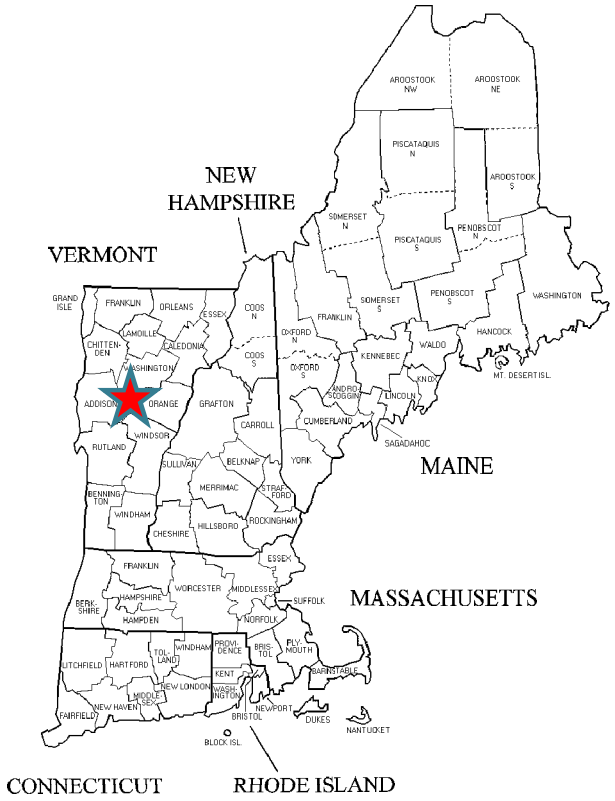
Fully Integral 2 Span Curved Girder Bridge Replacement in 72 days

River Road over New Haven River– New Haven, VT

Adam Stockin, PE

June 25, 2021

Project Site



- Town of New Haven, VT
- Population: 1,700
- 1,600 ADT

Project Location

Existing Conditions

- Built in 1935
- 3 span - 176’ (54’-74’-48’) long steel girder bridge
- 20’ curb to curb
- Ancillary Snowmobile Bridge
- Fair/Poor Condition

Alignment

- Increase Site Distance
  - Alignment shift
  - Widening roadway opening
- Minor Re-location of Halpin Rd.
- Widened Shoulder for Snowmobile Access

Hydraulics

- Bridge overtopped below Q100
- Discharge over road at Q100:
- Significant chase to vertical profile
  - East approach slopes <1%
- Need to eliminate 2 existing wall piers
- Maximize hydraulic opening

Geotechnical Conditions

- Very Poor Soils
  - 40’-75’ depth of Very Soft Clay (WR)
- No Bedrock encountered in 120’
- Scour potential of 15’ at the Pier for Q100

Depth (ft)	Strata	CLASSIFICATION OF MATERIALS (Description)	Blows/ft (N Value	Moisture Content	Gravel %	Sand %	Fines %	LL %	PI %
		A-2-4, SiSa, brn, Moist, Rec. = 0.4 ft	WH-WH-WH-1	24.6	0.8	64.3	34.9		
		A-4, SiSa, brn, Moist, Rec. = 1.3 ft	(WH)	17.9	4.8	57.4	37.8		
		A-4, SiSa, brn, Moist, Rec. = 2.0 ft	WH-1-1-2 (2)	27.6		53.4	46.6		
		A-4, SaSi with small pieces of Wood, brn-gry, Moist, Rec. = 1.8 ft	2-2-2-3 (4)	40.4		38.9	61.1		
		A-2-4, SiSa with lots of small pieces of Wood, brn-gry, Moist, Rec. = 0.9 ft	1-1-2-1 (3)	45.9	0.8	77.6	21.6		
10		Visual Description:, Wood, Rec. = 1.1 ft	1-5-6-7 (11)						
		A-1-b, GrSa with chunks of Wood, gry, Moist, Rec. = 0.7 ft	1-1-1-3 (2)	43.3	29.9	58.0	12.1		
		A-1-b, GrSa, brn, Moist, Rec. = 0.6 ft	1-1-1-1 (2)	18.5	39.6	53.2	7.2		
		A-7-6, Cl, gry, Moist		58.7	0.1	1.3	98.6	63	38
20		Visual Description:, Cl, gry, Moist, Rec. = 2.0 ft, Material similar as 27'-29'.	WH-WH-WH-WH	70.2					
30		A-7-6, Cl, gry, Wet, Rec. = 2.0 ft, Very wet & sloppy sample.	WR-WR-WR-WR	79.6		0.5	99.5	69	42
40		Visual Description:, Cl, gry, Moist, Rec. = 1.5 ft, Material similar as 47'-49'.	WR-WR-WR-WR	74.0					
50		A-7-6, Cl, gry, Moist, Rec. = 2.0 ft	WR-WR-WR-WR	69.4		0.3	99.7	67	41
		Visual Description:, Cl, gry, Moist, Rec. = 2.0 ft, Material similar as 47'-49'.	WR-WR-WR-WR	50.9					

Public Input

- Presented Matrix of Choices, including $$
- 2.5 Month Closure
- Town Chose to Close the Bridge
- Met with Abutters







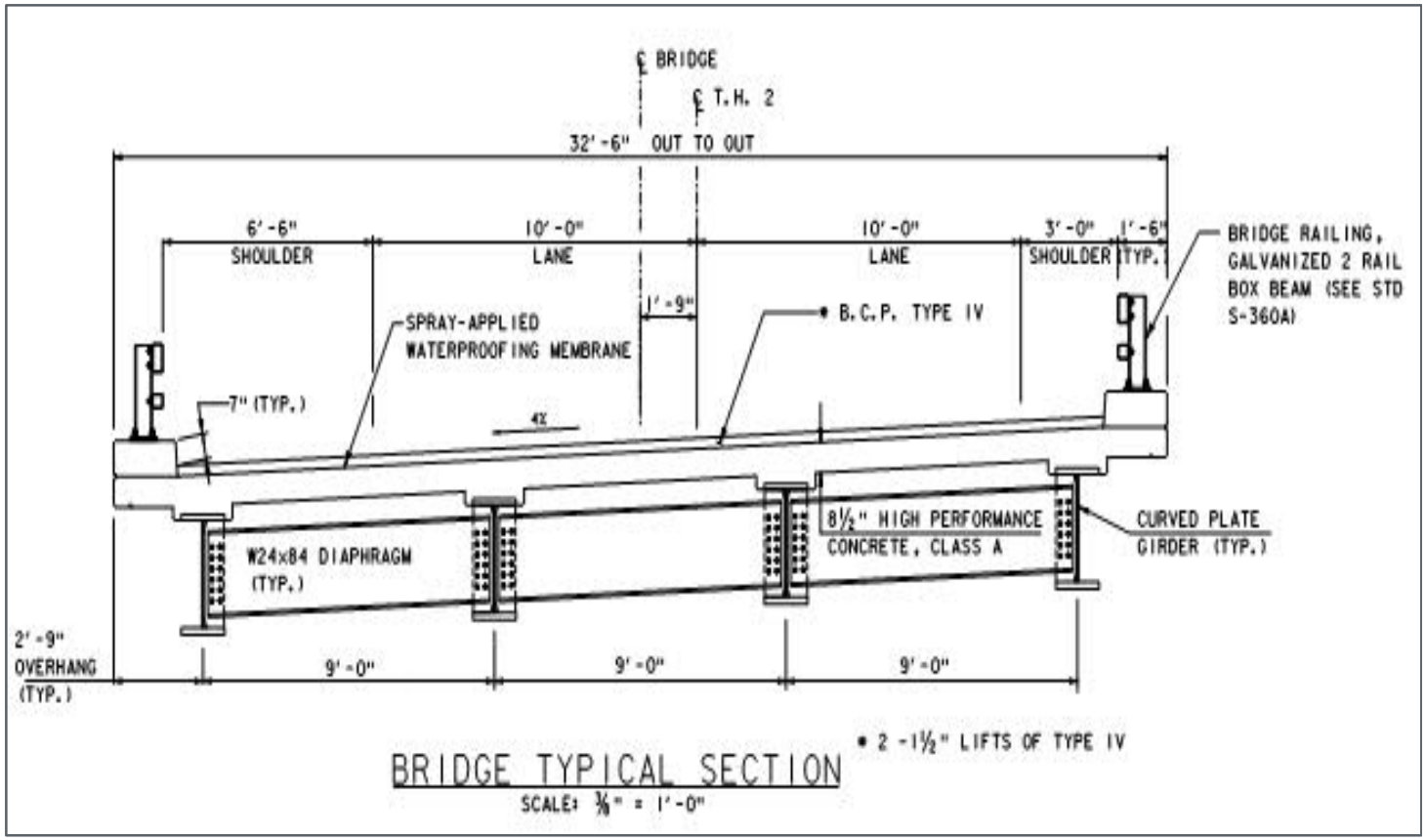
Design

Superstructure Solution

- Span Length = 164.35’ (2 - 82.2’ spans)
- 730’ Radius Horizontal Curve at Baseline
- 4% Superelevation
- Existing 50 degree skew eliminated

Superstructure

- 32’-6” Out to Out
- 29’-6” Curb-Curb
- 9’ Girder Spacing
- 33 ¾” Curved Steel Plate Girders
  - Metallized
- 8 ½” CIP Deck
- 3” Wearing Course

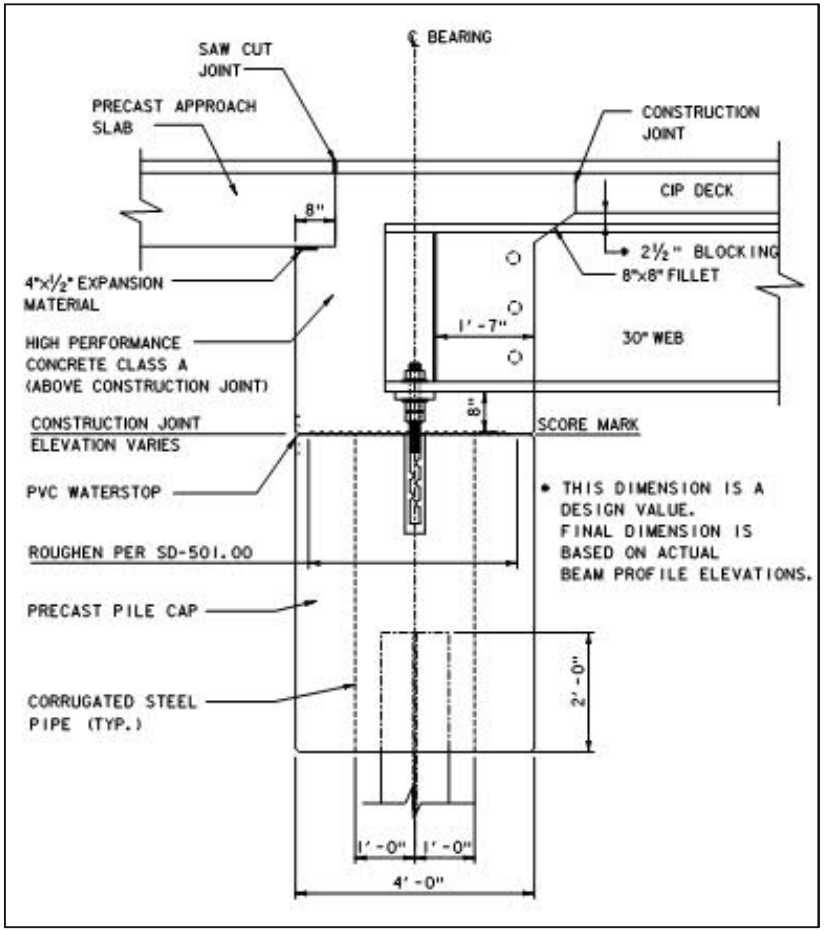


Substructure Solution

- Deep foundations required
- Precast Integral abutments on 75’ H piles
- 8’ Diameter Monoshaft
  - 120’ Deep
  - Supports 6’ CIP column and Precast Cap
  - Minimizes river obstructions

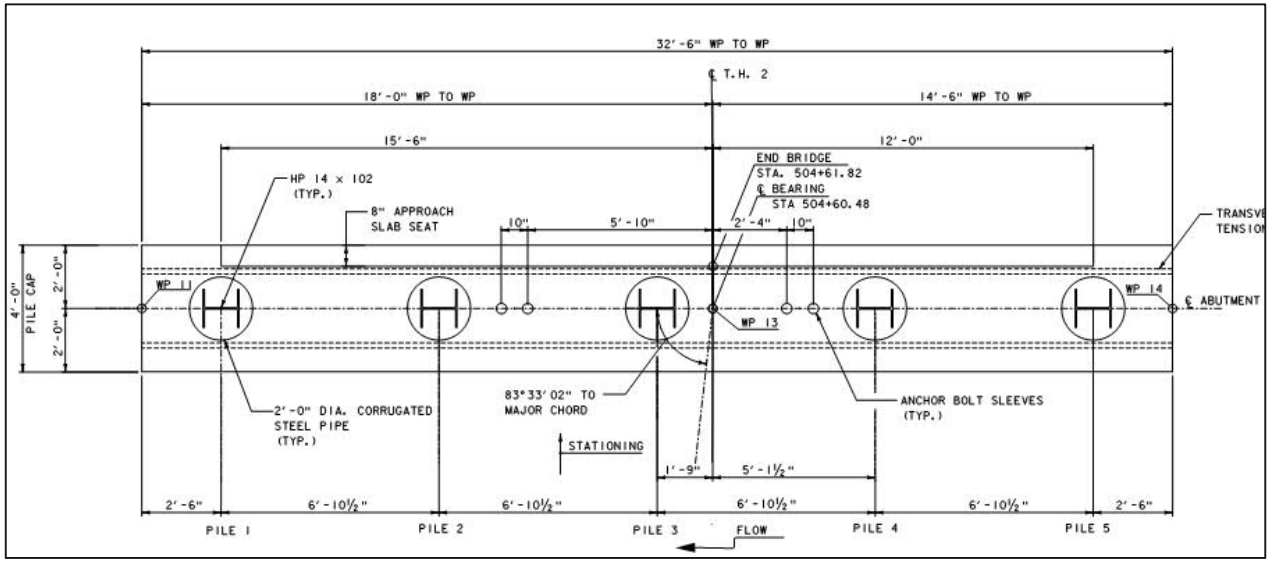
Substructure

- VTrans Prefers Jointless Bridges
- Integral Abutments w/Steel H-Piles



Pre-Cast Abutment and Wings

- Cavities in Precast to receive H-piles



Pre-cast Pier Cap

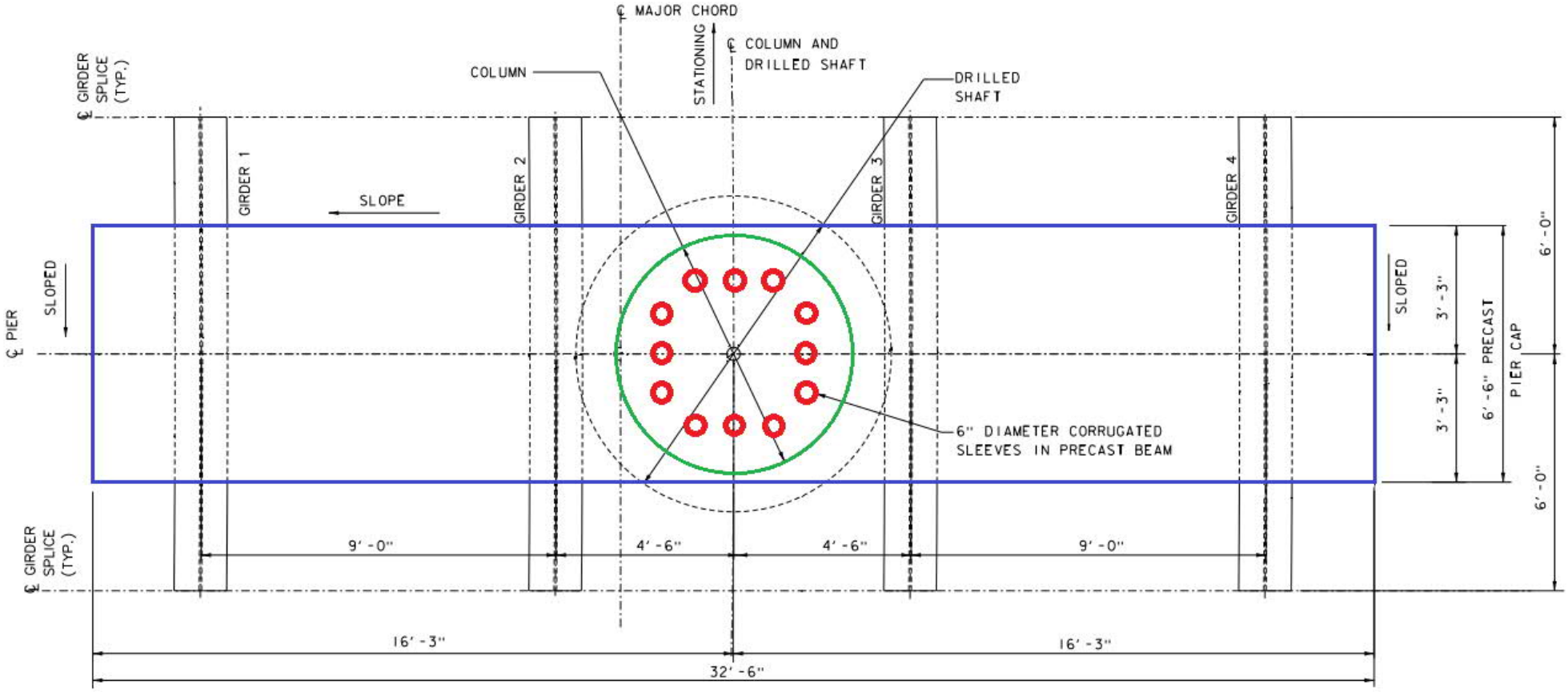
- Pre-cast Integral Pier Cap
- Limits Obstruction in River
- Removes cap from frequent high flow levels

- Required girder stubs to be included in precast element
  - Extend 6’ from CL to each side
  - Max 12’ shipping width

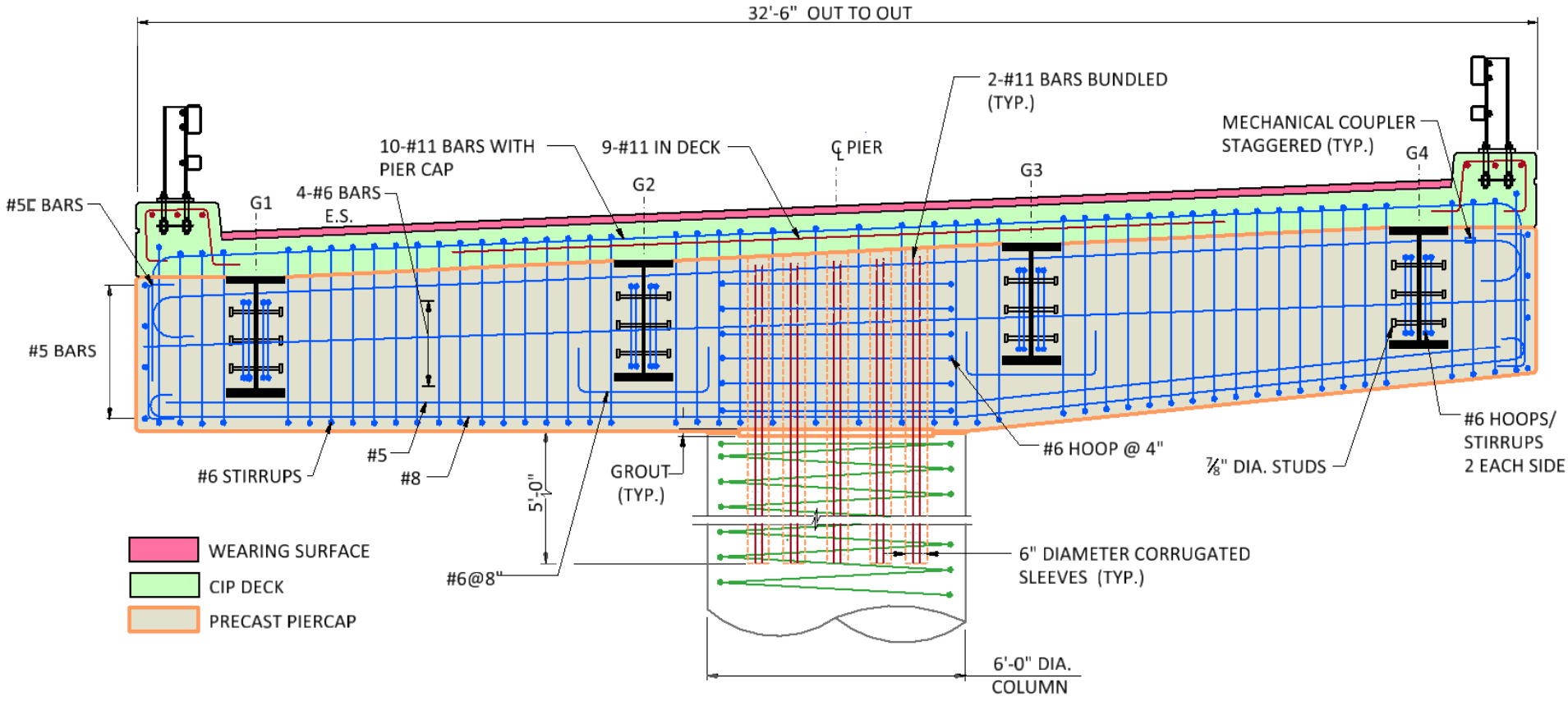
Pre-Cast Integral Pier Cap

- Steel Fabricated with 6’ Splices
- Shipped to Pre-cast Yard and Fully Assembled
- Pier Cap Poured – Steel Disassembled and Placed in Field
- Independent Engineer Hired by Contractor to Ensure Coordination

Pre-cast Pier Cap



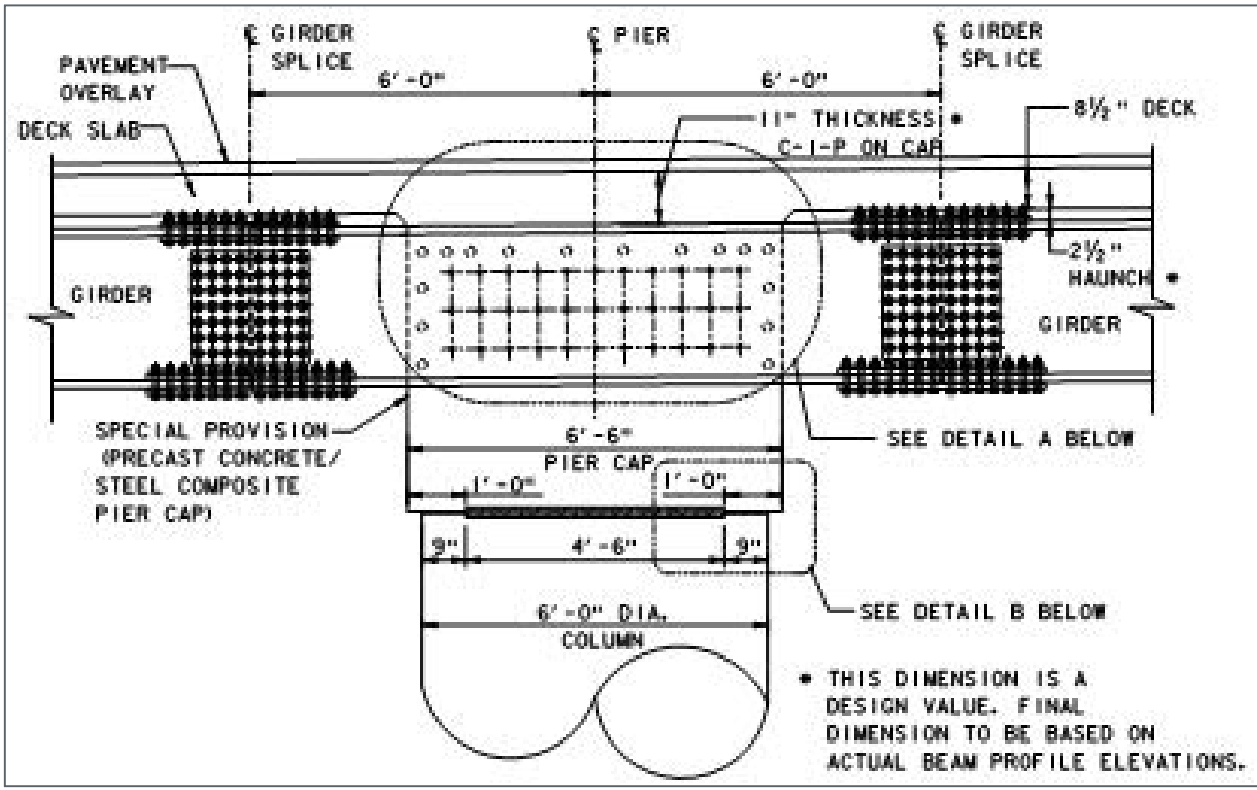
Pier Cap Details



Pre-cast Pier Cap

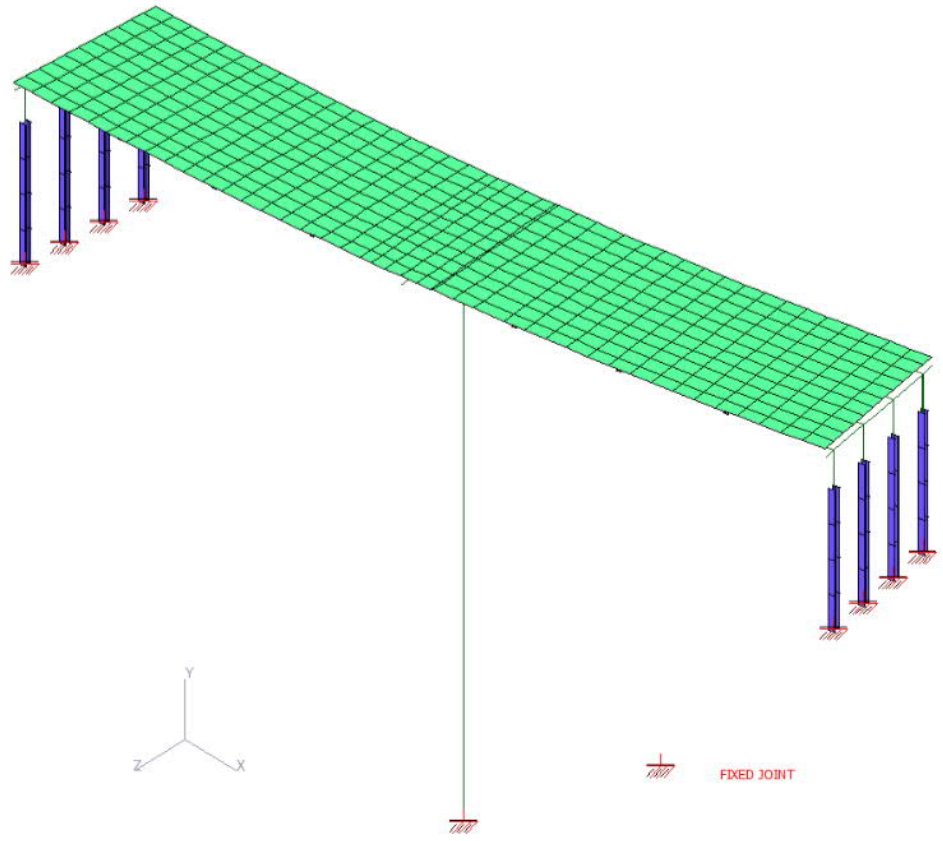
Column to Pre-Cast Connection

- 2” Grout Pad w/ ¾” Edge



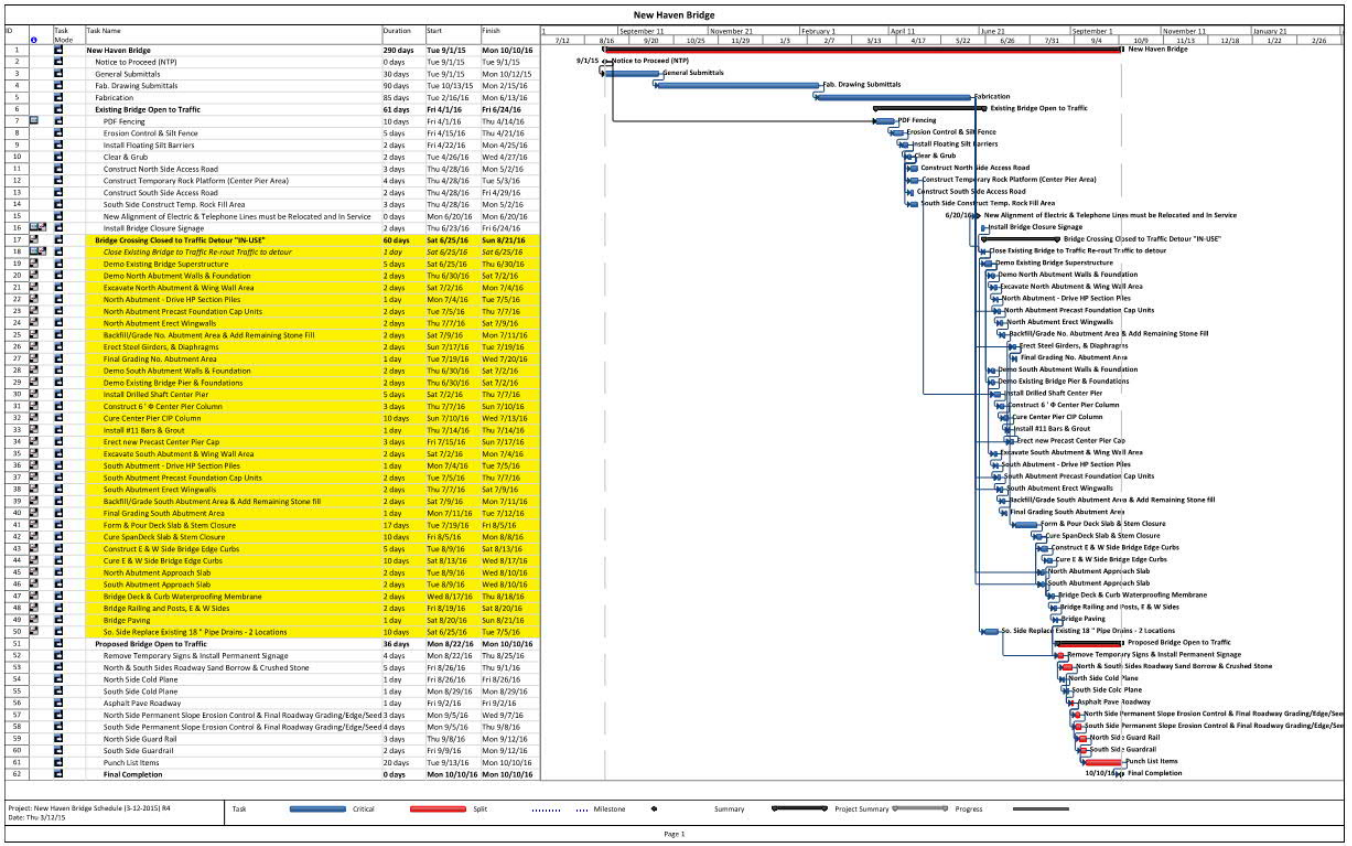
Complex Analysis

- 3D Analysis model included:
  - Full superstructure
  - Integral Abutment Stem and Piles
  - Integral Pier Cap
  - Monoshaft and column
  - Horizontal curvature and superelevation
  - Staged construction



Construction Schedule

- In-depth Task by Task Schedule
- Balance Practical v. Pushing Contractor
- Incentive/Disincentive
- 72 Days









Construction

Temporary Works – Bridge Open

Bridge Removal Prep- Bridge Closed

Superstructure Removal

Substructure Removal

Drilled Shaft

Drilled Shaft

Drilled Shaft

Drilled Shaft

Drilled Shaft and Integral Abutments

Integral Abutments

Integral Abutments

Pier Column

Steel Erection at Precast Yard

Precast Cap

Steel Erection in Field

Precast Approach Slabs

Bridge Open to Traffic

Completed Construction

Before

After







Conclusions

Conclusions

- Promised Town No Closure During School
- Improved Hydraulic Condition
- Estimated Cost v. Construction Cost (5%)
  - Due to precast supply/demand

Conclusions

- Balance $$, Pace, and Public Needs
- Innovative Complex Design
- Simple and Elegant Structure
- “This bridge is going to last a long time” – VTrans Chief Engineer

Acknowledgements

- Owner – Vermont Agency of Transportation
- Designer – WSP USA Inc.
- Contractor – CCS Constructors Inc.
- Precaster- JP Carrara and Sons Inc.
- Steel Fabricator – Casco Bay Steel Structures
- Owner's Rep- Vanasse Hangen Brustlin Inc.
- PCI New England

Questions?

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