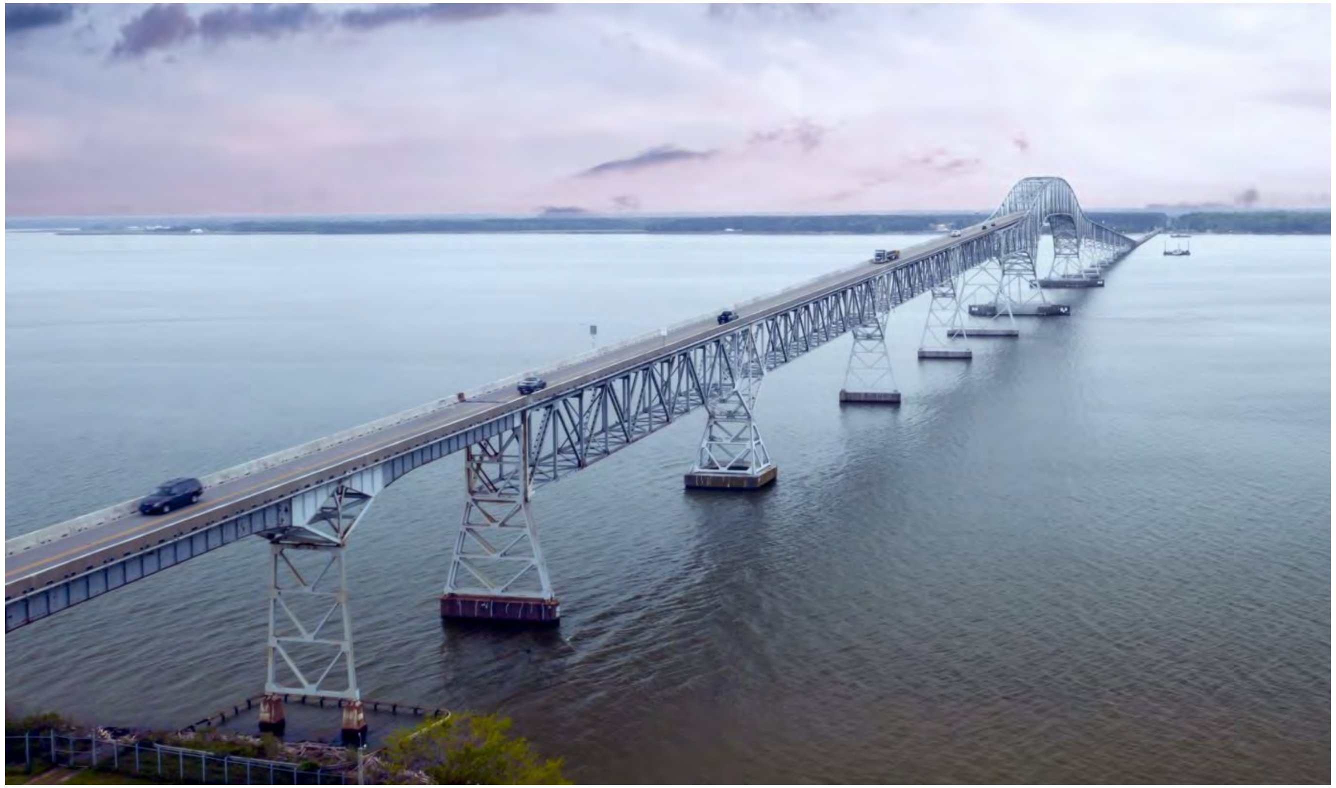
Nice Bridge Fast Facts

- Construction dates: March 1938 – December 1940
- Original cost to construct: $5 million
    - ✓ New Bridge cost $462,957,000
- Named in 1968 for Maryland Governor Harry W. Nice
    - ✓ Renamed in 2018 to include Senator Thomas “Mac” Middleton
- Length of entire facility (including bridge and approaches): 2.2 miles
- Bridge length: 1.9 miles of two-lane bridge
- CY 2019 traffic volume: 6.6 million vehicles (average annual daily traffic: 18,200)
- FY 2019 toll revenue: $21.0 million



Existing Bridge

- Designed by Greiner – now AECOM
- Two-Lane Steel Bridge
- Steel Beam Approach Spans
- Rhomboid Girder Approach Spans
- Truss Approach Spans
- Through Cantilever Truss Main Span



Most Significant Needs for New Bridge

- Severe Summertime Traffic
  - ✓ Routine weekend backups up to 4 miles
- Lane closure limitations for maintenance
  - ✓ Flagging operations required
- Safety Issues
  - ✓ Certain crash types more than double the Statewide averages




Process & Timeline

- June 2018 – Multiple Pre-Solicitation Conferences
- **October 20, 2018 – RFQ Advertised**
  - ✓ November 9, 2018 held Pre-Proposal Conference
  - ✓ Short listed the four (4) most highly qualified teams
- March 8, 2019 – RFP issued to reduced candidate list
- Procurement team processed:
  - ✓ 435 questions in 20 confidential one-on-one meetings (5 per team)
  - ✓ 96 Alternative Technical Concepts from the teams
  - ✓ 420 questions answered via 14 addendums
- July 30, 2019 – Technical Proposals received
- **September 6, 2019 – Price Proposals received**
- October 4, 2019 – Notice of intent of award issued to Skanska-Corman-McLean (SCM) team
- October 23, 2019 – SCM team approved to commence early submittals
- November 21, 2019 – MDTA Board approval of SCM team
- January 24, 2020 – SCM team awarded the Contract
- October 12, 2022 – Bridge opened to traffic

MDTA
Maryland Transportation Authority

Proposal Phase Design Philosophy

The greatest economy in the design of any structure is attained by making the structure as simple as possible and with the greatest amount of duplication of spans, superstructure, substructure, and foundations. Everything becomes less time consuming and costly including shop drawings, fabrication, and erection. Repetition not only results in faster construction, but also results in higher quality.

Proposal Phase Design Philosophy

- MDTA provided sufficient engineering data and comprehensive Performance Specifications, as well as other pertinent information to help make key decisions during the proposal phase design (Greatly reduced DB Teams Risk).

- Primary objectives during the design-build proposal phase was to evaluate the most economical, durable and constructible bridge types:

    - Understanding river mechanics & scour;
    - Foundation requirements;
    - Climate and exposure conditions as they relate to durability; and
    - Constructing the bridge in an aggressive marine environment.

- The level of development accomplished during the proposal phase facilitated starting construction as quickly as possible after project award (within 6-months).

Proposal Phase Design Philosophy

- Foundations provide the greatest potential for cost savings:
    - Seven (7) foundation types and sizes were evaluated including concrete square piles, concrete cylinder piles and steel pipe piles. Pile lengths ranged from 69-feet to 191-feet in length with nominal bearing resistances between 1,200 to 3,115-kips
- Design Repetition increases production and improves quality (i.e. assembly line process) by maintaining families of bridge component sizes for columns, pier caps, footings, pile types & layout, etc.
- Water Line Footings results in direct savings by eliminating costly coffer cells
- Precast Foundations & Superstructure allows bridge component production to start early, compresses the schedule by accelerating erection, and improves overall quality because the concreting and curing are done in a controlled environment as opposed to in the air over water
- Span Optimization considering the number of spans & span lengths cost balanced against the number and heights of piers and supporting foundations

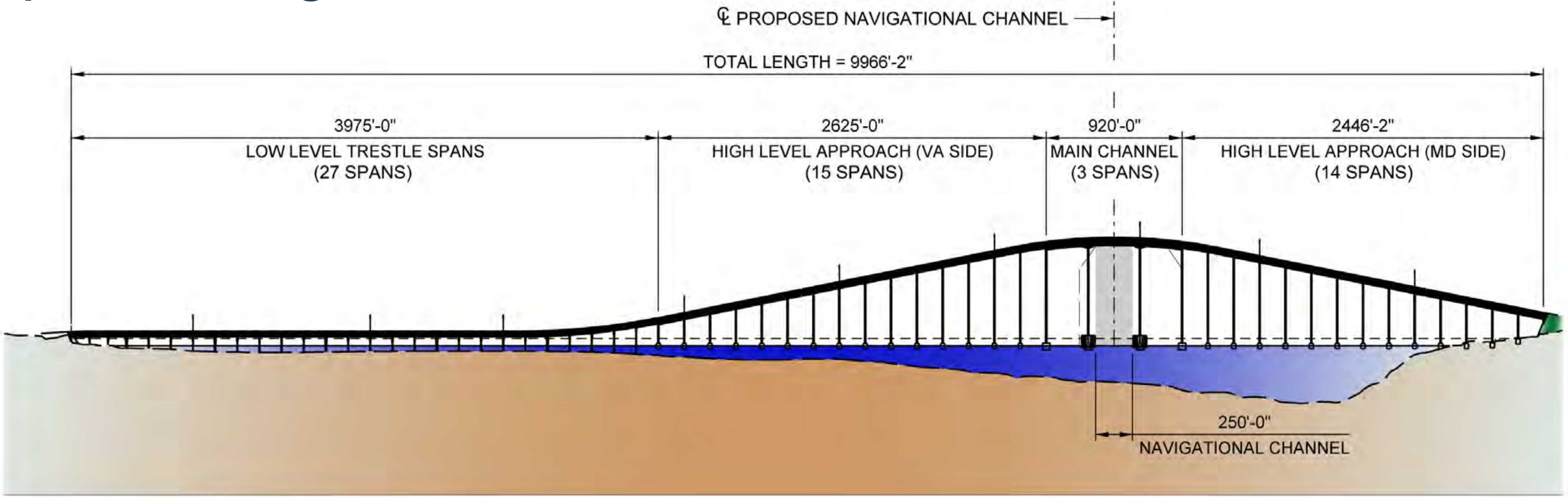
Proposal Phase Design Philosophy

- Eight (8) superstructure types were evaluated for a wide range of span length arrangements including PSC girders, spliced PSC concrete girders, steel girders, and precast concrete segmental box girders

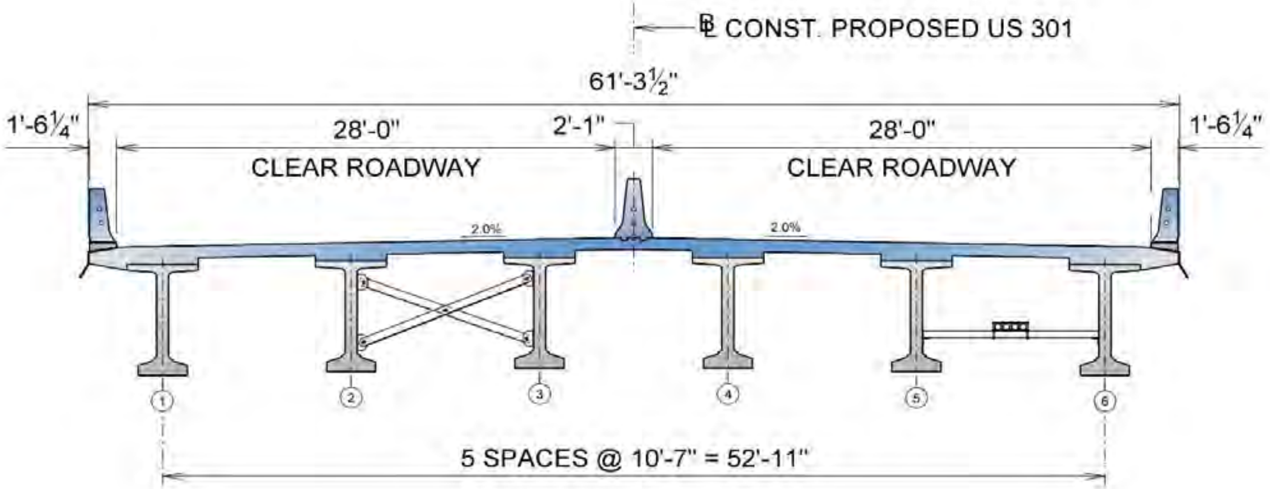
- The 9,966-feet long bridge (1.9-miles) is optimally divided into three distinct sections including the Low-Level Approach Spans, High-Level Approach Spans, and Main Channel Spans

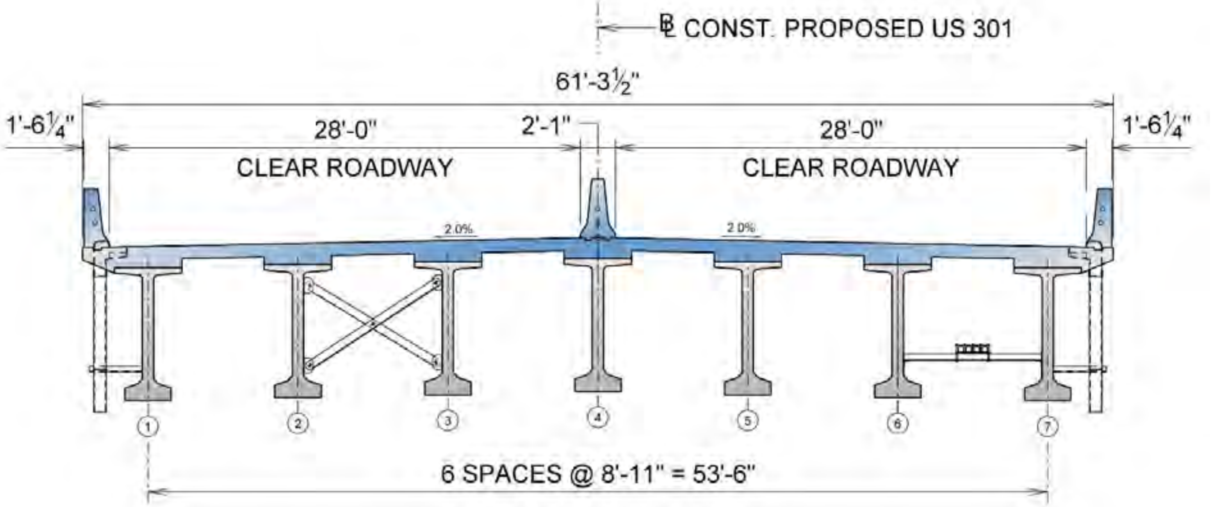
- Design focused on consistent spans, constant depth, consistent colors, clean lines, gradual curvature's sight line, and openness to improve overall aesthetics

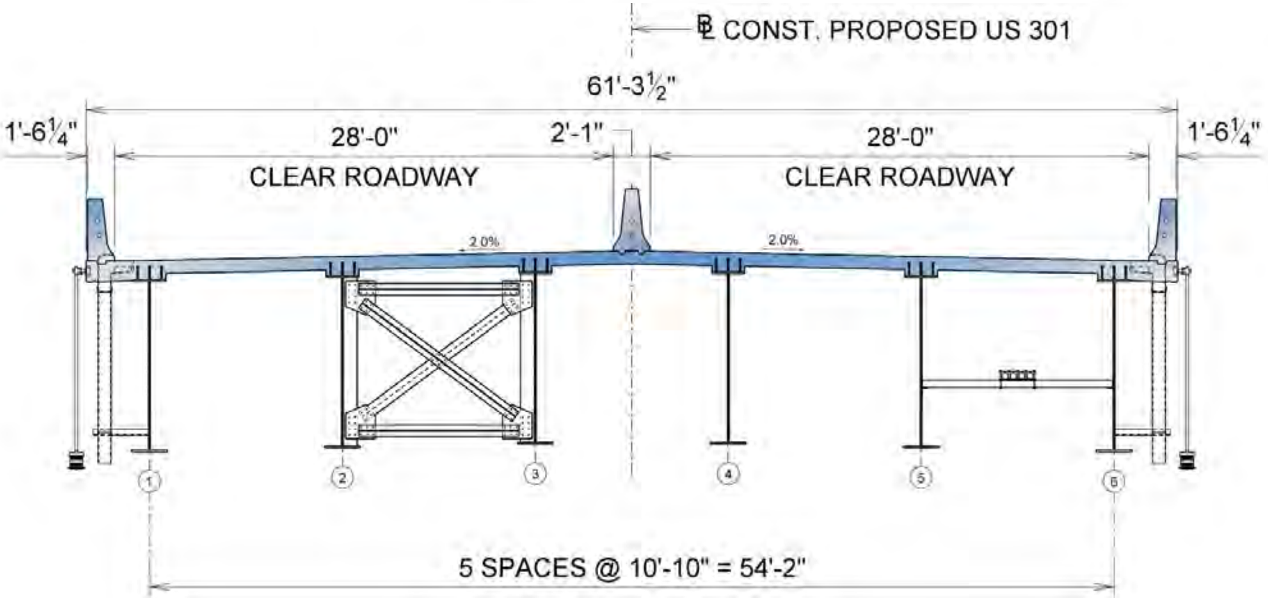
Span Configurations



- Low-Level Spans – 79″ Bulb-T's (150-ft typ span)
- High-Level Spans – 95″ Bulb-T's (175-ft typ span)
- Main Channel Spans – Steel Plate Girders (285'-350'-285')







Reinforced concrete decks include:

- ½-inch integral wearing surface & silane sealer;
- Low chromium carbon steel (deck and barriers);
- Concrete includes synthetic fibers for added corrosion protection.

Design Criteria

- AASHTO LRFD Bridge Design Specifications
- MDOT Office of Structures Structural Details Manual
- MDOT Office of Structures Guidelines, Policies and Procedures Memorandums
- Performance specifications
- 75-year service life
- Pier protection system

Alternative Technical Concepts

- Pile spacing reduction from 3D to 2.5D
- Concrete deck design per AASHTO LRFD
- Steel girder spacing increase from10′-6″ to 10′-10″

Governor Harry W. Nice / Senator Thomas “Mac” Middleton Bridge Replacement Design-Build Project

Key Elements in Final Bridge Design and Construction

Bridge Foundations

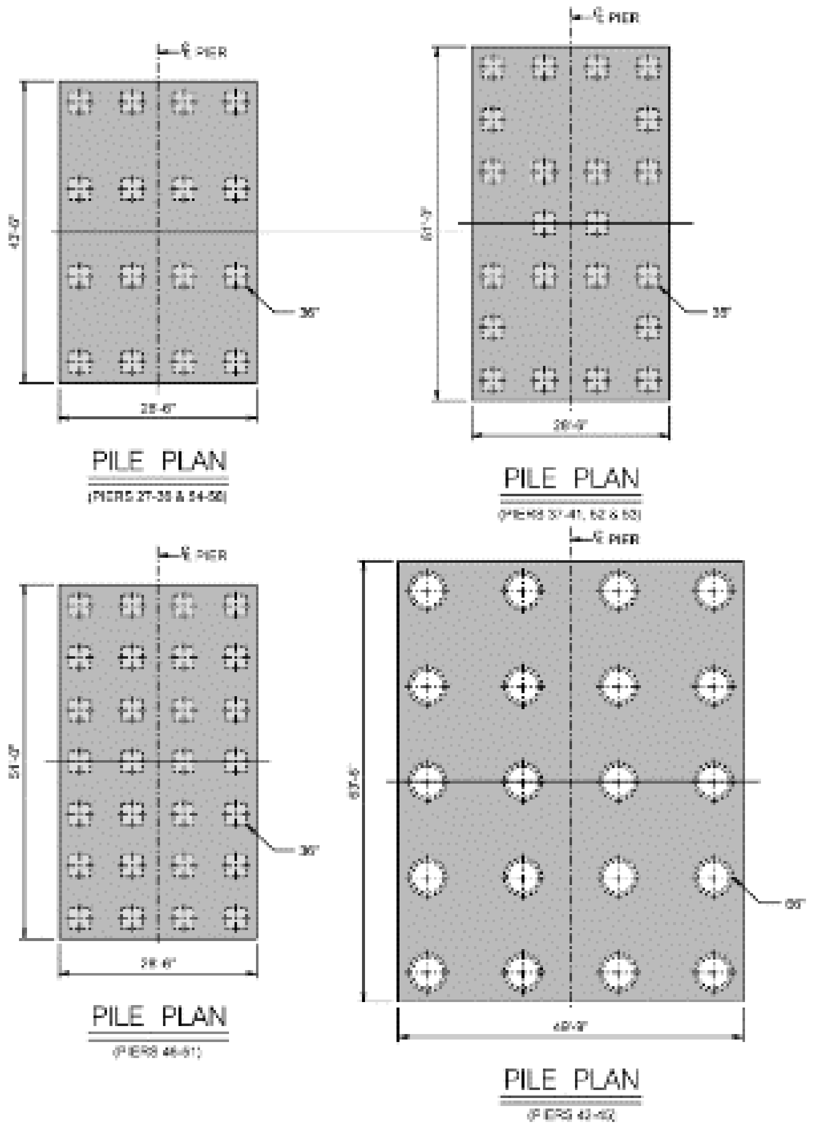
Prestressed Concrete Piles (7,000 psi):

- ***36" square piles for High-Level & Low-Level Approach Spans***
  - ✓ Solid
  - ✓ Plain Prestressing Steel Strands (32 @ 0.6")
  - ✓ 100-ft to 190-ft Long (combined water and soft soils range 70 to 150-ft)
  - ✓ NBR up to 1,566 kips

- ***66" cylinder piles for Main Channel Spans***
  - ✓ CFRP strands (36 @ 0.6")
  - ✓ Up to 188-ft Long
  - ✓ NBR up to 1,966 kips

Bridge Foundations

- Loads distributed based on effective stiffness
  - Pile foundation stiffness
  - Pier stiffness
  - Bearing stiffness
  - Scoured and unscoured condition
- FB-MultiPier
- High Level -16 to 28 piles
- Main Channel – 20 piles

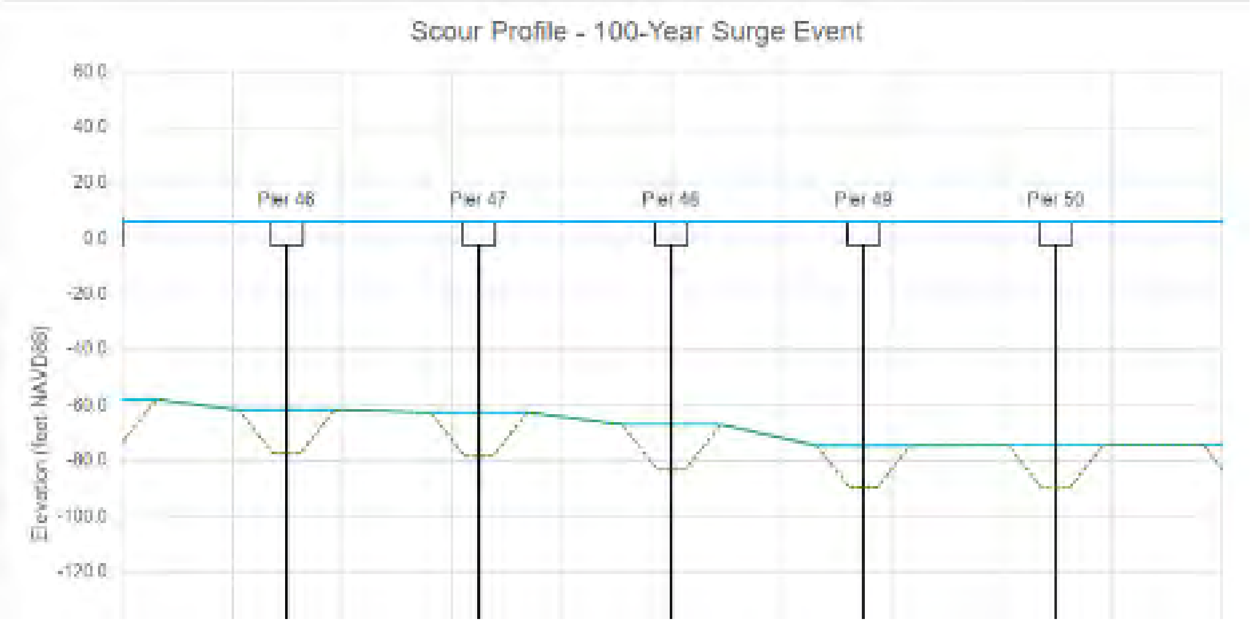


Bridge Foundations

Scour

- 100-yr storm for all load cases
- 500-yr storm for extreme event load case
- FB-MultiPier models considered both scoured and unscoured conditions.
- 3.5′ to 16.5′ for 100-yr
- 7.1′ to 23.8′ for 500-yr

- Scour Profile



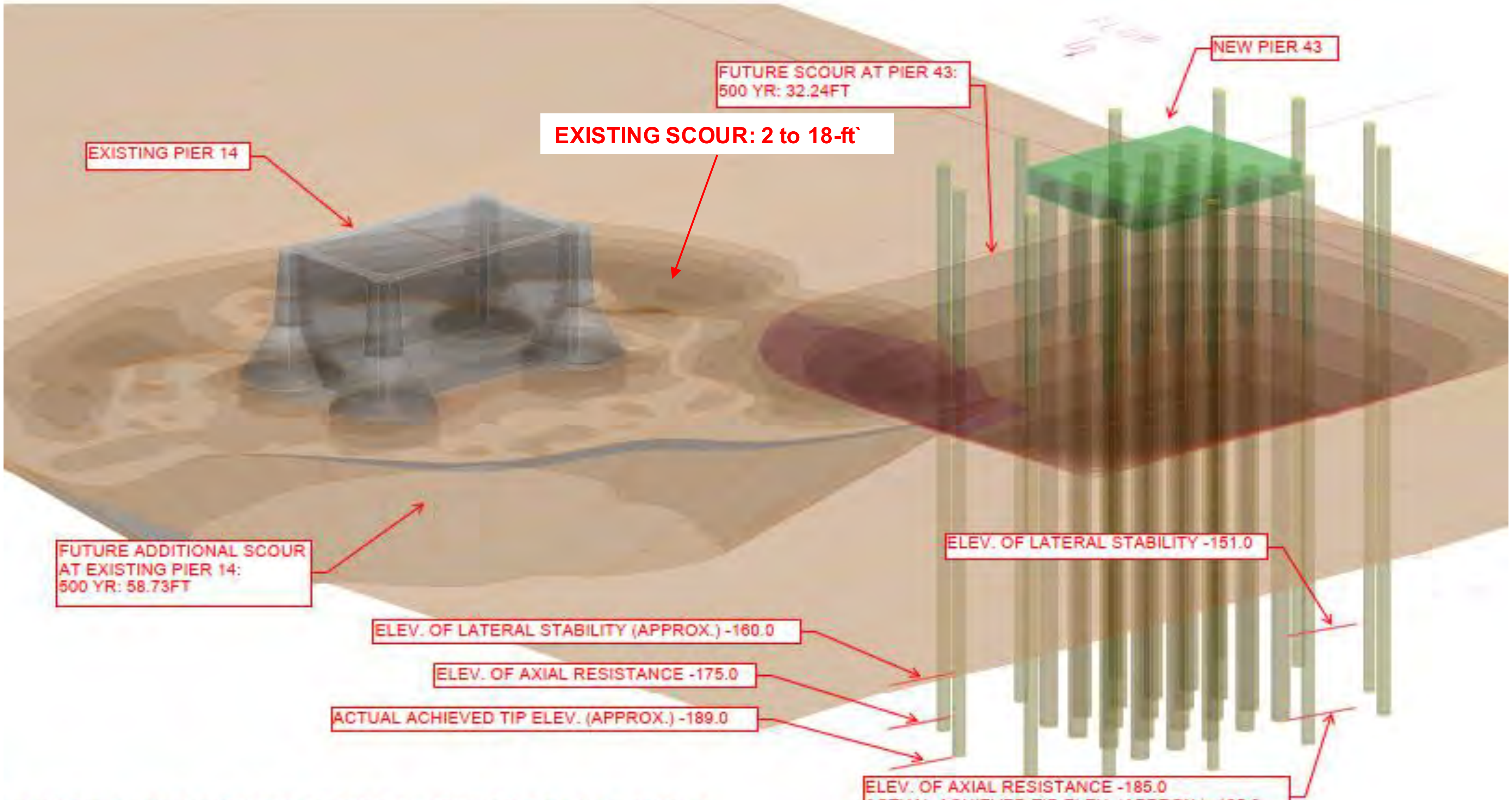


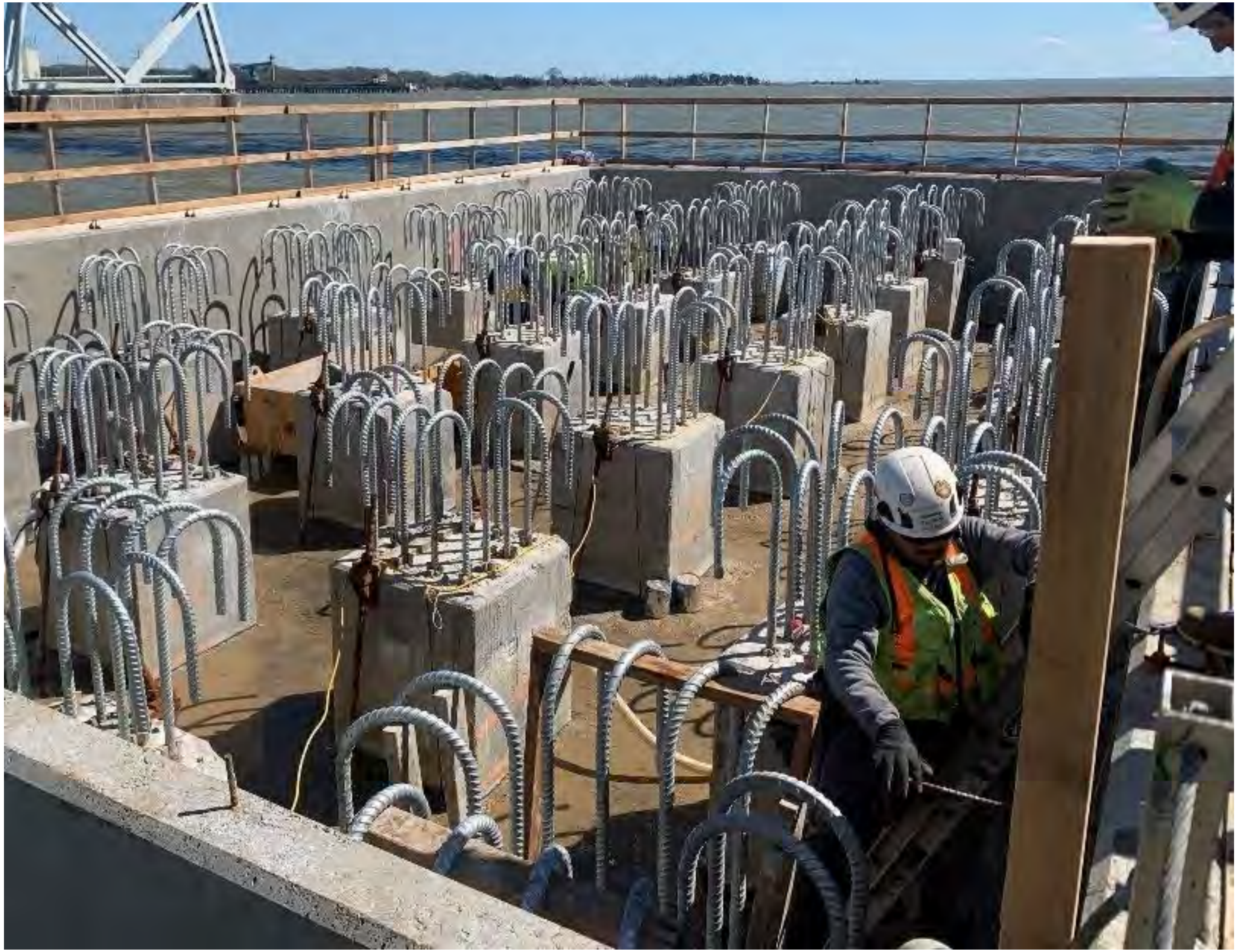
FIGURE 4 - MOD 2 SCOUR AT PIER 14; 500YR SCOUR AT PIER 43

Low-Level Approach Spans Pile Bents

- 6 or 7 piles
- FRP jackets in splash zone
- 200-ton barge impact (water depth > 2-ft)
- For climate change and sea level rise, the RFP required a bottom of superstructure elevation above the Maryland Coast Smart Council construction requirements = El 12.62 (500-year flood elevation at 6.82)

High-Level Approach Spans – Waterline Footings

- Precast tubs
- 7-ft deep
- 16 to 28 pile groups
- Piles embedded 3.5′ with #11 dowels (galvanized)
- 200-ton barge impact



High-Level Approach Spans - Substructure

- Two Column Piers w/ diameters 6′-6″ to 8′-6″
  - 6’-6” for pier heights up to 51-ft
  - 7’-6” for pier heights up to 86-ft
  - 8’-6” for pier heights up to 120-ft

Substructure

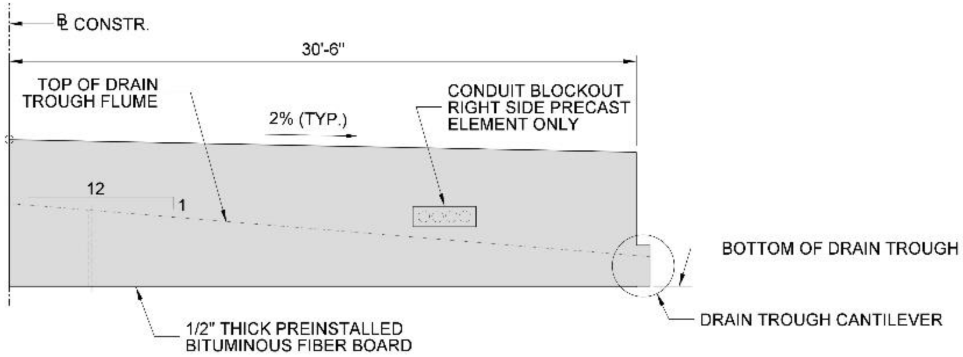
High Level and Main Channel

- Typical pier cap 61′ long, 8′ deep, 9′ wide
- Cap widths provide room for bearing replacement

Pier Cap Reinforcement

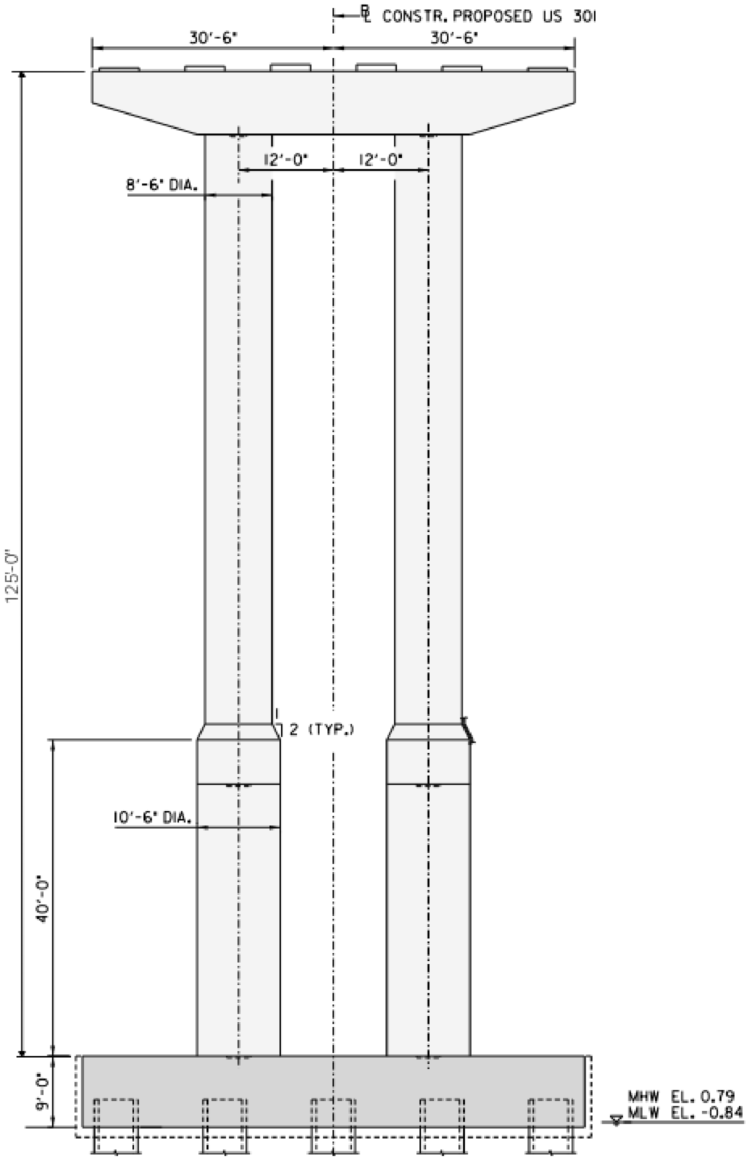
Expansion Joint Pier Cap

- VDOT trough on pier cap
- RFP requirement
- Trough is precast in two sections



Main Channel Spans – Waterline Footings

- Precast tubs
- 9-ft deep
- 20 pile group
- Piles embedded 3.5' w/ #11 dowels
- Interior filled with sand up to concrete plug
- Vessel Pier Protection

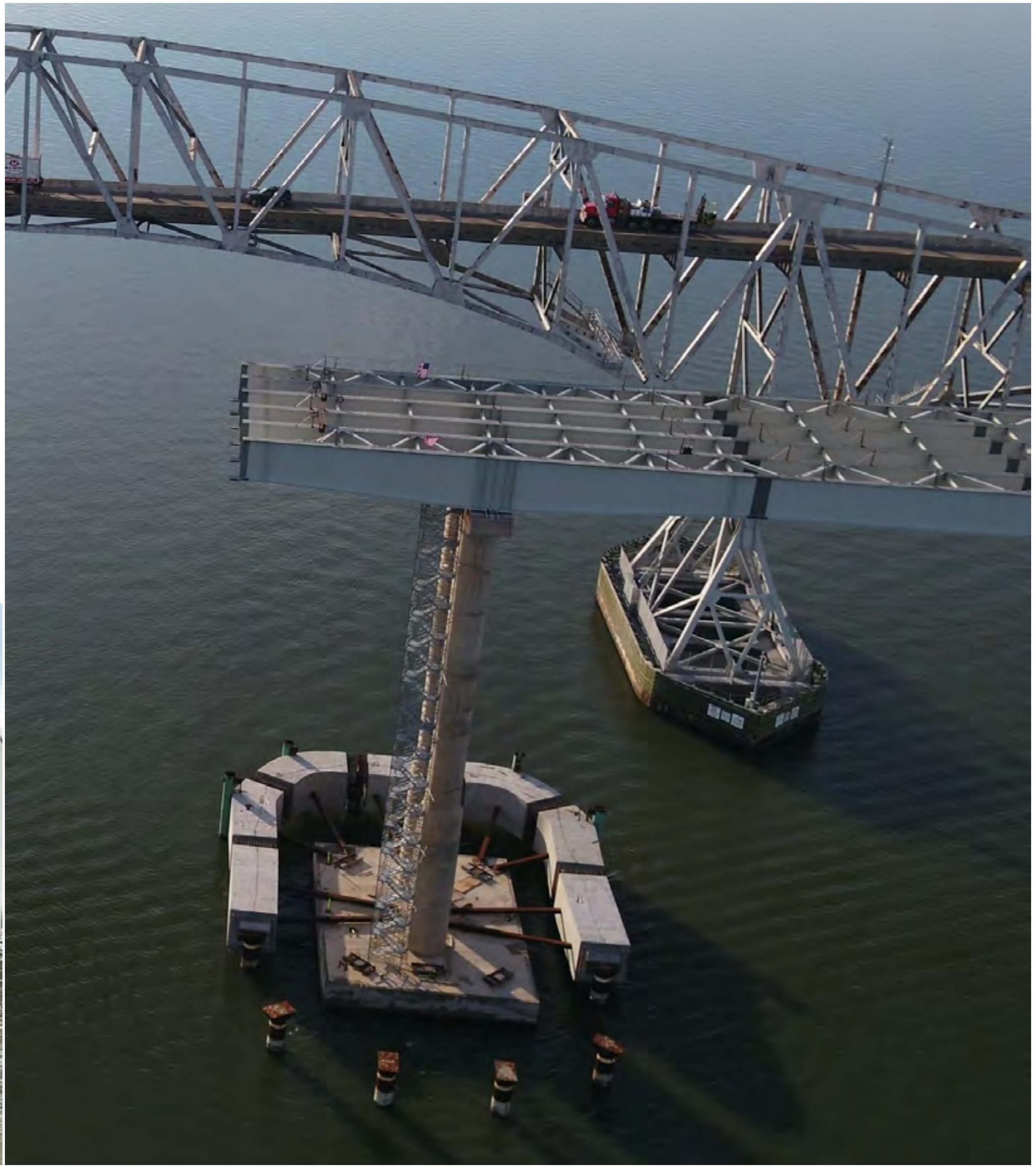

℄ CONSTR. PROPOSED US 301
30'-6"
30'-6"
12'-0"
12'-0"
8'-6" DIA.
125'-0"
1
2 (TYP.)
10'-6" DIA.
40'-0"
9'-0"
MHW EL. 0.79
MLW EL. -0.84

Vessel Pier Protection

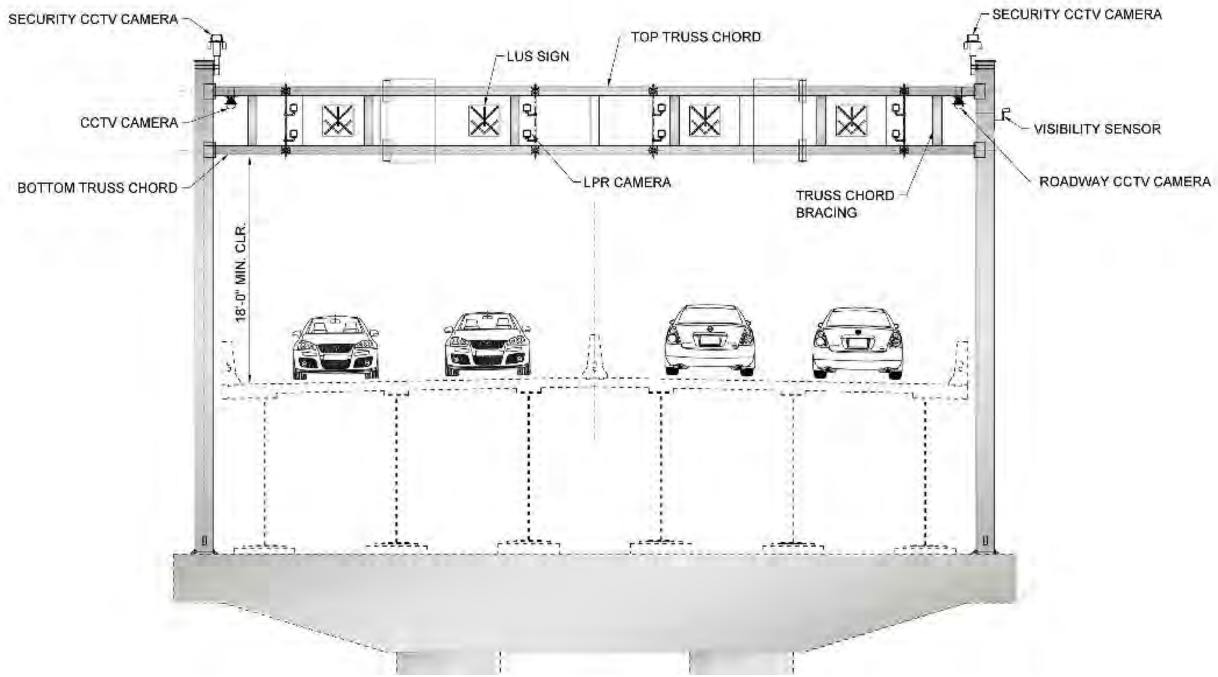
- 48″ diam steel pipe piles
- A572 Grade 50
- 1½″ wall – typical
- 1 $^{7}/_{8}$″ wall in fixity zone
- Shear rings near pile head
- 8′ of embedment into cap
- 22′ filled with 8 ksi concrete
- FRP jacket

Vessel Pier Protection

- 5,000 DTW at 8 knots (42 annual vessels each direction)
- Reinforced concrete ring
  - Precast with CIP closures
  - Voided (foam filled) provided to reduce P-delta effects
  - Designed for large deformations
- Composite lumber
- Must maintain 250′ horizontal channel clearance

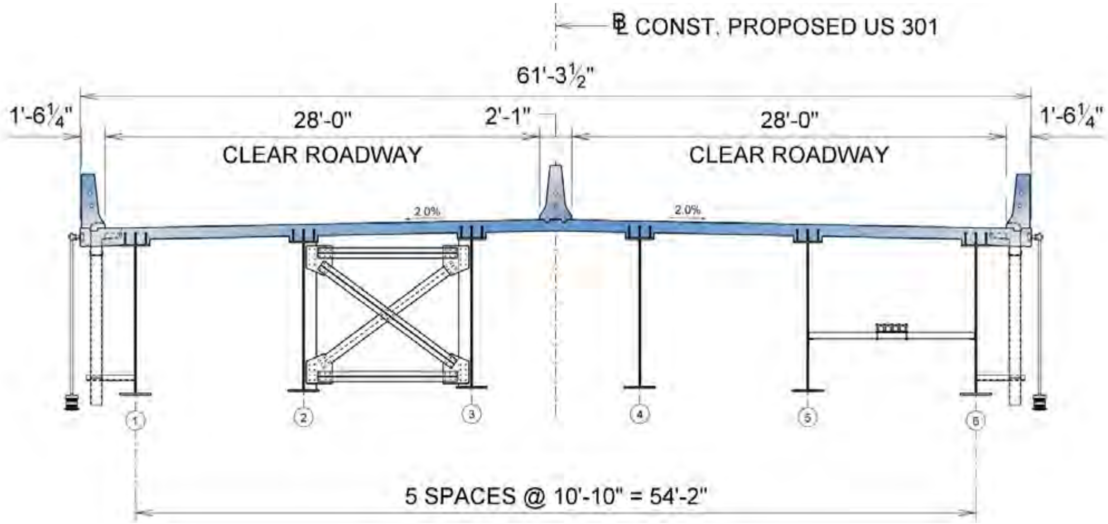


Pier Supported Gantries



- Gantries required for lane use control signals
  - Spaced approximately 1,000-ft
- Electrical platforms at some piers
- Pier caps 69′-6″ long

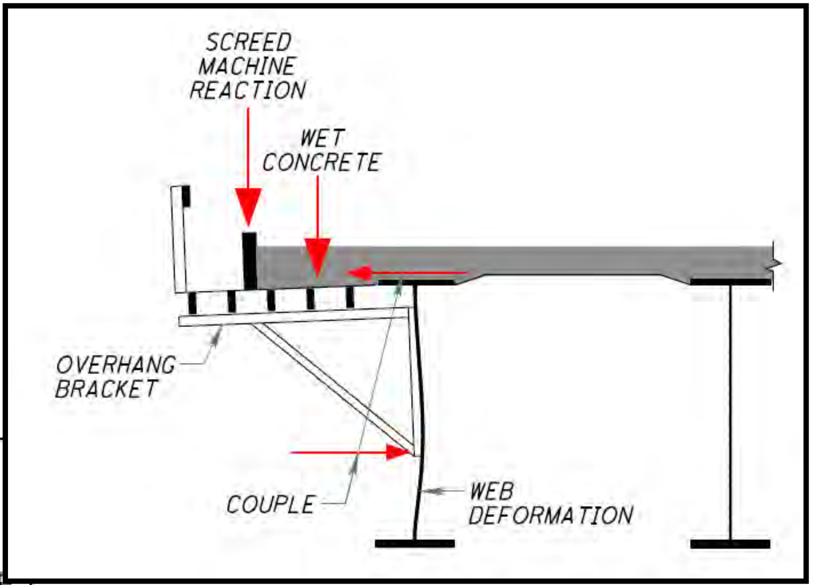
Main Channel Spans Superstructure

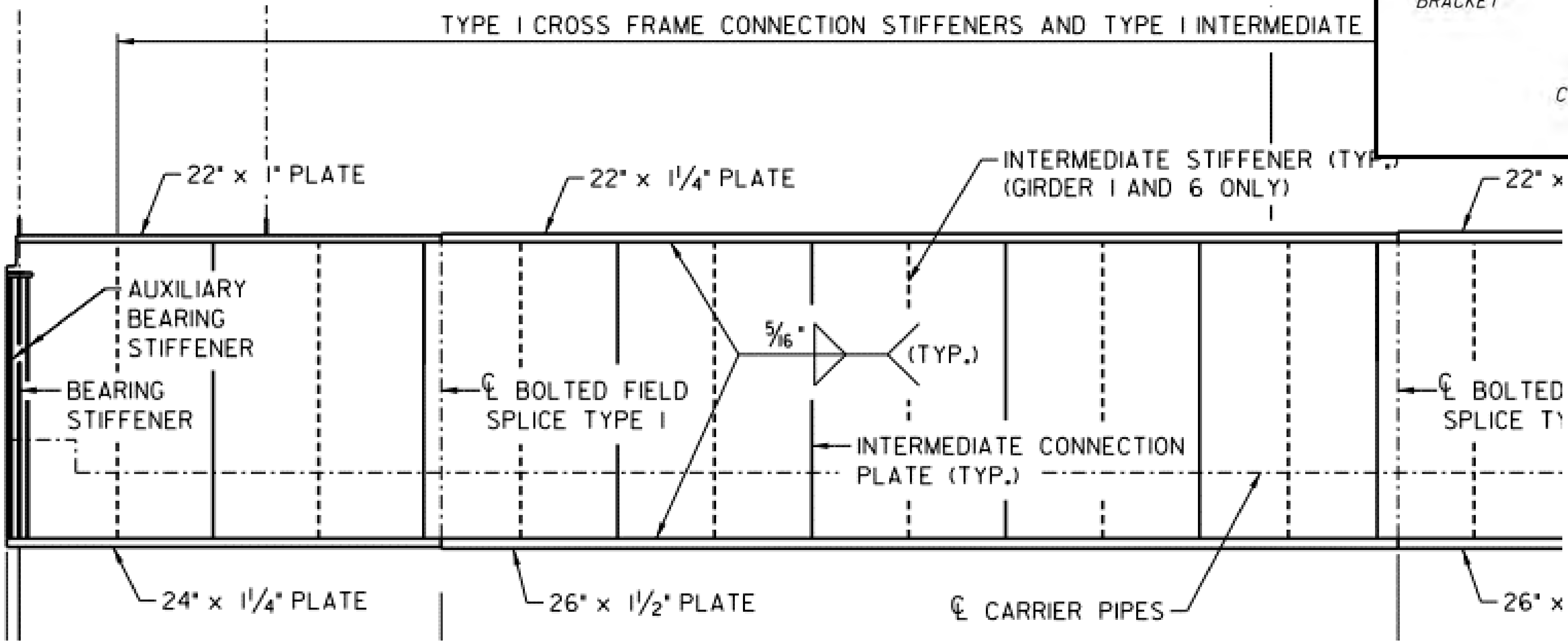


- 285′ – 350′ – 285′
- Variable depth plate girders (114″ to 144″)
  - HPS 70W flanges
  - Grade 50 webs
- 9” deck with low carbon/chromium steel
- 42” F-Shape Parapet
- Lateral bracing in exterior bays
- 1″ diameter A325 bolts

Main Channel Spans Superstructure

- Bridge deck overhang bracket load on web
- Additional transverse stiffeners to support deck overhang brackets.





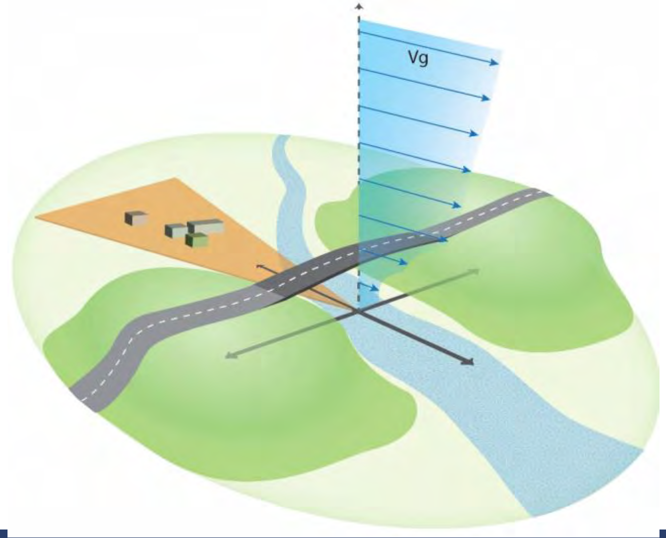
Main Channel Spans Superstructure

- Evaluated against potential wind excitation when L/W>30 or as required by AASHTO. T < 1.0 second
- RWDI performed climatological analysis to establish critical wind conditions
- Provided project required wind speeds for wind loading and aerodynamic stability
- Desktop (computer modeling) assessment of aerodynamic stability
- Determined risk of vortex shedding induced vibrations (VIO) at 30 to 50 mph
- Sectional Model testing performed with various wind faring options
- Buffeting Analysis provided equivalent static wind loads

Table 2-1b: Recommended Wind Speeds at Bridge Site, AASHTO 8th Edition

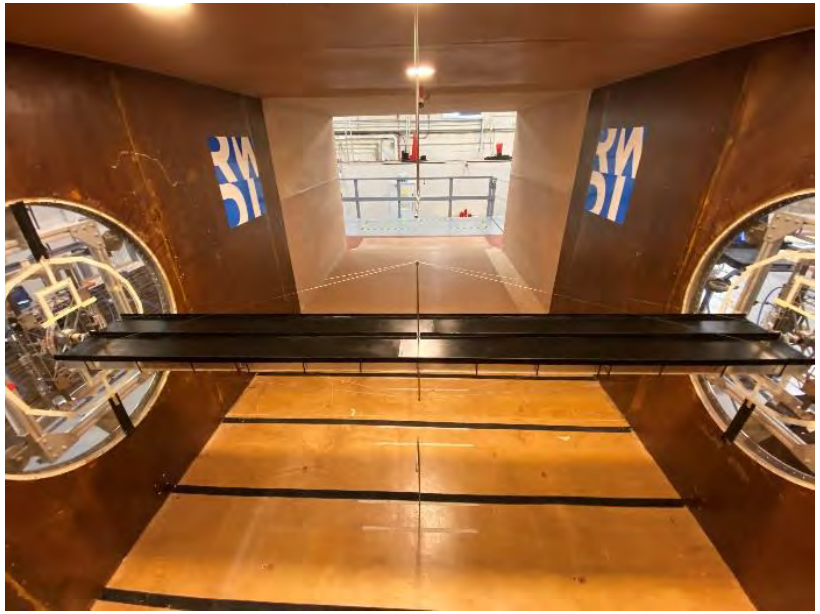
Wind Speed Applicable for	Return Period (years)	Mean Wind Speed (mph) at Deck Level 150 ft and Averaging Time		Corresponding 3-second Gust Speed (mph) atC 33 ft Open Terrain
Design during construction	28	64	1 h	85
Design of completed bridge	1400	85	1 h	112
Stability during construction	1,000	79*	10 min	101*
Stability of completed bridge	10,000	90*	10 min	116*

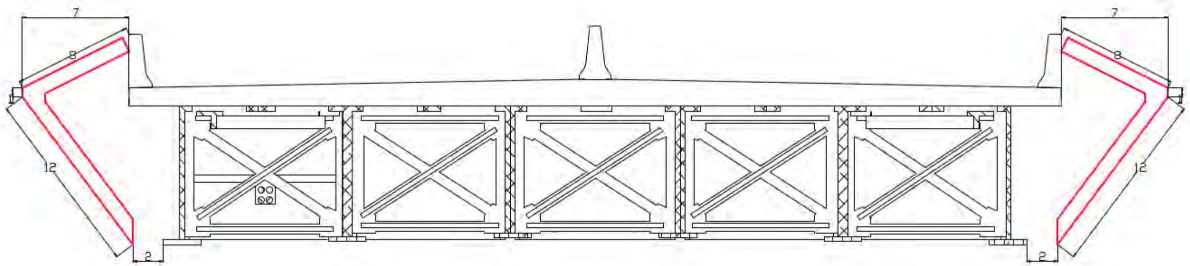
*Includes reduction due to extreme wind climate directionality



Wind Evaluation & Testing

- Site Specific Wind Study
- Section Model Tests
- Vortex-Induced Oscillations
  - Onset Wind Speed < 50 mph
- **Mitigation Strategies**
  - Tuned Mass Dampers (TMD)
  - Wind Fairings
  - ✓ 5% Increase Stiffness/Frequency (6” Increase Web Depth)
- **Design Wind Loads**
  - ✓ RWDI Buffeting Loads
  - ✓ AASHTO Wind Loads





Deck Section w/ Wind Fairings

Main Channel Spans Superstructure

Carboline Coating System

- 33-year service life
- 3 Coat system
  - Primer: Carbozinc 11HS @ 3.0-5.0 mils DFT
  - Stripe Coat: Carbozinc 859 applied at all weld seam, corners, edges.
  - Intermediate Coat: Carboguard 893 @ 5.0-8.0 mils DFT
  - Finish: Carboxane 2000 @ 5.0-7.0 mils DFT

NEW NICE MIDDLETON BRIDGE

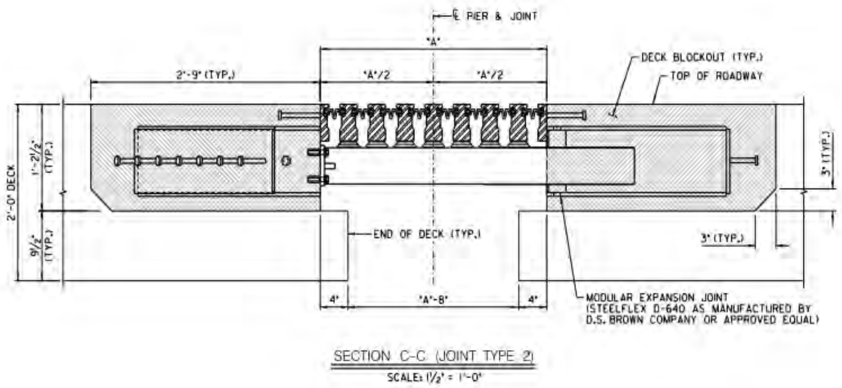
Maryland Transportation Authority

MDTA

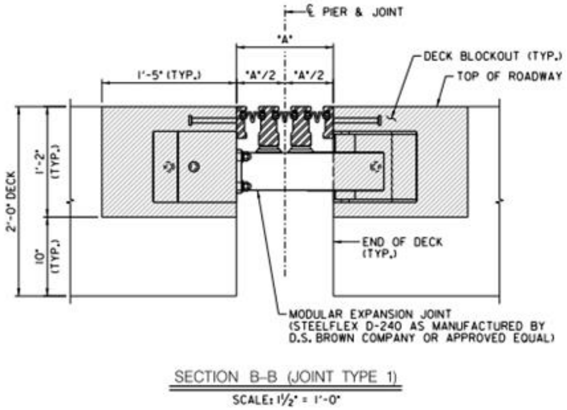
Main Channel Spans Superstructure

1570-Kip Disc Bearings

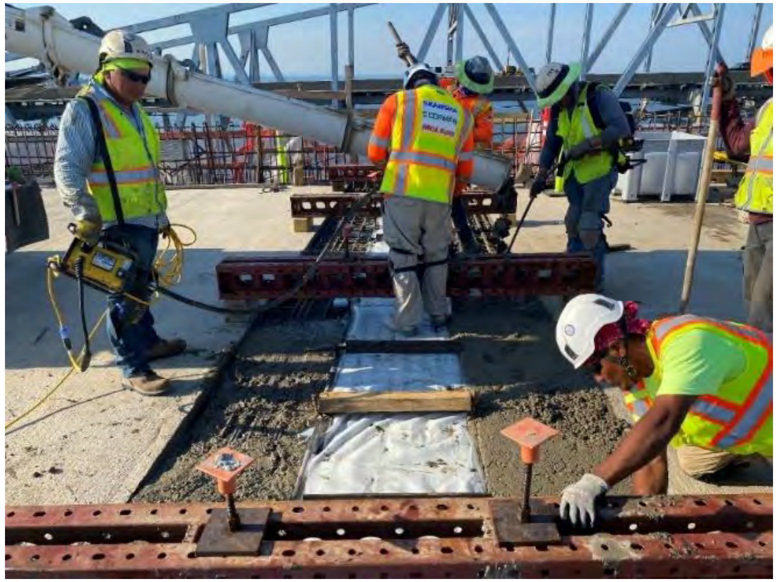
Modular Expansion Joints



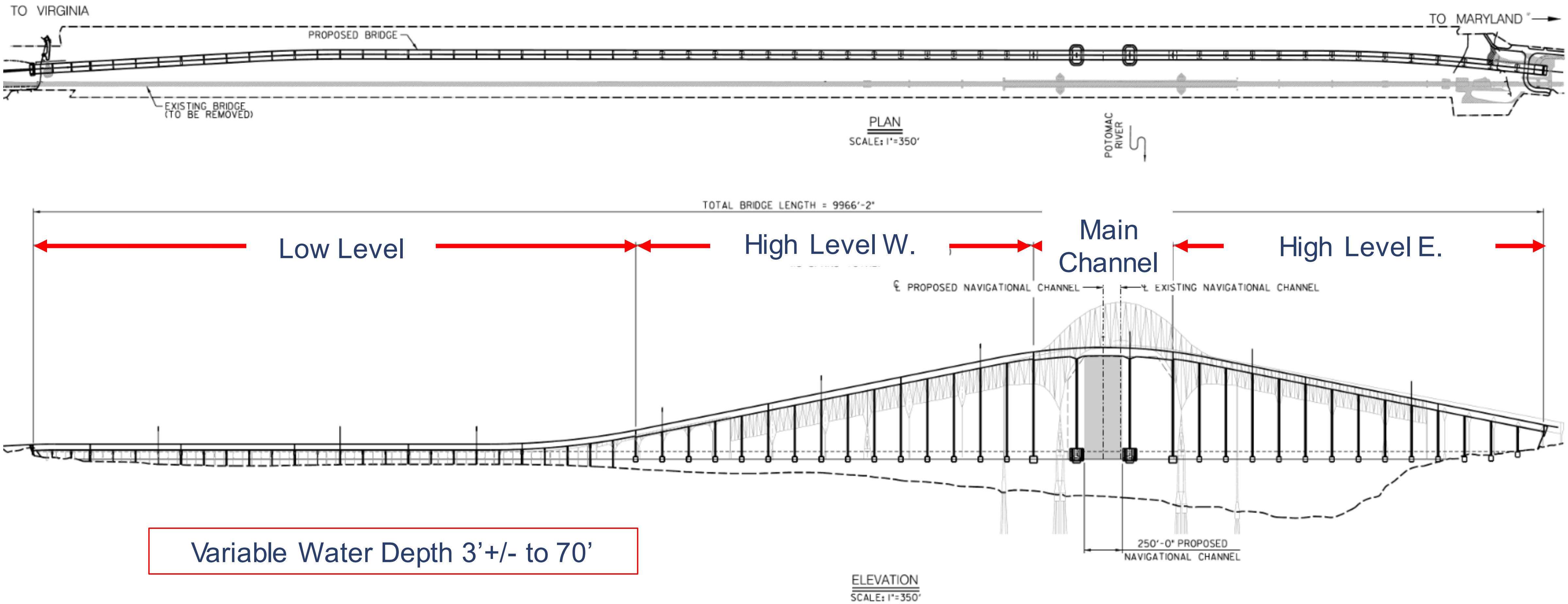
24" movement range



9" movement range



Field Operations


TO VIRGINIA
TO MARYLAND
PROPOSED BRIDGE
EXISTING BRIDGE (TO BE REMOVED)
PLAN
SCALE: 1"=350'
POTOMAC RIVER
TOTAL BRIDGE LENGTH = 9966'-2"
Low Level
High Level W.
Main Channel
High Level E.
℄ PROPOSED NAVIGATIONAL CHANNEL
℄ EXISTING NAVIGATIONAL CHANNEL
Variable Water Depth 3'+/- to 70'
250'-0" PROPOSED NAVIGATIONAL CHANNEL
ELEVATION
SCALE: 1"=350'

Logistics - Maryland

SKANSKA CORMAN KOKOSING McLean

Logistics - Virginia

Heavy Lift and Marine Equipment

(2) 888 Ringers, (1) 4100 Ringer, (2) Whirley Cranes

During peak period the project employed over 20 cranes, over 30 barges, and 5 tug boats

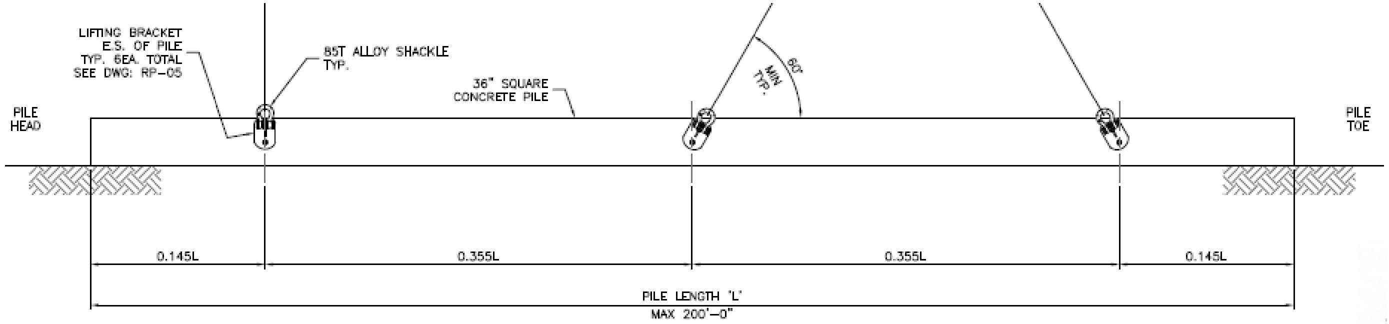
Equipment – Concrete Batch Plant/Barge Loading

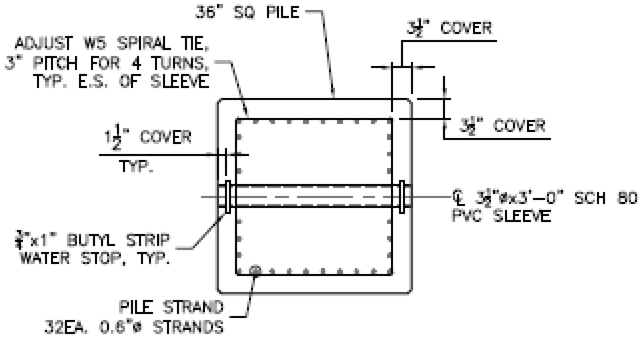
Marine Concrete Delivery

(2) Transport Barges w/ (2) lines of (3) 15CY Agitors
(1) Placing Barge with (2) Remixers, (1) Pump, (1) Placing Tower/Boom

Piling

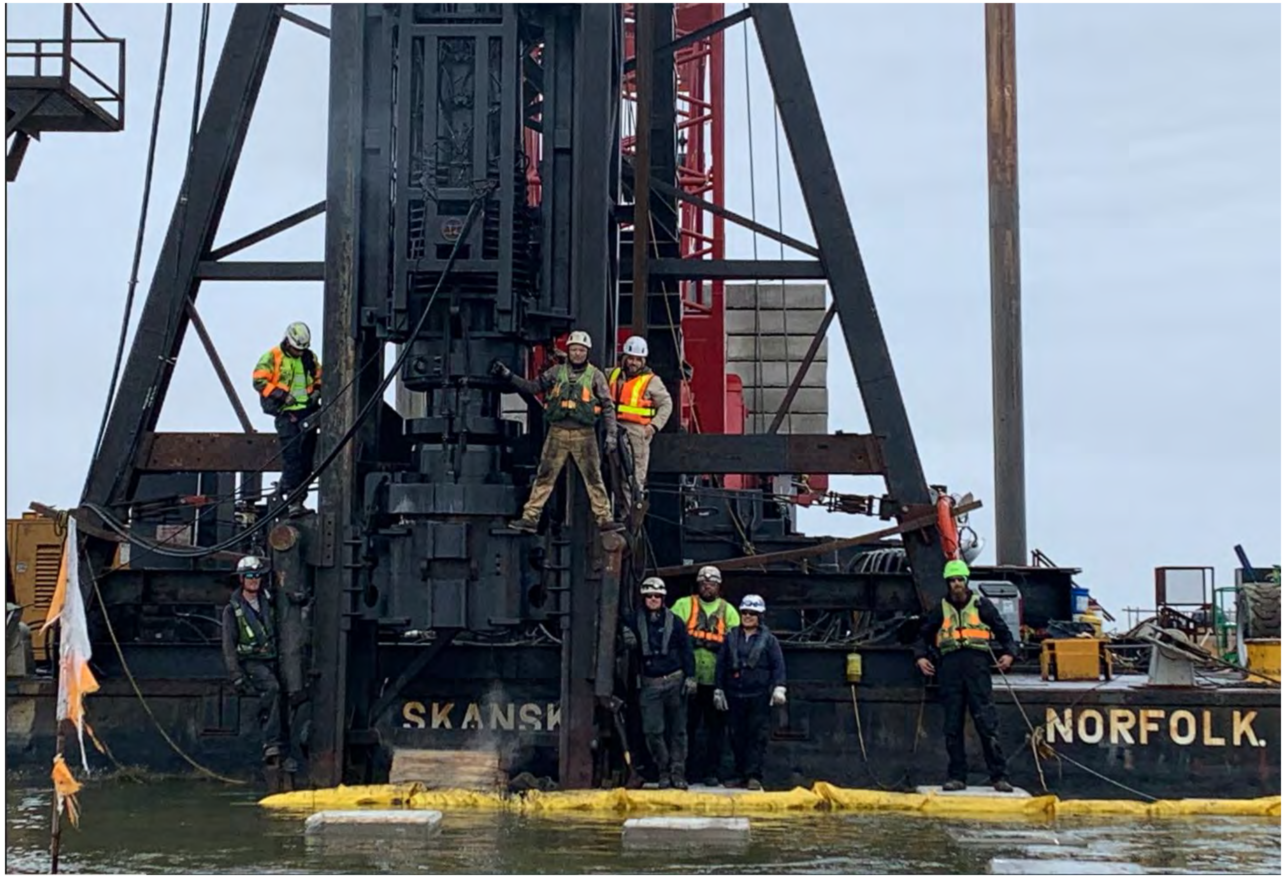
- 36” Square Piles – approx 740 piles – Avg 166’ (112 Ton) – Long 206’ (139 Ton)
- 66” Cylinder Piles – 80 Piles – Avg 187’ (122 Ton) – Long 200’ (131 Ton)
- Test Piles (indicator/load test) used as production piles
- Piles delivered via barge from Cape Charles VA
- Pile hammers included hydraulic, air, and diesel hammers
- Pile rigging employed a through pin lifting assembly in lieu of “choking” with slings



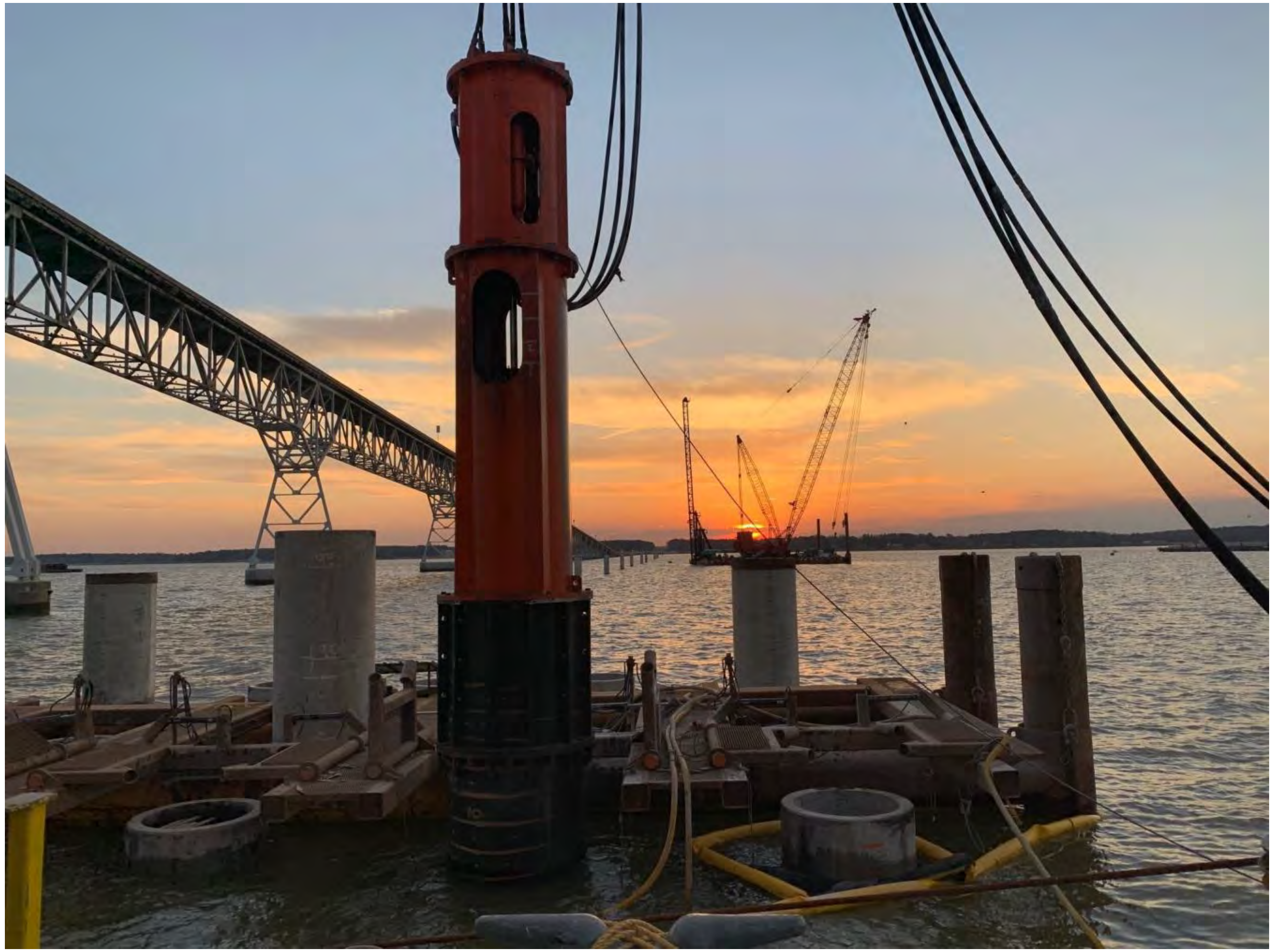


Pile Driving – “A” Frame Leads

Barges with “A” frames positioned using anchor lines and GPS

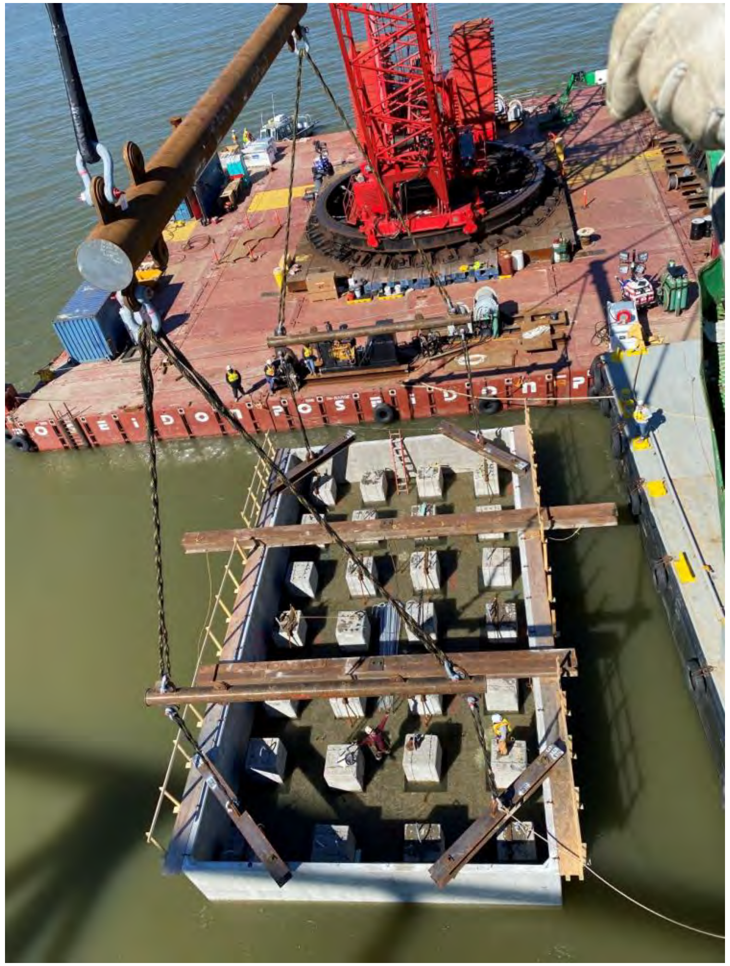


Pile Driving – Template



Pile Driving – Hanging Leads

Waterline Foundation – "Bathtub"



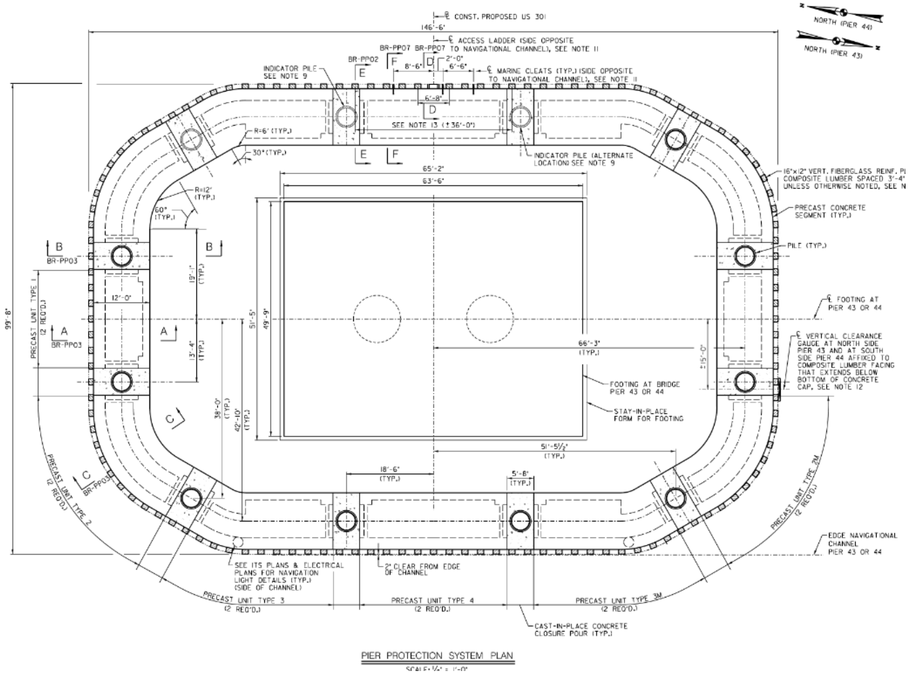
Waterline Foundation – Precast “Bathtubs”

- Piles driven to elevation or cut to elevation using diamond wire saw
- Custom hanging system with embeds cast into bathtub
- Soffit forms, hung from piles prior to placing precast, are drawn up to the bottom of the foundation and grouted.
- Bathtub is pumped out, cleaned, and prepared for concrete fill with installation of pile dowels and reinforcing

Pier Protection System

(24) Precast sections (12 per pier X 2 piers)

Range 185 Tons to 220+ Tons




1/4" SHIMS

Prestressed Girder Erection

Low Level 27 Spans (79” PCEF)
6 Girders per span (qty 162)
3 Spans @ 125’
24 Spans @ 150’

High Level 29 Spans (95” PCEF)
7 Girders per span (qty 203)
All @ 175’

Majority tandem picks
Unit weight range 73T to 112T

Superstructure Team Members

INTERLOCK STEELWORKERS, INC.

HIGH STEEL STRUCTURES

RJ Watson Inc

Cosmec

D.T. Read Steel Co

CMC

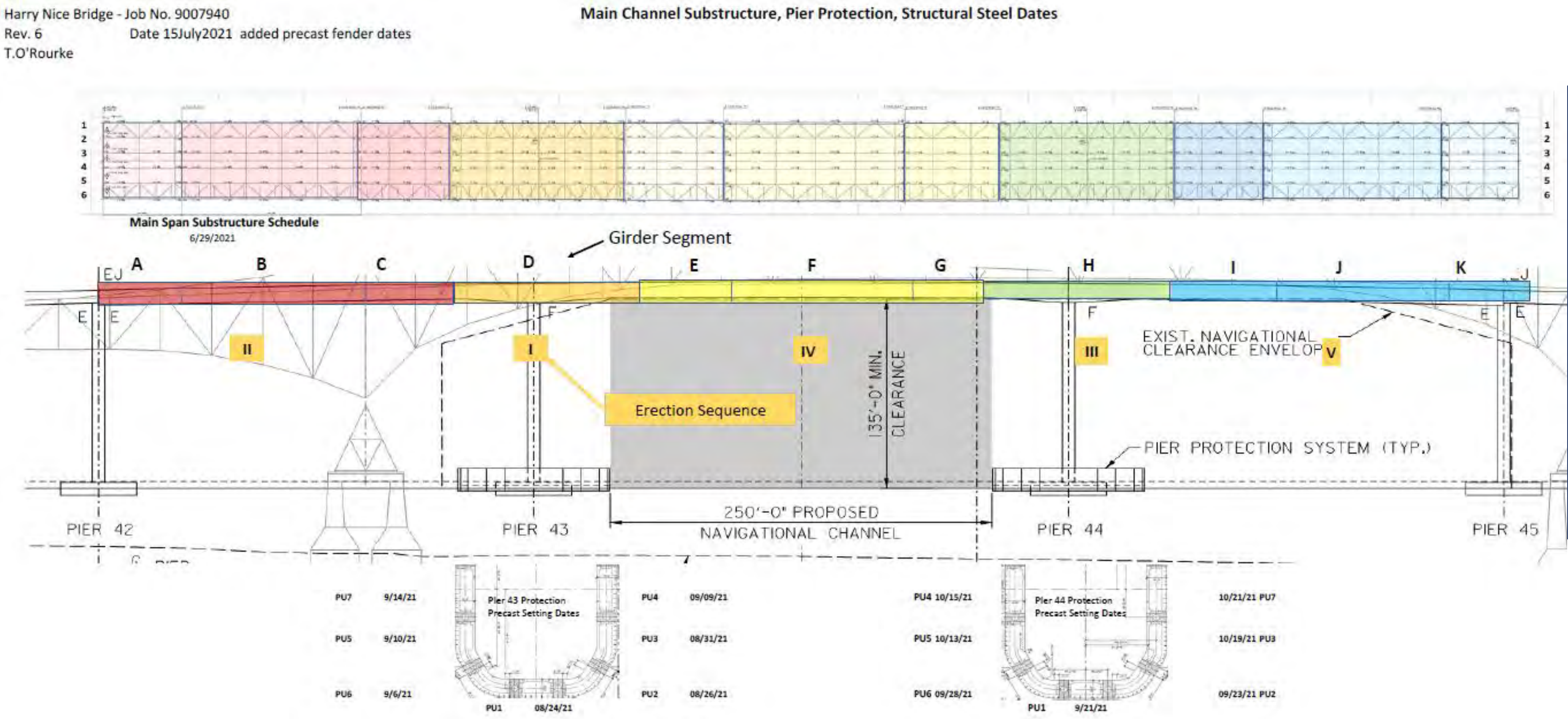
CHANEY ENTERPRISES

Watson Bowman Acme

Paul J. Rach, Inc. CONCRETE CONSTRUCTION

HURTT FABRICATING

Superstructure – Steel



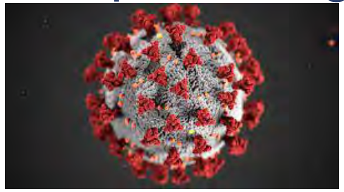
3 Spans – Continuous
920' (285'/350'/285')
6 Girder Lines
11 Segments

Erection
Girder Pairs
3 Pairs X 5 Assemblies

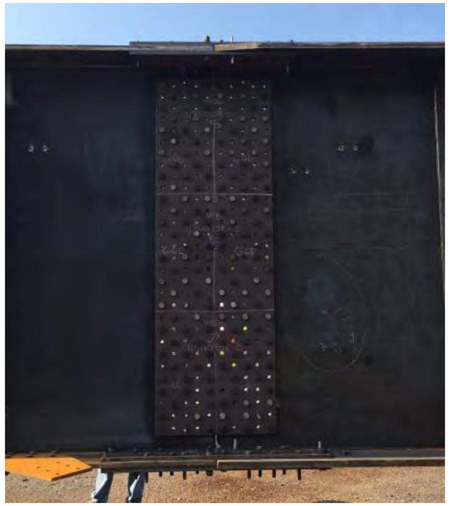
SKANSKA CORMAN McLean

Project Timeline – Steel Spans

JV Agreement formed Winter 2016
MDTA Notice of selection Fall 2019
MDTA Notice to Proceed March 2020
Main Channel Superstructure Released for Construction Dwgs. Nov.2020
Subcontract for Structural Steel December 2020
Shop Drawing Initial Submission February 2021



Initial Shop Visit April 2021
Start of Fabrication June 2021
Complete Fabrication and Coating October 2021
Start field activities October 2021
Complete field activities March 2022

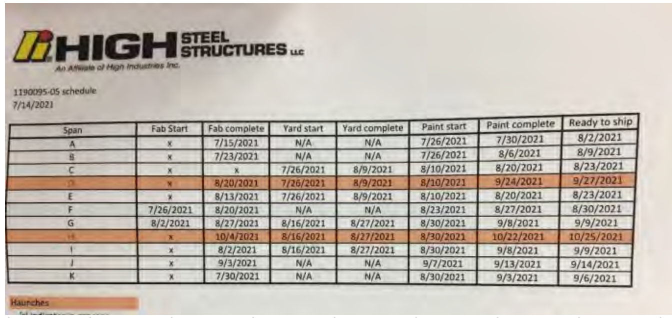


Attacking COVID Together

Mitigating a 3-month gap between original schedule and forecasted completion

Changes to field activities – move erection start from Sept to Oct.

Reduce trial assemblies – cut 45 days from final ship date



HIGH STEEL STRUCTURES LLC
An Affiliate of High Industries Inc.

1190095-05 schedule
7/14/2021

Span	Fab Start	Fab complete	Yard start	Yard complete	Paint start	Paint complete	Ready to ship
A	x	7/15/2021	N/A	N/A	7/26/2021	7/30/2021	8/2/2021
B	x	7/23/2021	N/A	N/A	7/26/2021	8/6/2021	8/9/2021
C	x	x	7/26/2021	8/9/2021	8/10/2021	8/20/2021	8/23/2021
D	x	8/20/2021	7/26/2021	8/9/2021	8/10/2021	9/24/2021	9/27/2021
E	x	8/13/2021	7/26/2021	8/9/2021	8/10/2021	8/20/2021	8/23/2021
F	7/26/2021	8/20/2021	N/A	N/A	8/23/2021	8/27/2021	8/30/2021
G	8/2/2021	8/27/2021	8/16/2021	8/27/2021	8/30/2021	9/8/2021	9/9/2021
H	x	10/4/2021	8/16/2021	8/27/2021	8/30/2021	10/22/2021	10/25/2021
I	x	8/2/2021	8/16/2021	8/27/2021	8/30/2021	9/8/2021	9/9/2021
J	x	9/3/2021	N/A	N/A	9/7/2021	9/13/2021	9/14/2021
K	x	7/30/2021	N/A	N/A	8/30/2021	9/3/2021	9/6/2021

Haunches

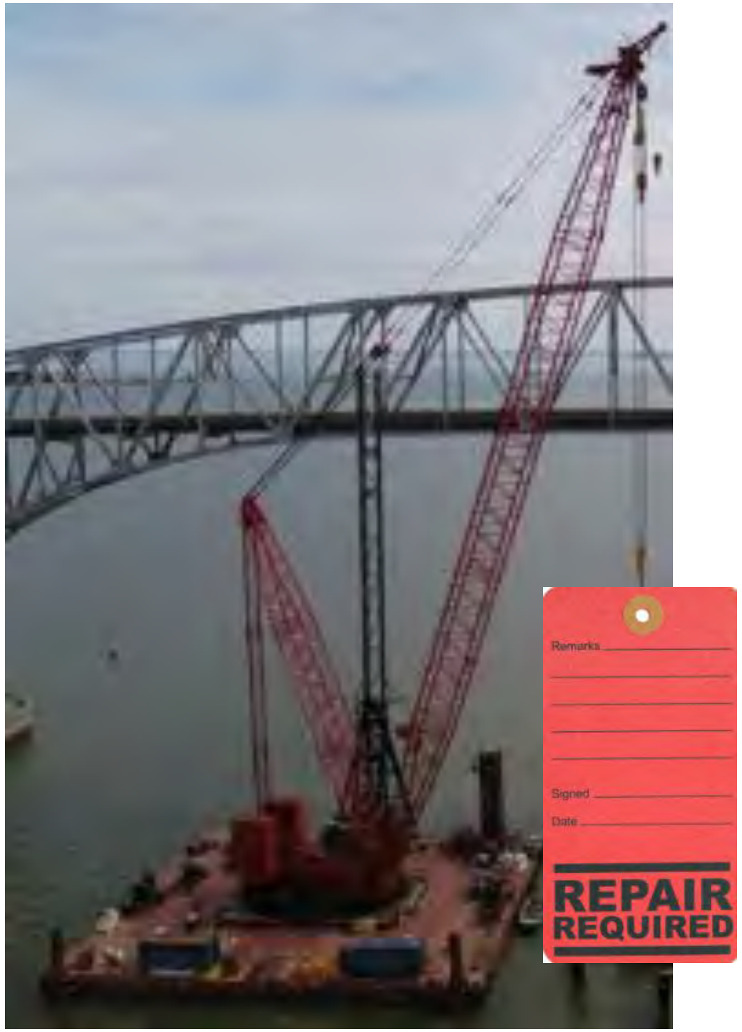
Harry Nice Bridge - Main Channel Steel Fabrication vs Required on Site Dates
14-Jul-21
T.O'Rourke

Girders Series	Girders Lines	Receive on Site Start	Receive on Site Finish	High Stl Date Start	High Stl Date Finish	Variance Start	Variance Finish
D	1 to 6	20-Sep	23-Sep	23-Aug	27-Sep	28	-4
A to C	3 to 6	30-Sep	7-Oct	9-Aug	23-Aug	52	45
A to C	1 & 2	14-Oct	18-Oct	2-Aug	9-Aug	73	70
H	1 to 6	25-Oct	27-Oct	9-Sep	25-Oct	46	2
E to G	3 to 6	4-Nov	11-Nov	16-Aug	9-Sep	80	63
E to G	1 & 2	18-Nov	22-Nov	16-Aug	23-Aug	94	91
I to K	3 to 6	26-Nov	3-Dec	30-Aug	9-Sep	88	85
I to K	1 & 2	10-Dec	14-Dec	23-Aug	6-Sep	109	99

HNB - Shop Fabrication of Steel Girder Spans
27-Jul-21
*excl. Line Assembly/Painting/Shipping

Girder Series	Series Fab % Complete	Job Fab % Complete
A	98%	5%
B	100%	11%
C	100%	6%
D	44%	7%
E	90%	6%
F	43%	4%
G	6%	0%
H	17%	3%
I	75%	5%
J	0%	0%
K	77%	4%
		51%

	Line %	Job%
Parallel Girder Complete	61%	41%
Haunched Girder Complete	31%	10%



Follow on Challenges

- Equipment parts availability
- Winter weather
- High winds
- Rough water

Girder Logistics

- Haunched girders shipped horizontally and up-righted at the jobsite using a custom fabricated hitch
- Constant depth girders shipped vertically
- Majority of girders staged at the jobsite along the site access road
- Girder pairs assembled on transport barge
- Each barge load had an engineered loading and unloading plan

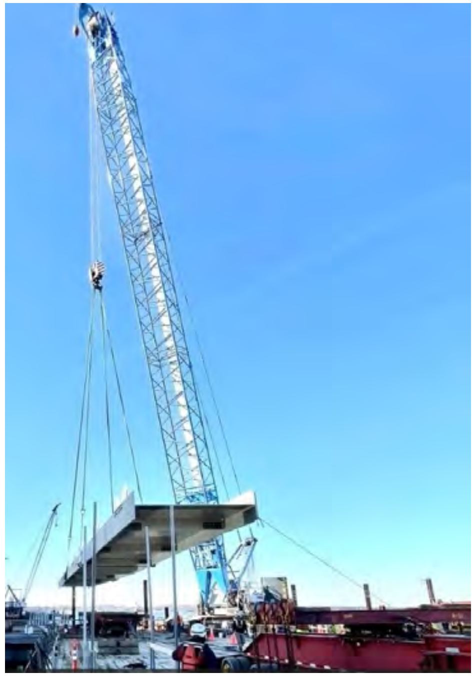
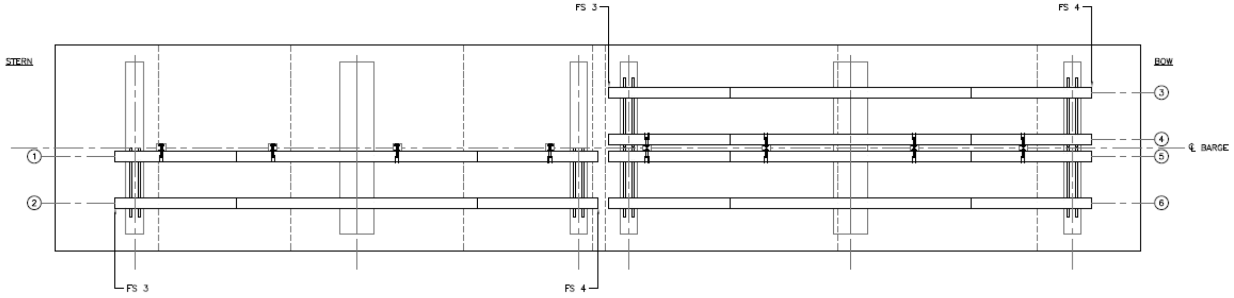


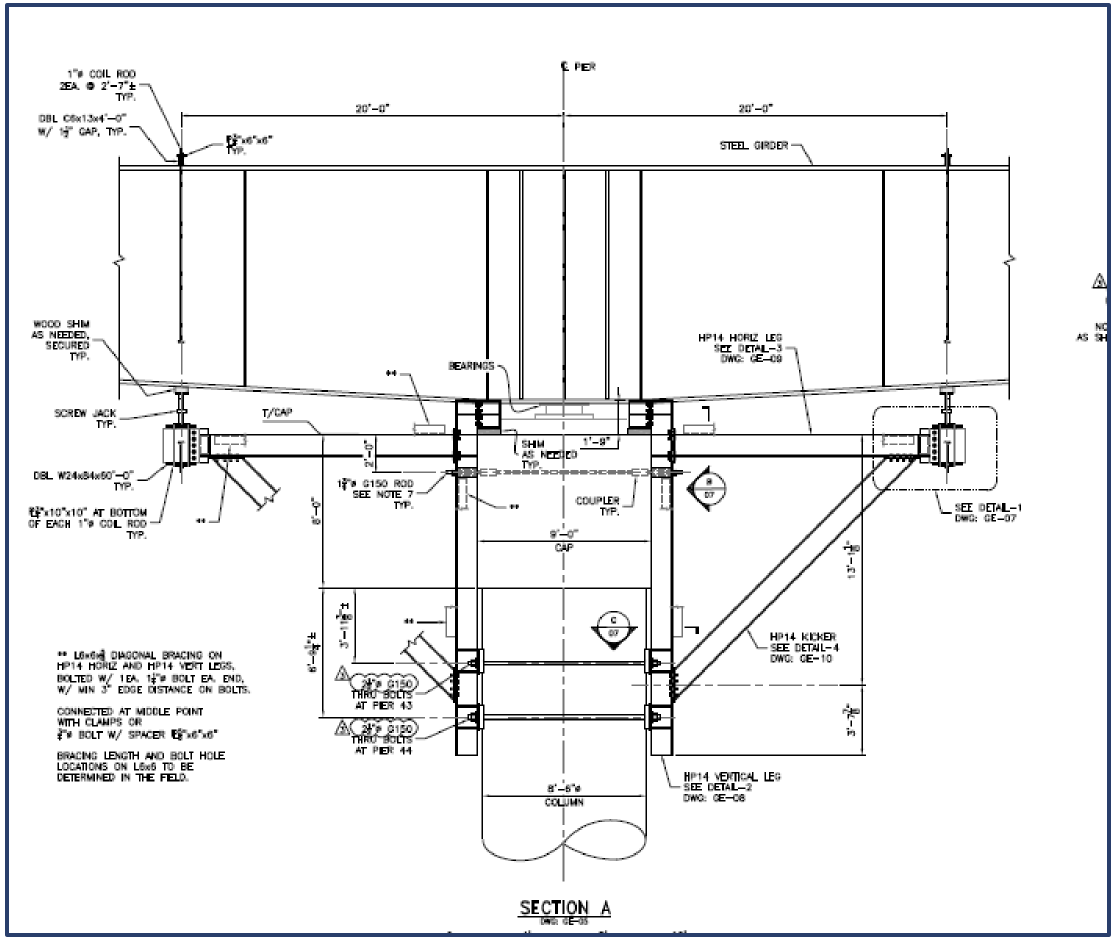
Photo credit High Steel

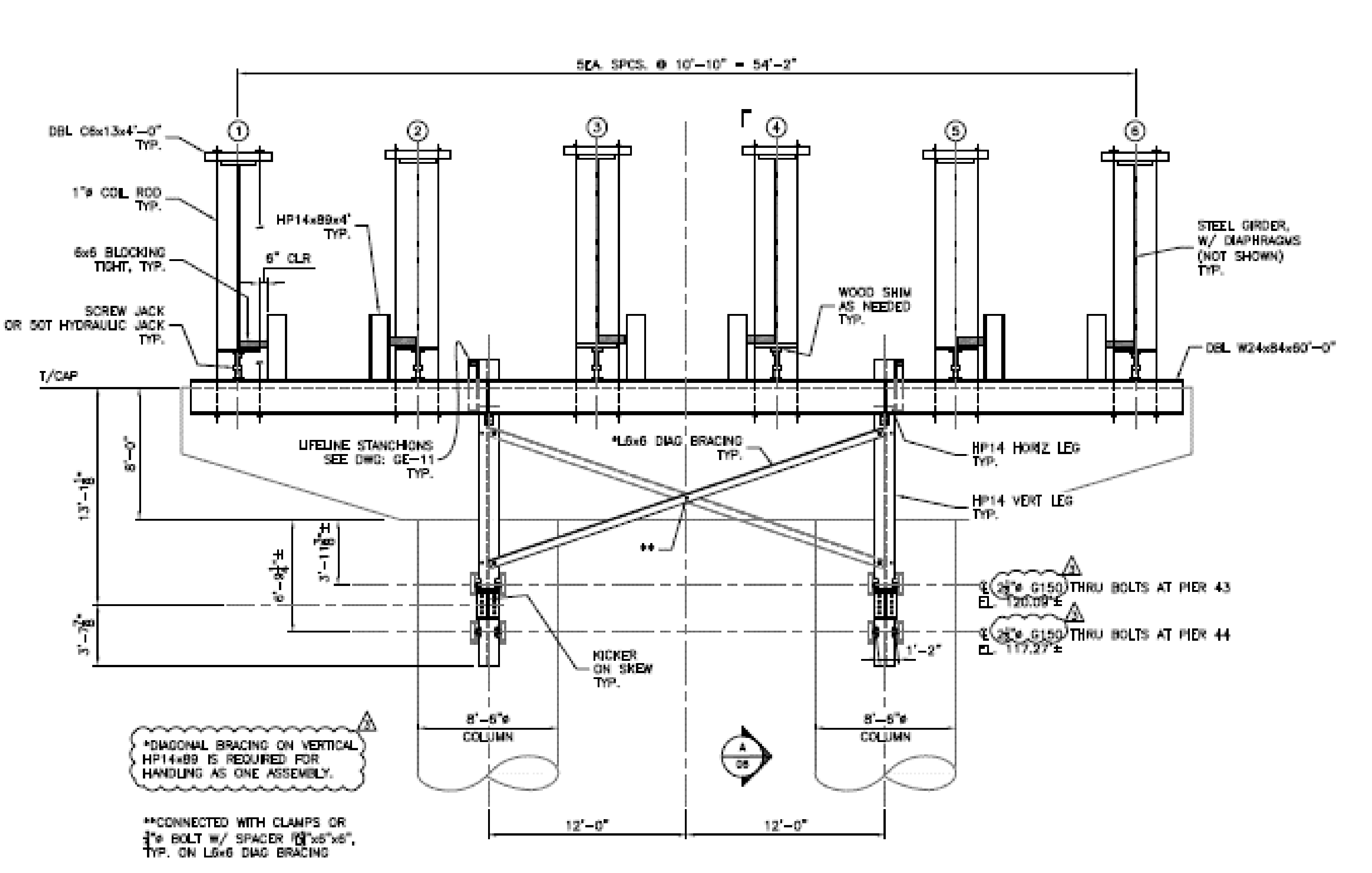
Photo credit High Steel



VA HAUNCH GIRDER SEGMENTS – BEAMS 1 THRU 6
PLAN – ASBUILT

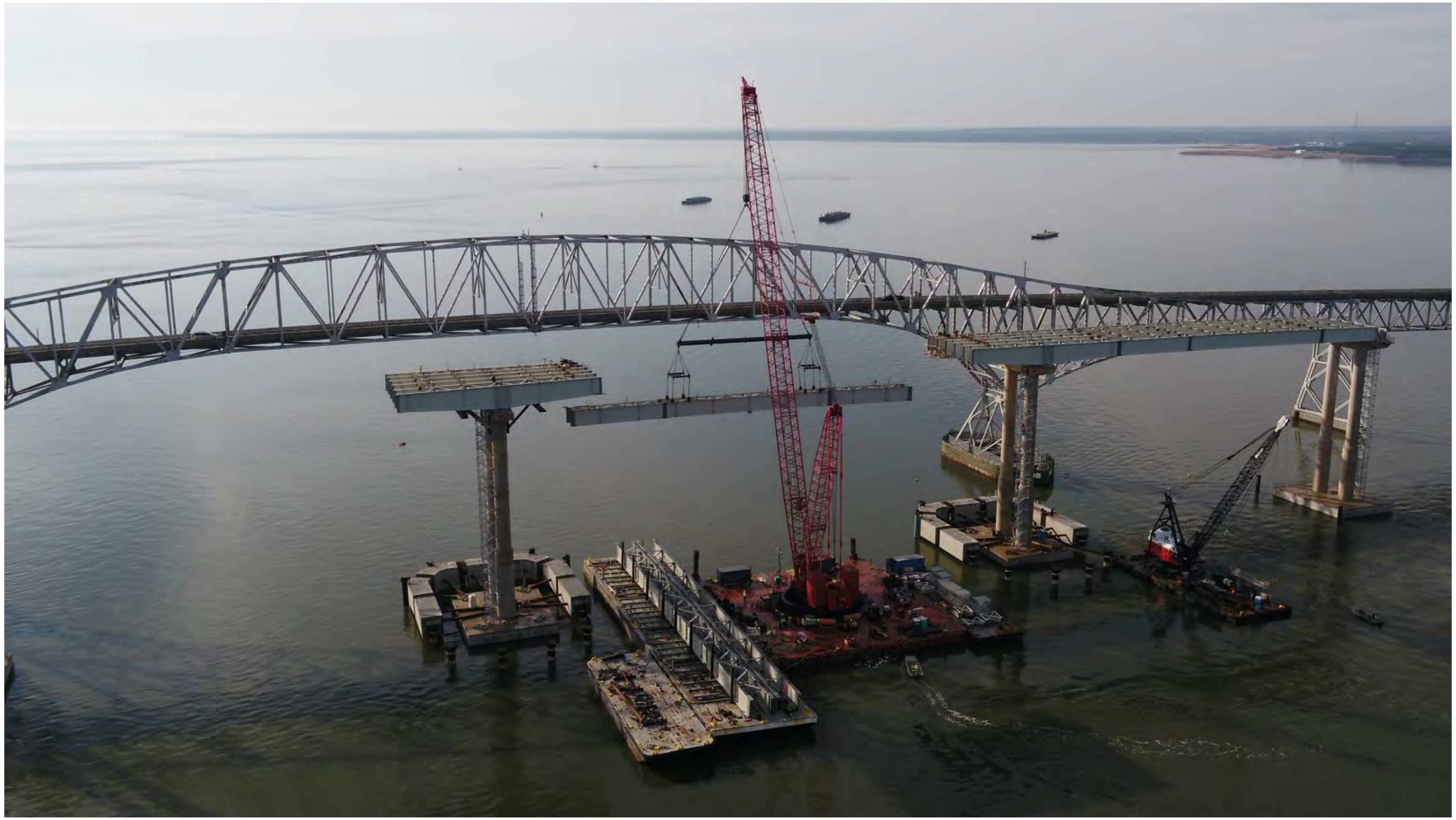
Haunched Girder Erection





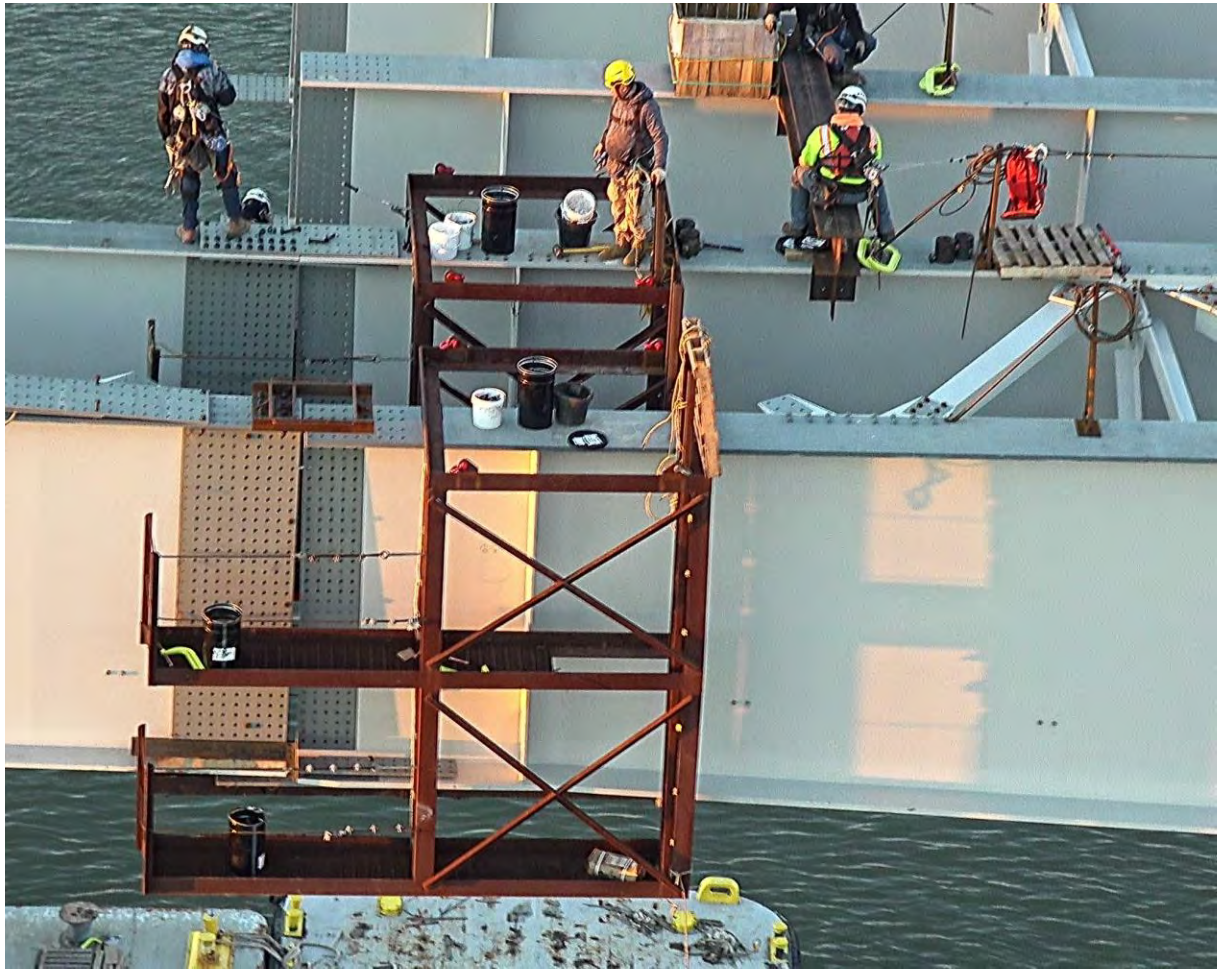
5EA. SPCS. @ 10'–10" = 54'–2"
DBL C6x13x4'–0" TYP.
1"ø COIL ROD TYP.
HP14x89x4' TYP.
6x6 BLOCKING TIGHT, TYP.
6" CLR
SCREW JACK OR 50T HYDRAULIC JACK TYP.
T/CAP
WOOD SHIM AS NEEDED TYP.
STEEL GIRDER, W/ DIAPHRAGMS (NOT SHOWN) TYP.
DBL W24x84x60'–0"
LIFELINE STANCHIONS SEE DWG: GE–11 TYP.
*L6x6 DIAG BRACING TYP.
HP14 HORIZ LEG TYP.
HP14 VERT LEG TYP.
THRU BOLTS AT PIER 43
THRU BOLTS AT PIER 44
KICKER ON SKEW TYP.
1'–2"
8'–6"ø COLUMN
8'–6"ø COLUMN
12'–0"
12'–0"
*DIAGONAL BRACING ON VERTICAL HP14x89 IS REQUIRED FOR HANDLING AS ONE ASSEMBLY.
**CONNECTED WITH CLAMPS OR
TYP. ON L6x6 DIAG BRACING

888 Ringer Used to Erect Steel Girders



Custom Fabricated Spreader Beams/Frames

Rigging consisted of standard slings/shackles/girder clamps



Access

- Crew boats transported craft to barges/piers
- Stair tower installed at channel piers
- Fall protection installed on each girder during pre-assembly on barges
- Job specific bolt up frames fabricated
- Crane mats placed on girders to stage equipment and materials

SKANSKA CORMAN KOKOSING McLean

- Erection sequence required postponing erection of flanking precast girder spans and drainage roughs
- Drop in span required jacking haunched girders to close a gap allowed for girder entry
- Bolt tensioning employed “turn of the nut”
- Stay in place decking used – installation performed after field survey and camber checks
- Studs field installed
- Touch up painting performed in two stages – areas concealed or having restricted access and upper regions of girders performed prior to decking – balance of touch up performed using underbridge access equipment after the deck and barrier were placed

Nice Middleton Bridge Open 10/12/22

For more information, please visit us at:
https://mdta.Maryland.gov/NiceMiddletonBridge/Home

NEW NICE MIDDLETON BRIDGE

We finished ahead of schedule and had a blast!

Thank You