



# Kittery, Overpass Bridge Replacement

Date: October 30, 2014

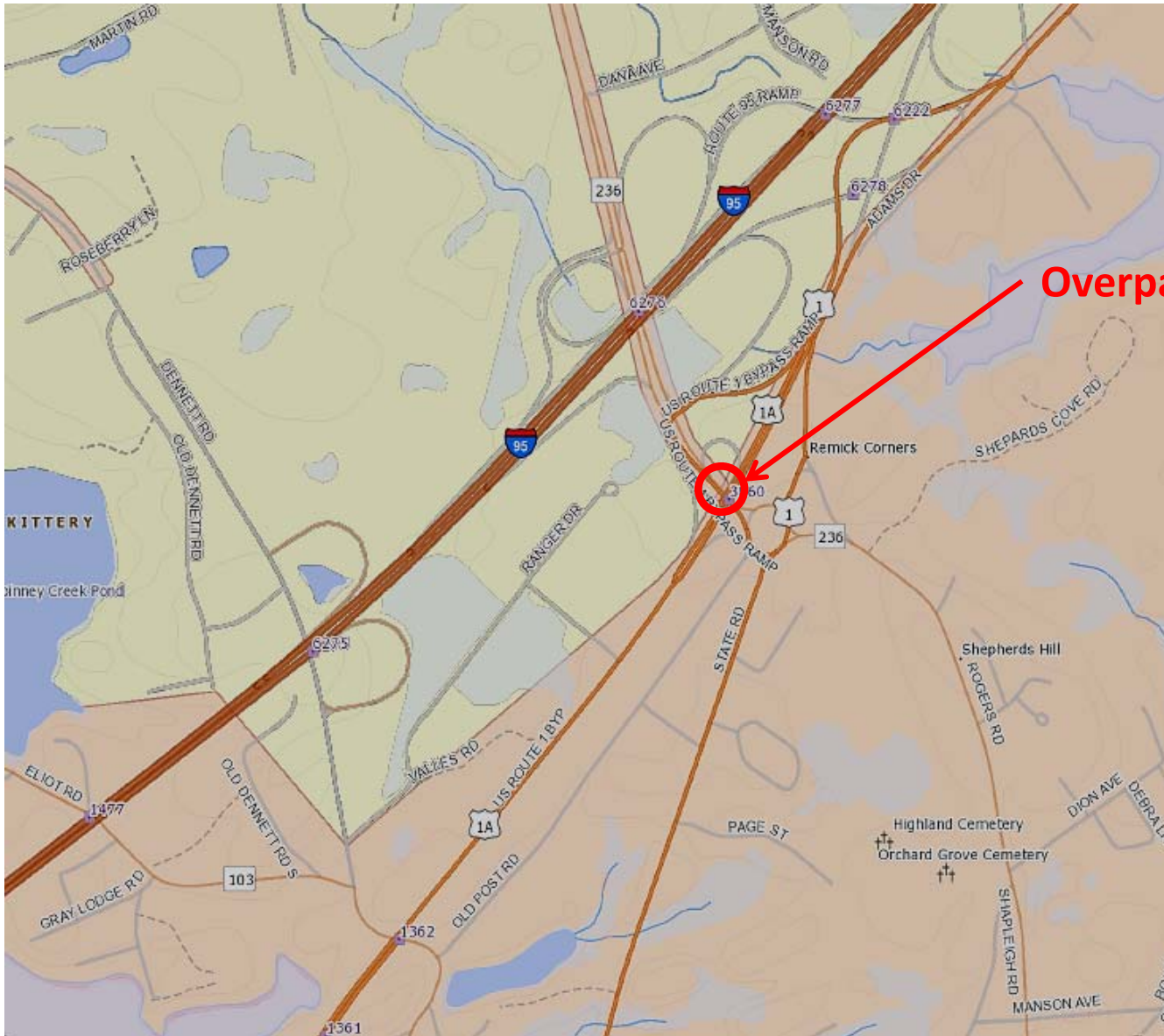


U.S. Department of Transportation  
Federal Highway Administration



TRANSPORTATION RESEARCH BOARD  
OF THE NATIONAL ACADEMIES

# Overpass Bridge Location



Overpass Bridge

# Overpass Bridge



# Kittery, Overpass Bridge

## Design, Construction, and Fabrication Team

- McFarland Johnson, Concord, NH – Consultant Designer
- Wyman & Simpson, Richmond, ME – General Contractor
- Shaw Brothers, Gorham, ME – Subcontractor
- High Concrete, Denver, PA – NEXT-D Beam Fabricator
- Precast of Maine, Topsham, ME – Precast Abutments & Approach Slabs Fabricator
- Oldcastle Precast, Auburn, ME – Precast T-Walls Fabricator
- Tokyo Rope Mfg., Tokyo, Japan – Carbon Fiber Composite Cable (CFCC) Prestressing Strands Fabricator

# Old Overpass Bridge



# Kittery, Overpass Bridge

## Existing Bridge and Project Overview

- Carries US Route 1 Bypass over Route 236
  - 4 traffic lanes with wide median and guardrail barrier
    - 2 thru lanes NB
    - 1 thru lane and 1 onramp SB
- Built 1942
- Rehabilitation 1993
- 47'-4" span concrete rigid frame founded on bedrock
- 71'-4" to 74'-4" fascia-to-fascia width
- 13'-10" vertical clearance over Route 236 (posted)
- Adjacent to Memorial Circle – a rotary with 6 legs

# Project Issues

## Bridge Condition

- 72 years old with poor concrete condition overall
- Narrow lanes and shoulders
- Substandard vertical clearance

## Bridge Design Considerations

- Incorporate experimental Carbon Fiber Composite Cable (CFCC) prestressing strands
- Design durable, long-lasting structure
- Improve vertical clearance

# Project Issues (cont.)

## Town of Kittery Preferences

- Minimize traffic impacts
- Nice looking structure – considered bridge to be gateway to Town of Kittery
- Black bridge rail color
- Anti-graffiti coating on concrete walls
- Room for bicyclists on new bridge
- Sidewalks along Route 236



# Project Issues (cont.)

## Traffic

- 7,740 AADT - US Route 1 Bypass (used to be higher)
- 20,000 AADT - Route 236
- Tourist destination
- Portsmouth Naval Shipyard commuter traffic

## Construction Timing

- Need to wait until US Route 1 was reopened to traffic in 2013 due to recent Memorial Bridge construction
- Cannot coincide with construction of SML Bridge on US Route 1 Bypass, which starts in Fall 2014
- SML Bridge is considered the backup to the I-95 Bridge when there are lane closures
- Ordering, Fabrication, and Delivery of CFCC prestressing strands

# Kittery-Portsmouth Bridges



**Memorial Bridge  
On US Route 1**

**SML Bridge  
On US Route 1  
Bypass**

**Piscataqua Bridge  
On I-95**

**Kittery, ME**

**Portsmouth, NH**

# Project Solutions

## New Bridge

- Utilize precast concrete elements – abutments, wings, approach slabs, NEXT-D precast prestressed concrete beams
- Pre-buy CFCC prestressing strands due to long lead time
- Improve vertical clearance by raising finish grade about 2'
- Allow space for future sidewalks on Route 236

# Project Solutions (cont.)

## Maintenance of Traffic and Construction Timing

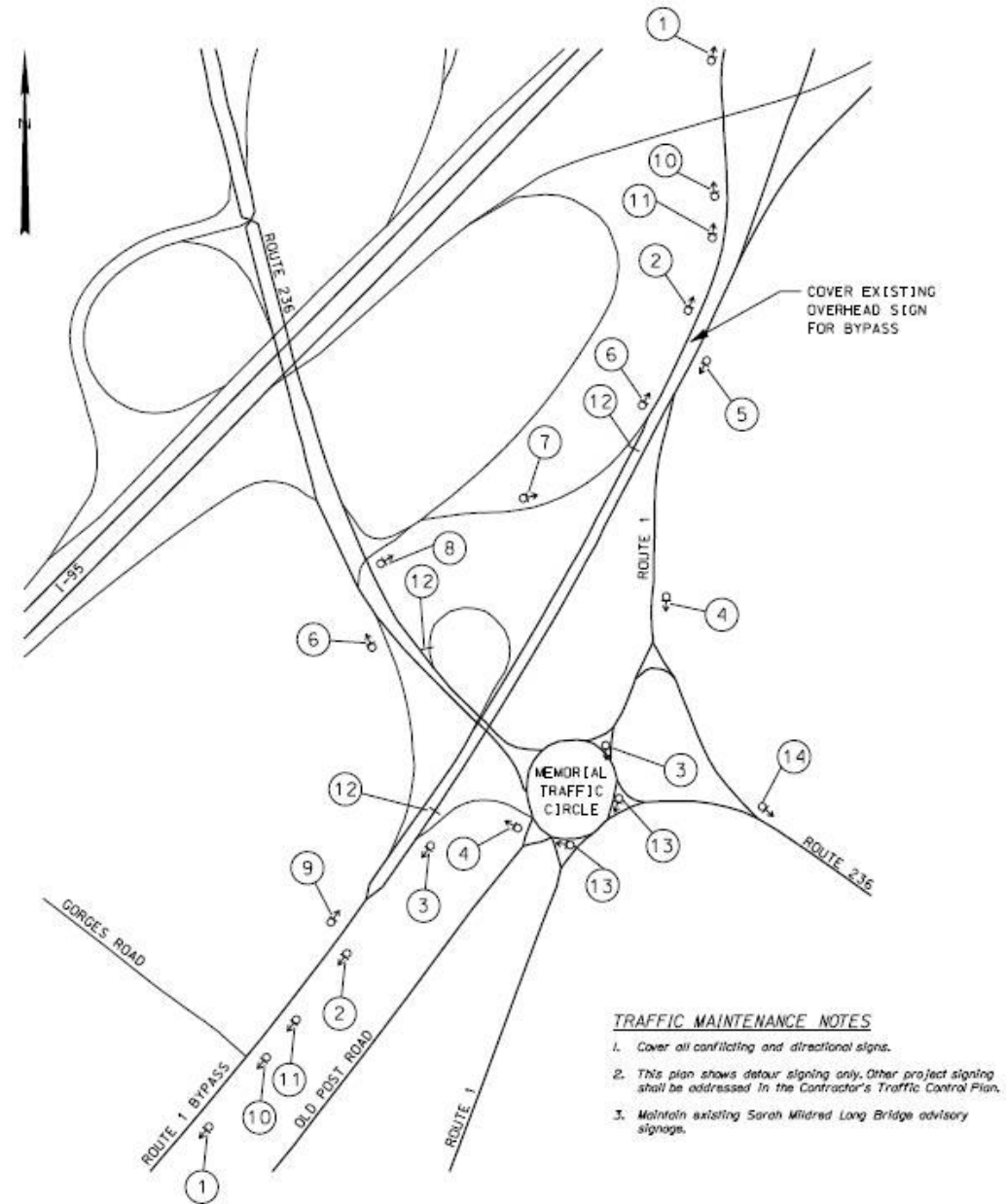
- Allow up to 35 days closure of US Route 1 Bypass and detour onto adjacent ramp system
- Allow up to 24 hours closure of Route 236 for demolition (within 35 day closure window)
- Be complete prior to start of construction of SML Bridge on US Route 1 Bypass
- Include incentives/disincentives for road closure durations
  - \$10,000/day for 35 day closure
  - \$5,000/hour for 24 hour closure
  - Maximum total incentive = \$125,000

# Kittery, Overpass Bridge

## New Bridge

- 60' span NEXT-D precast prestressed beams with CFCC prestressing strands
- 75'-4" fascia-to-fascia width
- 4 traffic lanes with mountable median and no barrier and 6' shoulders to accommodate bicyclists
- Dual coated corrosion resistant rebar
- Precast concrete abutments on CIP footings founded on bedrock
- Precast T-walls for return wings
- Ashlar masonry form liner on abutments and wing walls
- 16' vertical clearance over Route 236
- Bridge length allows for future sidewalks along Route 236, but no sidewalks included

# US Route 1 Bypass Detour



NOT TO SCALE

# Project Timeline

Advertised Bridge Project	1/8/14	
Bridge Contract Awarded	2/20/14	
Executed CFCC Pre-Buy Contract	2/24/14	
CFCC Strands Delivered	5/9/14	
US Route 1 Bypass Closed	7/23/14	6:00 AM
Route 236 Closed	7/23/14	8:00 AM
Route 236 Opened	7/23/14	9:00 PM
Route 1 Bypass Opened	8/21/14	
Construction Completed	10/6/14	

# Project Results

## New Bridge

- CFCC strands delivered a little later than expected from Japan, but in time for NEXT-D beam fabrication
- Precast concrete elements all fabricated and delivered on time
- Improved vertical clearance and improved sight distance through the bridge opening towards Memorial Circle
- Town of Kittery happy with results

## Maintenance of Traffic and Construction Timing

- Closure of US Route 1 Bypass lasted 29 days – Contractor earned \$10,000/day incentive for a total of \$60,000
- Closure of Route 236 lasted 11 hours – Contractor earned \$5,000/hr incentive for a total of \$65,000
- Project completed on time and on budget



# Project Results (cont.)

## Other Factors Contributing to Success of Project

- Schedule required long work hours, a skilled work force, and proper equipment to complete the work
- Survey layout was critical
- Precast concrete quality control was critical
- Contractor used multiple shims in the erection of precast abutment pieces
- Traffic control during the Route 236 detour was a major issue; however, the Kittery Police Department was a major player in making this work
- No delays due to bad weather
- Teamwork between all the players was critical
- Good General Contractor management of all subs was critical in meeting project schedule milestones

# ABC vs. Conventional Construction Cost Comparison

## Conventional Construction

Construction = \$2.43 million

Incentive Allowance = \$0

Total = \$2.43 million

## ABC

Construction = \$2.79 million

Incentive Allowance = \$125,000

Subtotal = \$2.92 million

= +20%

CFCC Strand = \$180,000

Total = \$3.10 million

= +27.6%

# Bridge Demolition



# Bridge Demolition



# Bridge Demolition



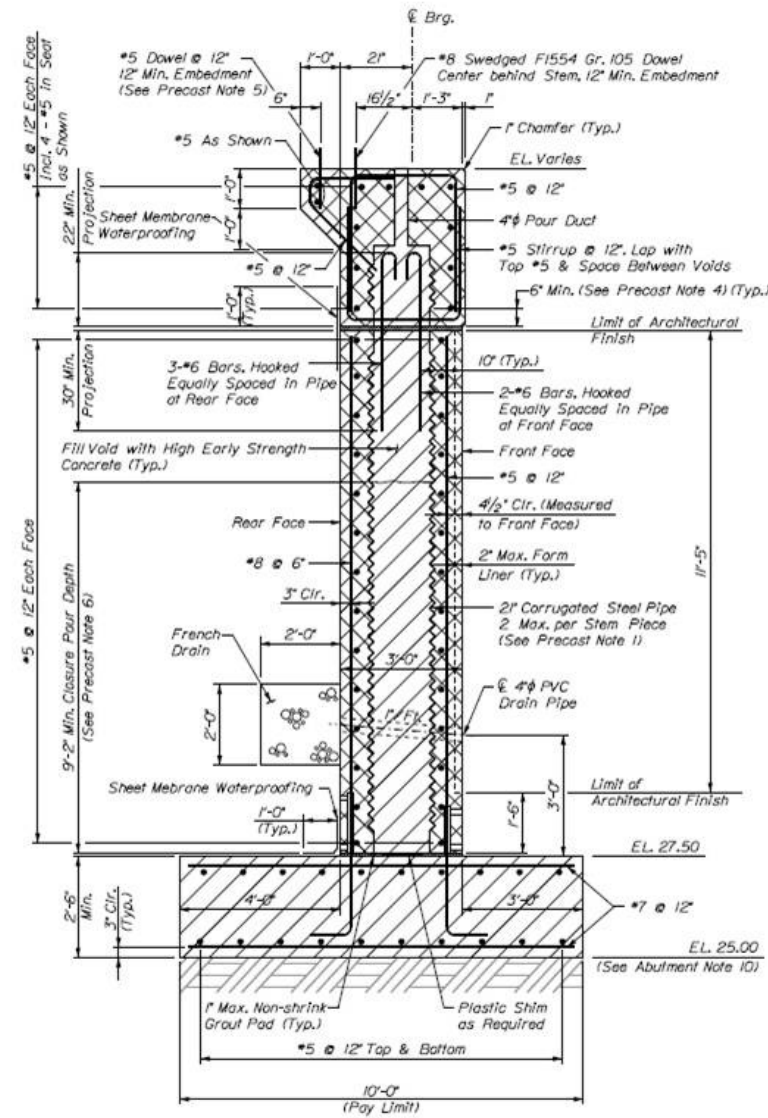
# Bridge Demolition



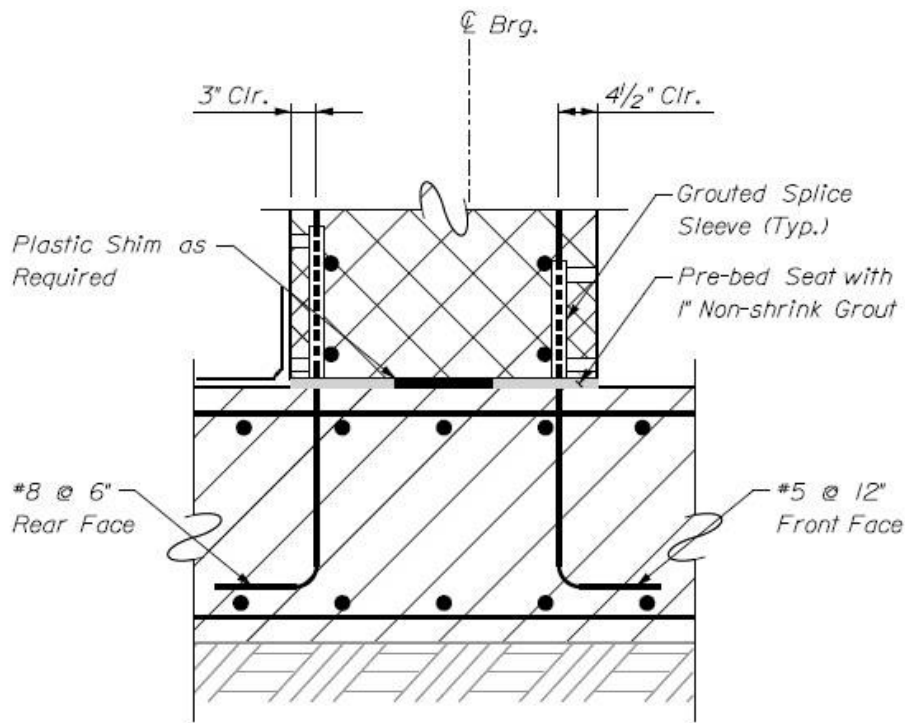
# Abutment Construction

## Each Abutment:

- 8 precast stem wall sections with 2 21" vertical voids
- 2 precast corner stem wall sections
- 6 precast stem cap sections
- Precast approach slabs
- Precast T-walls for return wings
- Heaviest abutment elements weighed about 47,000 lbs; most were in 30,000-40,000 lbs range

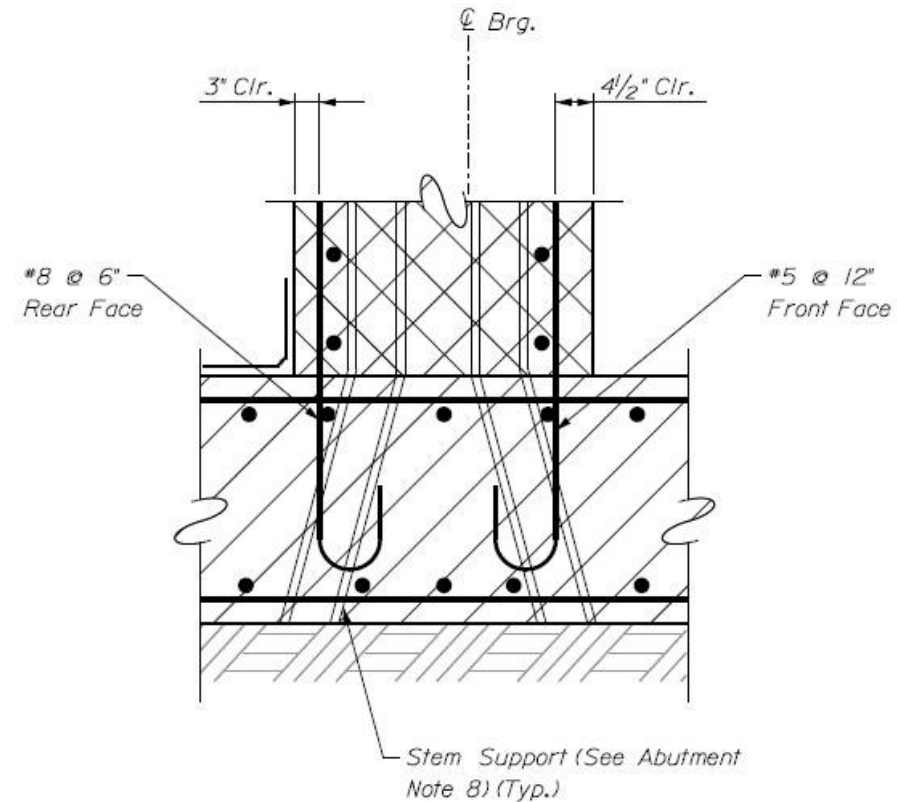


# Abutment Construction



FOOTING CONNECTION DETAIL

**From SHRP2 ABC Toolkit  
Not Used**

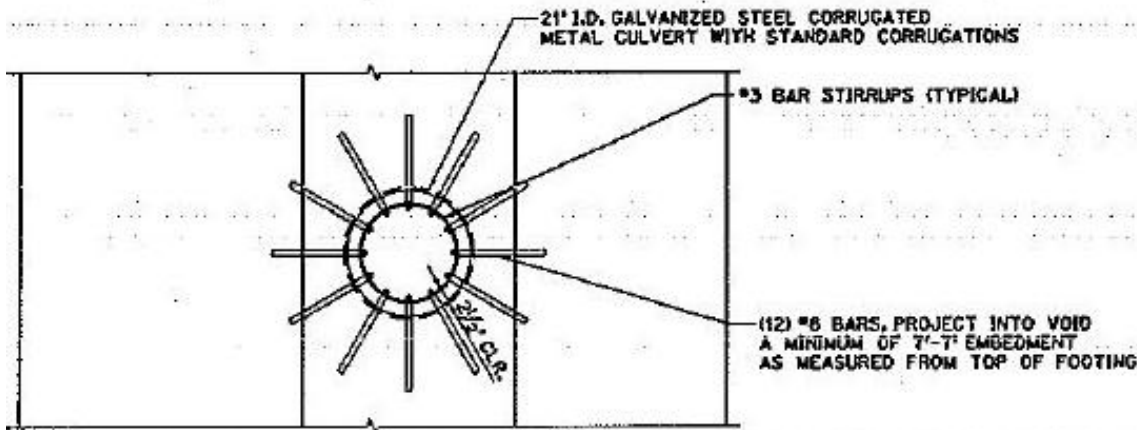


ALTERNATE FOOTING CONNECTION DETAIL

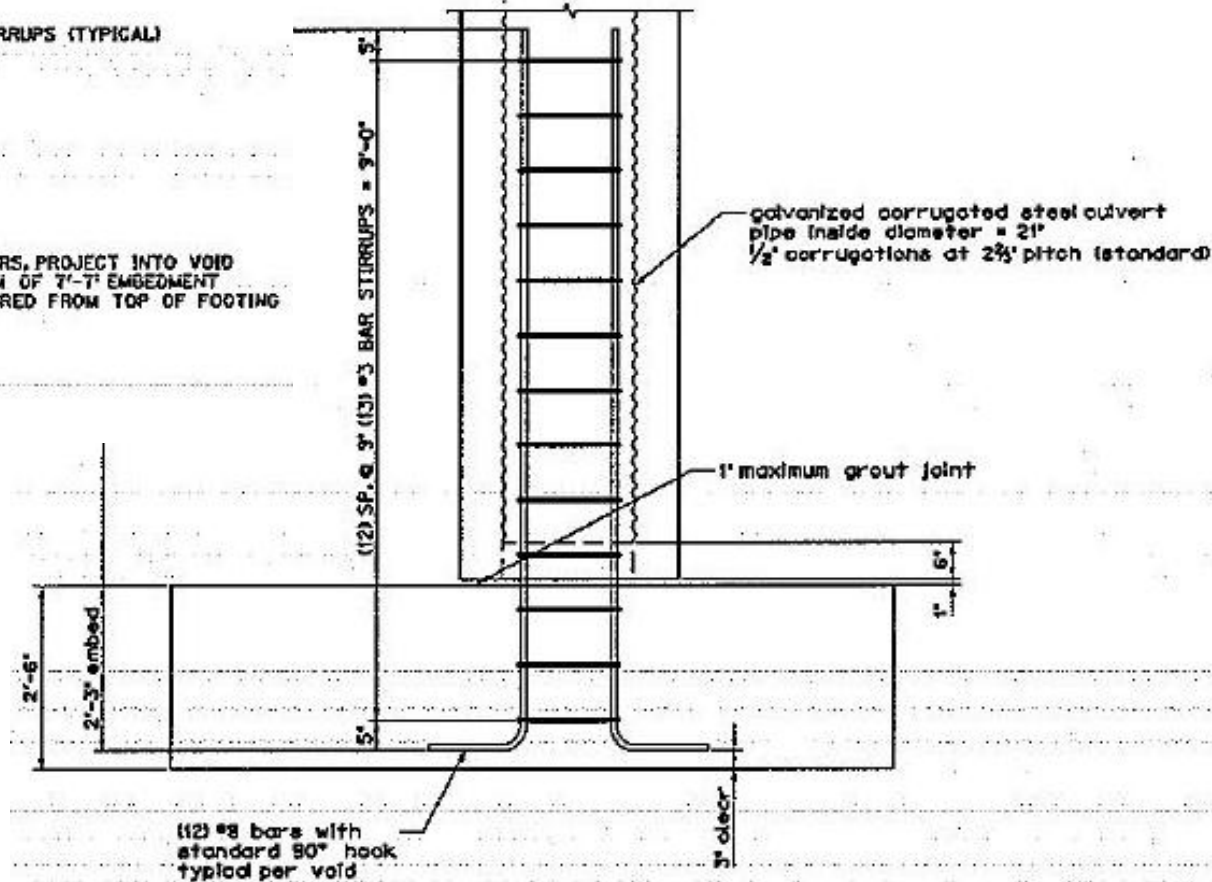
**From EDC Workshop sponsored by MassDOT  
Not Used**



# Abutment Construction



ALTERNATE FOOTING CONNECTION PLAN VIEW



ALTERNATE FOOTING CONNECTION ELEVATION

OTHER REINFORCING STEEL NOT SHOWN SHALL BE THE SAME AS THAT SHOWN IN THE CONTRACT DRAWINGS WITH THE EXCEPTION THAT NMB COUPLERS MAY BE OMITTED AND DOWELS FROM THE FOOTING INTO THE NMB COUPLERS MAY ALSO BE OMITTED

# Abutment Construction Leveling Slab



# Abutment Construction

## CIP Footing



# Abutment Construction Stem Walls



# Abutment Construction Stem Wall



# Abutment Construction Filling Stem Wall Voids



# Abutment Construction T-Wall Return Wings



# Abutment Construction Stem Wall Cap





# Abutment Construction Approach Slab



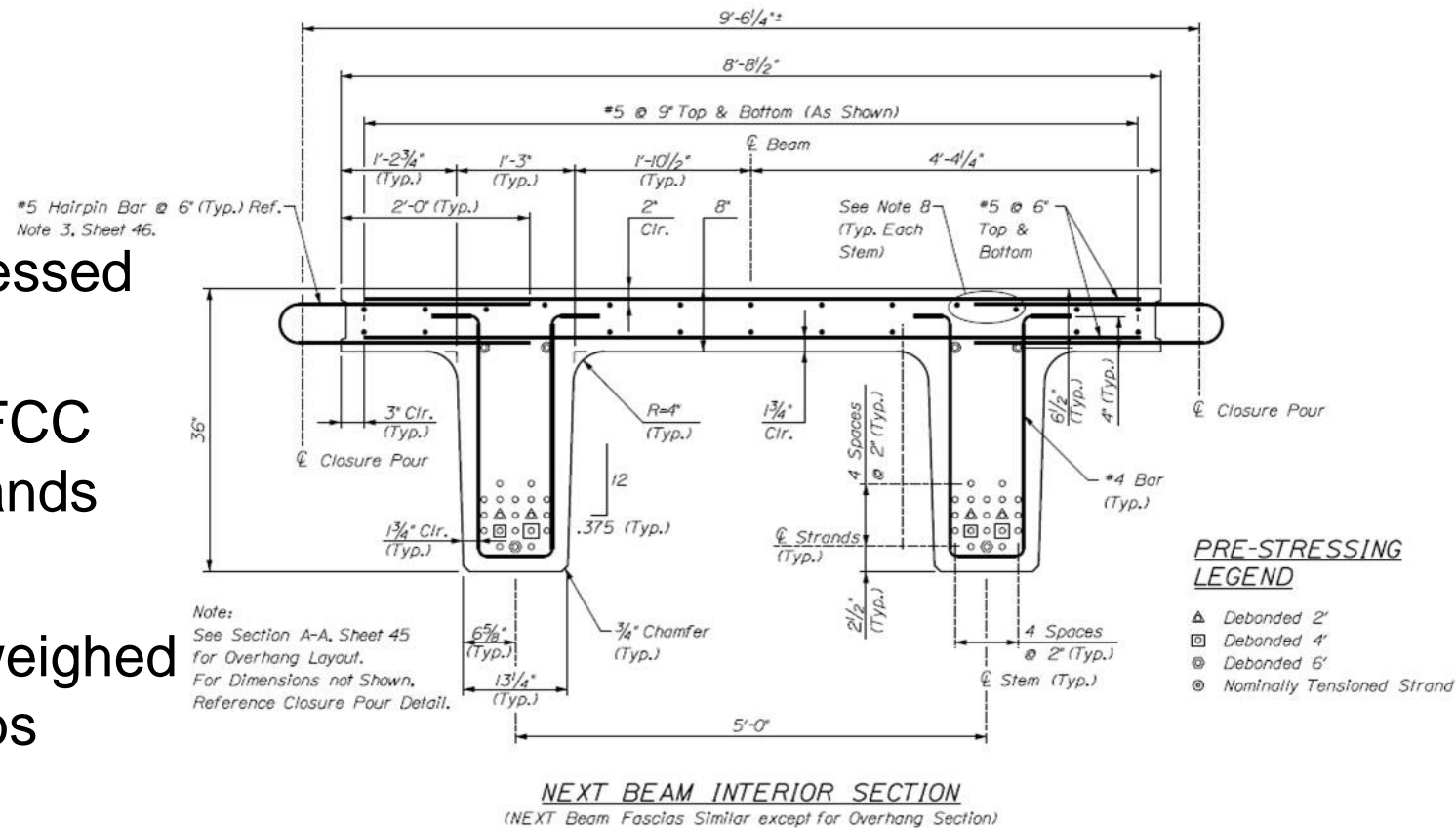
# Abutment Construction



# Superstructure Construction

## NEXT-D Beams:

- 8 precast prestressed concrete beams
- Experimental CFCC prestressing strands
- Full depth deck
- Interior beams weighed about 105,500 lbs
- Exterior beams weighed about 122,500 lbs



# Superstructure Construction



# Superstructure Construction



# Superstructure Construction



# Superstructure Construction



# Superstructure Construction CIP Concrete Median





# Superstructure Construction High Performance Membrane



# Superstructure Construction Bridge Rail and Paving



# New Overpass Bridge



# Time Lapse Video

