NEW HAMPSHIRE HISTORIC PROPERTY DOCUMENTATION
ABUTMENTS OF THE GENERAL SULLIVAN BRIDGE
ROUTE 16/4, DOVER AND NEWINGTON, NH

NH State No. 703

LOCATION:	Bypassed section of Route 16/4 over Little Bay Between Newington and Dover, Strafford and Rockingham Counties, NH USGS Portsmouth NH Quadrangle UTM Coordinates: 19 N 351415 E4775280 (NAD1983)
BUILDER/ENGINEER	Fay, Spofford & Thorndike
FABRICATOR:	Crandall Engineering Company, Cambridge, Massachusetts
DATE:	1933-1934
PRESENT OWNER:	State of New Hampshire
PRESENT USE:	Pedestrian bridge
SIGNIFICANCE:	The concrete abutments of the General Sullivan Bridge are an abutment substructure known as a bin type or vaulted abutment. The "bin" or "vault" construction of the abutment's concrete perimeter walls creates a concrete container that can then be filled or partially filled with crushed rock or stabilized earth and spanned over with a reinforced concrete slab. This type of abutment construction is typically used in locations where the site is tightly constrained. This constrained site condition is highly evident at the narrow points of land at Newington and Dover Point where the General Sullivan Bridge crosses Little Bay.
PROJECT INFORMATION:	This abbreviated New Hampshire Historic Property Documentation form was prepared to fulfill Stipulation III. Minimization of the Adverse Effects to the General Sullivan Bridge, which was part of the Memorandum of Agreement regarding the widening of NH 16/US 4 in Newington and Dover, New Hampshire. As part of the work to rehabilitate the General Sullivan Bridge as a pedestrian crossing, changes will be made to the bridge's north abutment, wingwalls, several of the trusses, and embankment. This recordation was undertaken in accordance with agreements between the New Hampshire Division of Historical Resources (NHDHR) and Federal Highway Administration. The report was completed by Walter Maros, Steven Hodgdon, and Rita Walsh, Vanasse Hangen Brustlin, Inc. (VHB) 2009 and 2012. The large format photographs were taken by Charley Freiberg.

INTRODUCTION

This abbreviated New Hampshire Historic Property Documentation form was prepared to fulfill Stipulation III. Minimization of the Adverse Effects to the General Sullivan Bridge, which was part of the Memorandum of Agreement regarding the widening of NH 16/US 4 in Newington and Dover, New Hampshire. The project involves proposed reconstruction and widening of sections of the Spaulding Turnpike; reconfiguration and reconstruction of several turnpike interchanges; reconstruction of a local connector road; construction of three new bridge structures and widening of two others; construction of a new Little Bay Bridge, widening and rehabilitation of the existing Little Bay Bridge; and rehabilitation of the General Sullivan Bridge to function as a pedestrian/bicycle/recreational facility As part of the work to rehabilitate the General Sullivan Bridge as a pedestrian crossing, changes will be made to the bridge's north abutment, wingwalls, several of the trusses, and embankment.

The General Sullivan Bridge's abutments were not extensively mentioned in the New Hampshire Division of Historical Resources Individual Inventory Form that the Preservation Company prepared for the bridge in 2004. The purpose of preparing this abbreviated New Hampshire Historic Property Documentation form for the abutments is to supplement the information provided by the Preservation Company and to include an architectural description and comparative evaluation of the abutments.

Fieldwork for the completion of this report was conducted in May 2009 and large-format photographs of the bridge were taken in July 2009.

Background research on the abutments was conducted using the resources of the Massachusetts State Transportation Library; internet searches; personal communications with James Garvin of the New Hampshire Division of Historical Resources and Robert McCullough of the University of Vermont.

DESCRIPTION

The General Sullivan Bridge's abutments are unadorned reinforced concrete structures measuring 28' (water elevation) by 33' (side elevations). The exposed height of the abutments is approximately 17' on the highest (water) side. The abutments are supported on four 5'-square (land side) and one 7' x 30' (water side) footings. Three-foot wide sidewalks are cantilevered up and out from the sides of the abutments. A railing, original to the bridge, is located to the outside of both sidewalks on both abutments. It consists of three lengths of 8'-3" steel pipe railing alternating with large (2' x 1'-2'') concrete fence posts.[1]

The General Sullivan Bridge's abutments appear to be in fair cosmetic condition, based on the limited portions of the abutments that are accessible and visible from land approaches. The north abutment, situated in the town of Dover, is the more accessible of the two abutments as a result of its location along a paved pathway within the maintained landscape of Hilton State Park. In contrast, land access to the south abutment, situated on untended land in the town of Newington, is difficult for several reasons: the nearest access road (an unpaved utility road) is separated from the south abutment by steep declivities in the immediate setting which are either thickly overgrown with vegetation, are swampy, or in the case of the waterfront of Little Bay under the bridge, are covered with riprap. Although more accessible, the

[1] Casella, 39.

north abutment is partially hidden from view, due to the presence of trees on its west side and an adjacent retaining wall on its east side. This retaining wall dates from the 1980s.

As the north abutment is much more visible, the following description is based on this abutment. The south elevation of the north abutment is the most visible portion of either abutment when viewed from land. This elevation's current appearance clearly matches the contract drawing prepared for the New Hampshire Toll Bridge Commission in June 1933, including the concrete coping below the truss anchor plates at elevation 115.5 and the three rectangular 8" by 30" ventilation openings at elevation 127.0[2]. The location of the ventilation openings is consistent with the same 1933 contract drawing's plan, which shows that each of the openings ventilated a separate chamber within this closed-end bin or vault type abutment (Figure 3). The south, west and east elevations of this abutment all show board form marks in the concrete. The east and west elevations of the abutment feature overhanging concrete flanges that are centered at elevation 132.45. Field observations indicate that the aggregate is exposed in localized areas of the abutment concrete, most noticeably at the northern top ends of the abutment's east and west elevations.

Land erosion below the concrete bridge deck adjoining the north abutment's west elevation shows that the underside of the deck at this specific location is heavily weathered, with exposed aggregate and rebar. The earthen embankment surrounding this abutment has been altered from the flat oval plan shown in the 1933 contract drawing (Figure 3). The eastern extremity of the oval embankment appears to have been truncated for the creation of the circa 1980s retaining wall that abuts the Hilton State Park service road on the east side of the General Sullivan Bridge. The immediate vicinity of the north abutment also appears to have been altered by the extension of the shoreline southward in order to construct the Park's paved walkway under the bridge.

BIN OR VAULT TYPE ABUTMENTS

There are two general abutment types, closed end and open end. Closed end abutments are usually tall and retain crushed rock or earth, and bridges with closed end abutments do not usually have significant earthen embankments directly in front of them. In contrast, open end abutments are typically set into the upper portion of roadway approach embankments below the bridge. Each of these general types has several subtypes. [3] Closed end abutment subtypes include bin/vault, cantilever, stub and rigid frame abutments. Open end abutment subtypes include integral, semi-integral, spill-through, and short seat abutments.[4] Figures 5-8 illustrate a variety of these abutment subtypes.

The concrete abutments of the General Sullivan Bridge are a closed end abutment subtype known as a bin type abutment. The "bin" or "vault" construction of the abutment's concrete perimeter walls creates a concrete container that can then be filled or partially filled with embankment material. This type of abutment construction is typically used in locations where the site is tightly constrained.[5] This constrained site condition is highly evident at the narrow points of land at Newington and Dover Point where the General Sullivan Bridge crosses Little Bay.

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[2] The elevations noted are not accurate as they are based on an assumed datum of approximately 100 feet above NGVD29 typical.
[3] NMDOT Bridge Procedures and Design Guide, 9-1
[4] Wai-Fah Chen, 25.6.3.1 and 25.6.3.2
[5] Wai-Fah Chen, 25.6.3.2

The choice of closed or open end abutments by bridge engineers and designers tends to be a function of cost, site constraints, esthetic considerations, and maintenance requirements. In the case of the General Sullivan Bridge, which was begun in 1933 and completed in 1934 during the economic hard times of the Great Depression, the choice of a closed end bin/vault type abutment is likely to have been shaped by all these considerations but particularly by site and cost constraints. Unlike in the current era when labor costs are high and therefore the higher degree of labor associated with the construction of bin/ vault type abutments would be more expensive than for other abutment types, the high unemployment rates of the 930s meant that labor was then cheap in relation to the cost of concrete and other abutment materials at the time. The low cost of 1930s labor may have been a factor in the choice of bin /vault type abutments for the General Sullivan Bridge.

The abutment face is the plane of the abutment that is perpendicular to the chords of the superstructure. The wingwalls and a 9" thick reinforced concrete deck slab are supported at the back of the abutment by four 2'-6" x 2'-6" columns founded on 5' x 5'square footings. A 2'-6" x 2'-6" square horizontal strut connects these columns about halfway up the columns. . Embankment inside this abutment is partially full as it is similar to embankment slopes along the exterior faces of the wingwalls.. The top concrete slab is constructed with a pair of integral concrete beams, 1.75' wide x 2' high that span from the abutment backwall to square columns at the rear of the abutment bin/vault.

OTHER BRIDGES WITH COMPARABLE ABUTMENTS

Research to positively identify other bridges with bin or vault type abutments that are comparable to those at the General Sullivan Bridge was unsuccessful. Identifying comparable abutments is difficult without being involved in the original construction, or reconstruction, of abutments that happen to be bin or vault type abutments, because abutments are buried and not all parts are visible. From the exterior, one abutment would look like any other abutment that has a front wall and sidewalls. Bin or vault type abutments cannot be identified by simply looking at the exterior of an abutment, but instead require physical investigation of the interior of the abutment, or a review of the record plans for the construction of an abutment. In the case of the General Sullivan Bridge, the abutments are now known to be bin or vault type abutments because physical investigative work was conducted on their interior in preparation for the rehabilitation of the bridge.

Bridges that may or may not have comparable bin or vault type abutments include: Sarah Mildred Long Bridge (completed 1940) in Portsmouth NH, Judge Harlan Fiske Stone Bridge (1937 Chesterfield Arch) in Chesterfield NH, Ledyard Bridge (1934 edition) in Hanover NH, Stratford VT-Bloomfield NH Bridge, Neil R Underwood Bridge/Hampton Harbor Drawbridge in Hampton NH and Brentwood NH 101EB & 101 WB (1997) over Little River. Record drawings of these bridges may yield definitive information on the types of abutments used.

REFERENCES

___, "High-Level Bridge Link in the Dover-Portsmouth Road," Engineering News-Record, September 27, 1934.

___, Maine Department of Transportation Bridge Design Guide, 2003, http://www.maine.gov/mdot/technical-publications/brdesignguide.php, accessed 18 April 2012.

___, New Mexico Department of Transportation Bridge Procedures and Design Guide, www.nmshtd.state.nm.us, accessed 12 May 2009.

___, Proceedings of the American Railway Engineering Association, Vol. 10, Part 2 (1909)

___, Proceedings of the American Railway Engineering Association, Vol. 13 (1916).

Casella, Richard/Griggs, Frank/Hooper, Carol. New Hampshire Division of Historical Resources Individual Inventory Form: General Sullivan Bridge/NHDHR Inventory Number DOV0158, November 2004.

Garvin, James. Personal communication to Walter Maros and Rita Walsh May 2009 concerning comparable bridge abutments.

Wai-Fah Chen, E.M. Lui, Handbook of Structural Engineering (Boca Raton, FL: CRC Press, 2005).

McCullough, Robert. Crossings: A History of Vermont Bridges. (Barre, VT. Vermont Agency of Transportation and the Vermont Historical Society, 2005)

McCullough, Robert. Personal communication to Walter Maros May 2009 and June 2009 concerning the abutments of the Lake Champlain Bridge.

Waddell, J.A.L. Bridge Engineering (New York: John Wiley & Sons, Inc., 1916)

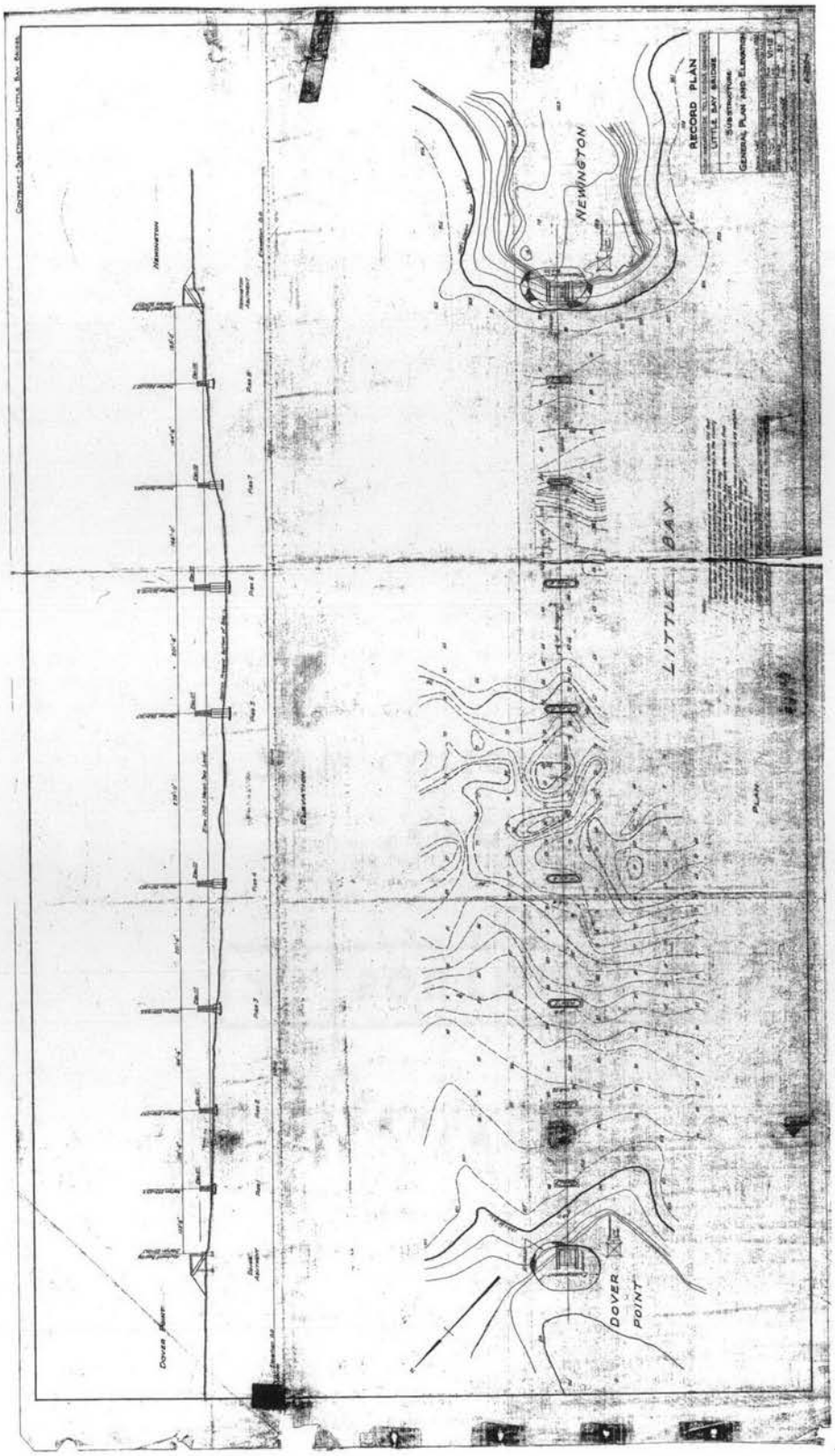


Figure 1. Record Plans, Substructure General Plan and Elevation, V1-12-31

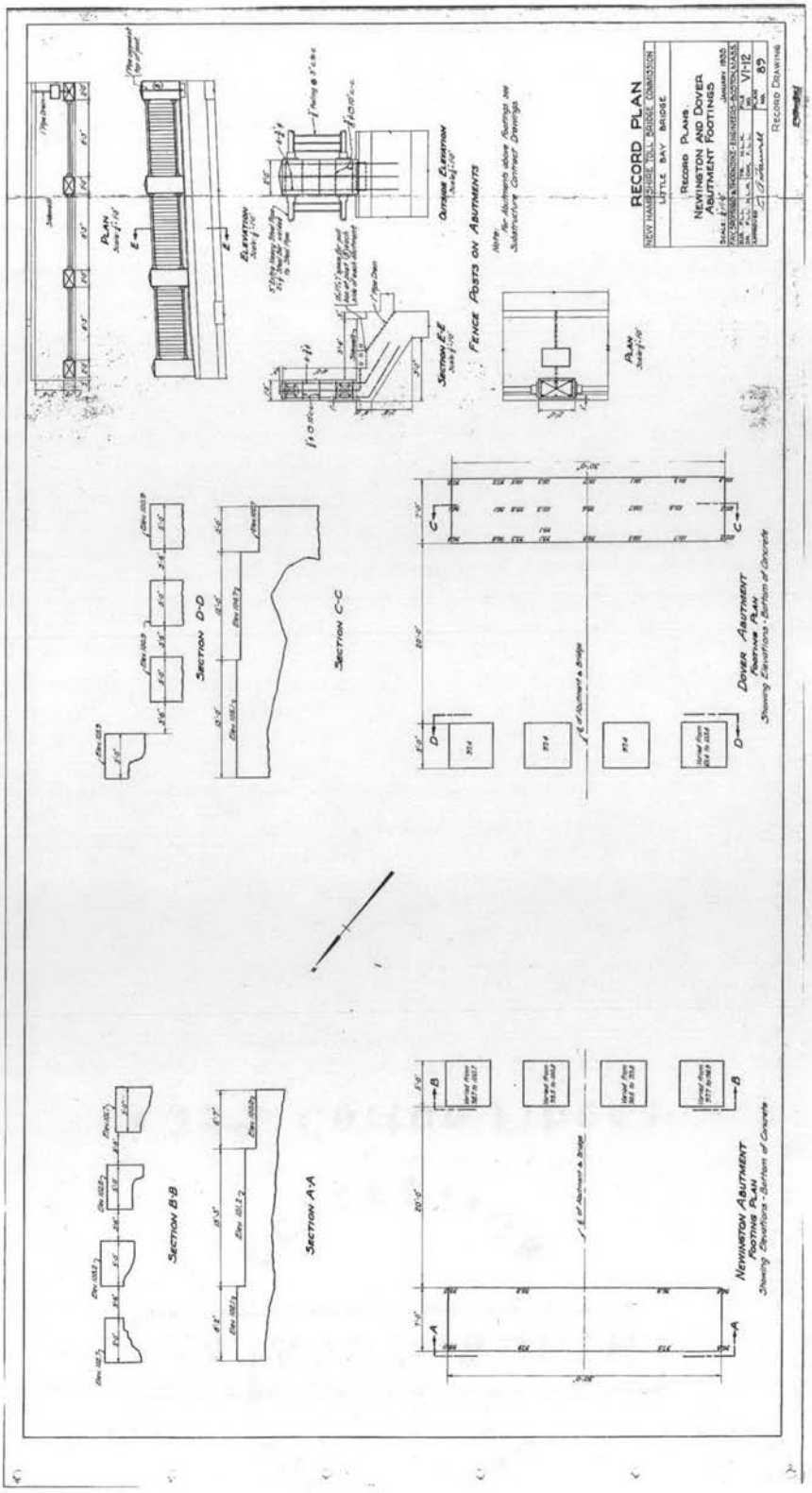


Figure 2. Record Plans, Newington and Dover Abutments Footings, V1-12-89

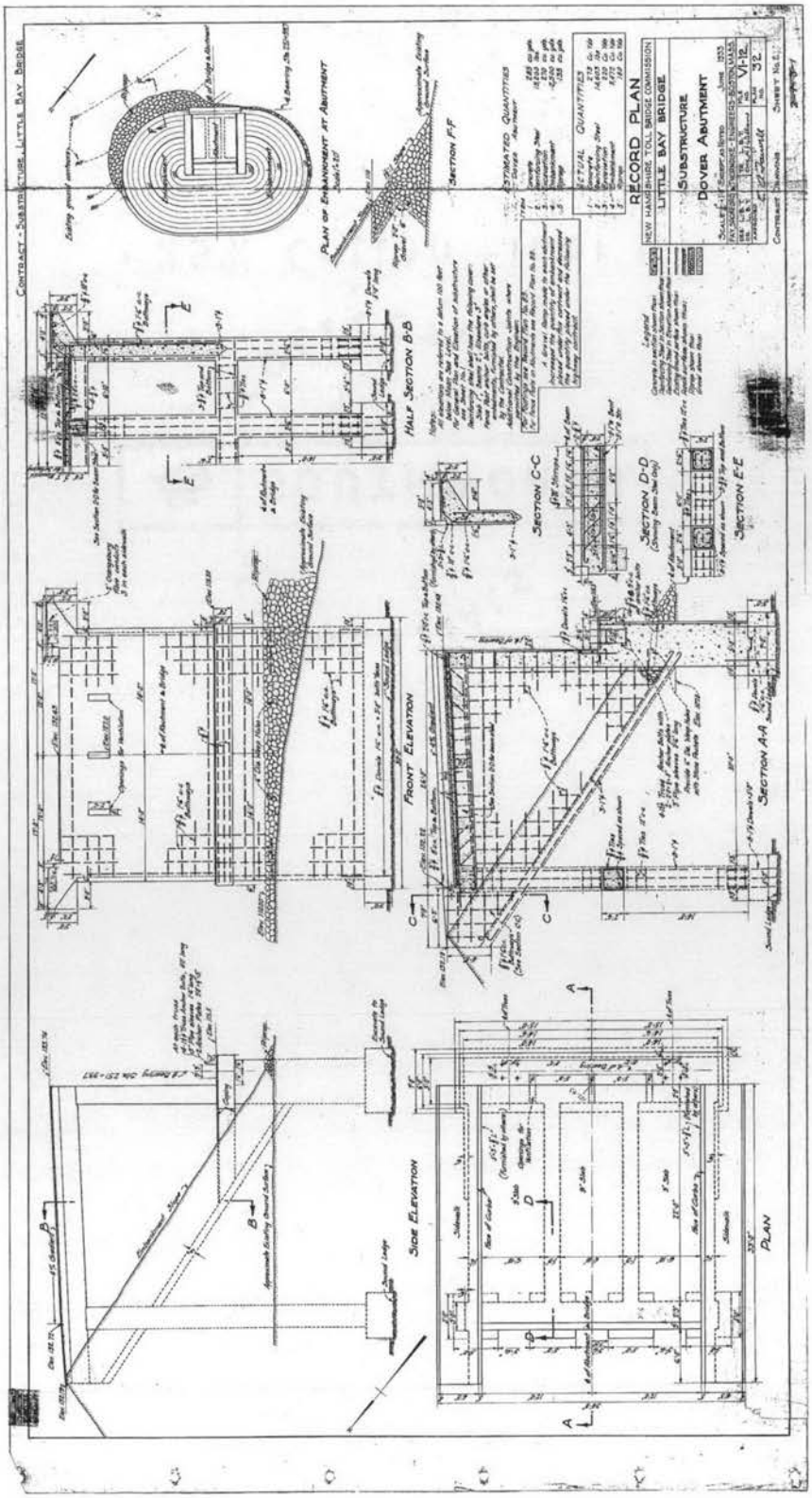


Figure 3. Record Plans, Substructure, Dover Abutment, V1-12-32

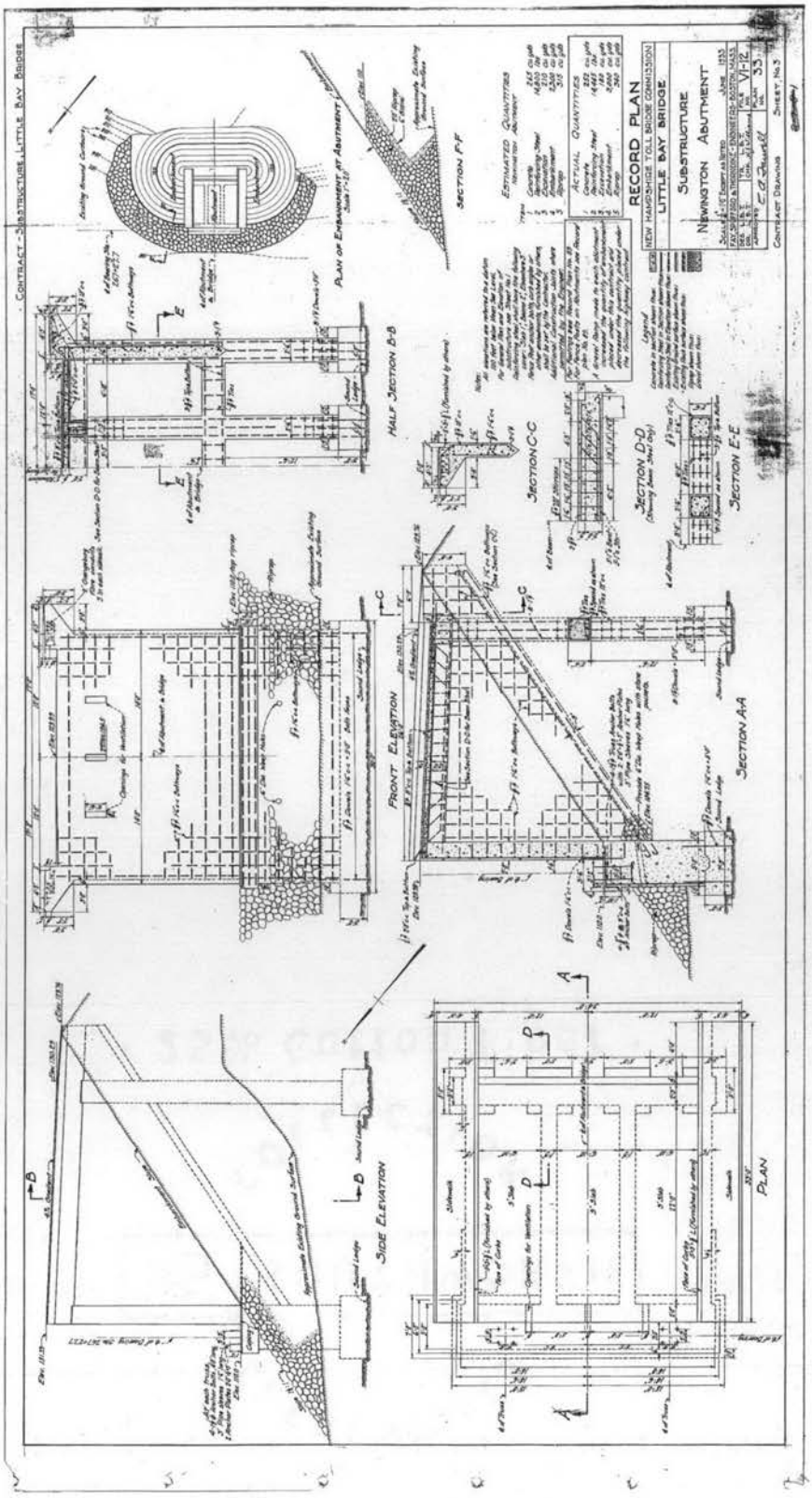


Figure 4. Record Plans, Substructure, Newington Abutment, V1-12-23

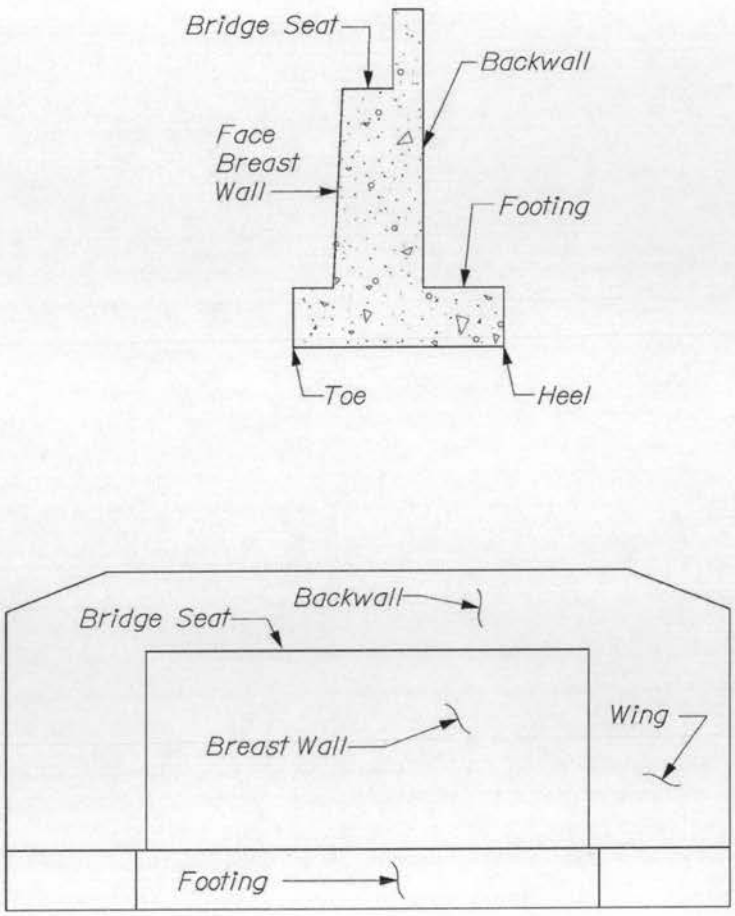


Figure A-4 Full Height Cantilever Abutment

Figure 5.Full Height Cantilever Abutment, from Maine Department of Transportation Bridge Design Guide. This is a closed abutment with no openings in the wall elevation.

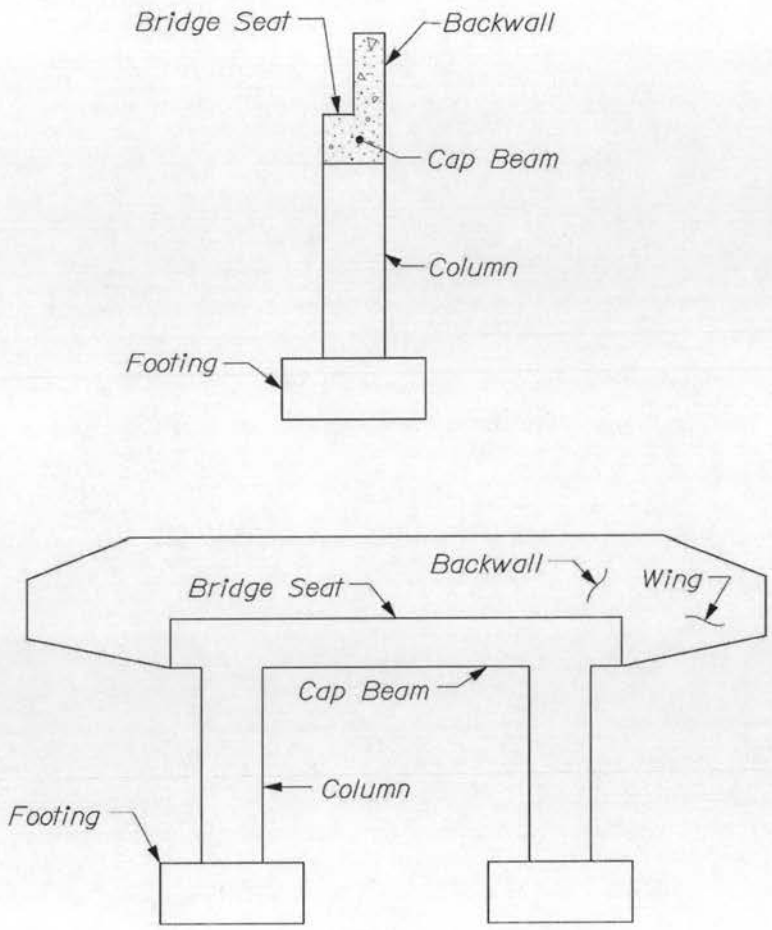


Figure A-6 Open Abutment

Figure 6. Open Abutment, from Maine Department of Transportation Bridge Design Guide

Figure 9.3B
Types of Abutments

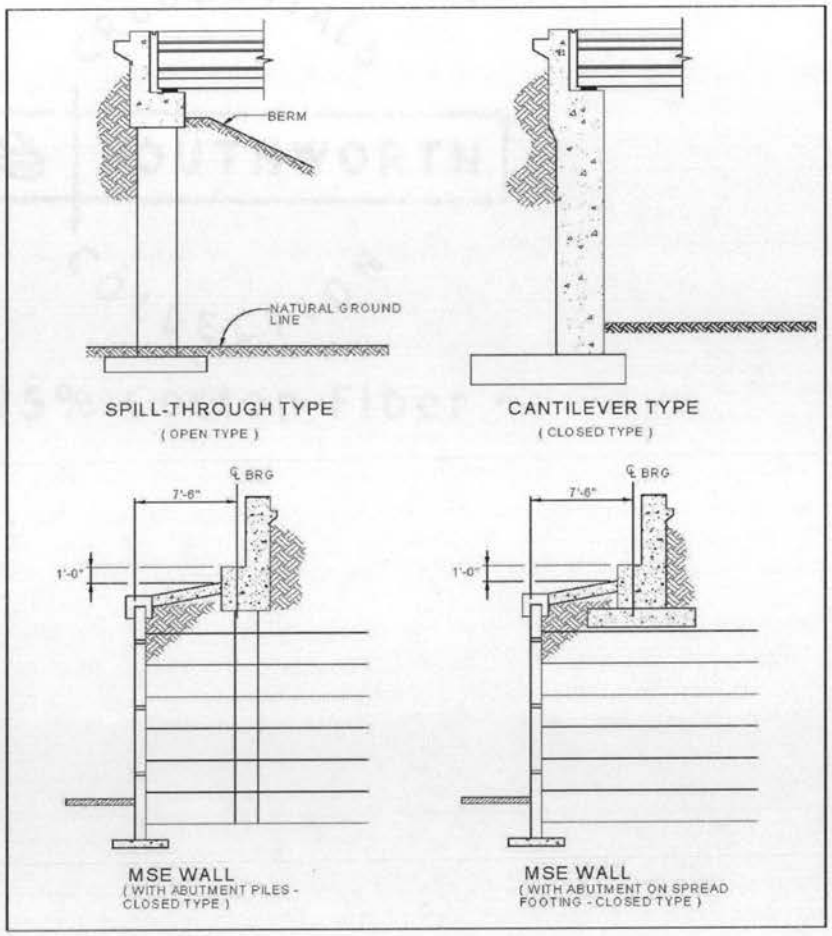


Figure 7. Illustrations of various abutment types, both open and closed, from New Mexico Department of Transportation Bridge Procedures and Design Guide

Figure 9.3A
Types of Abutment

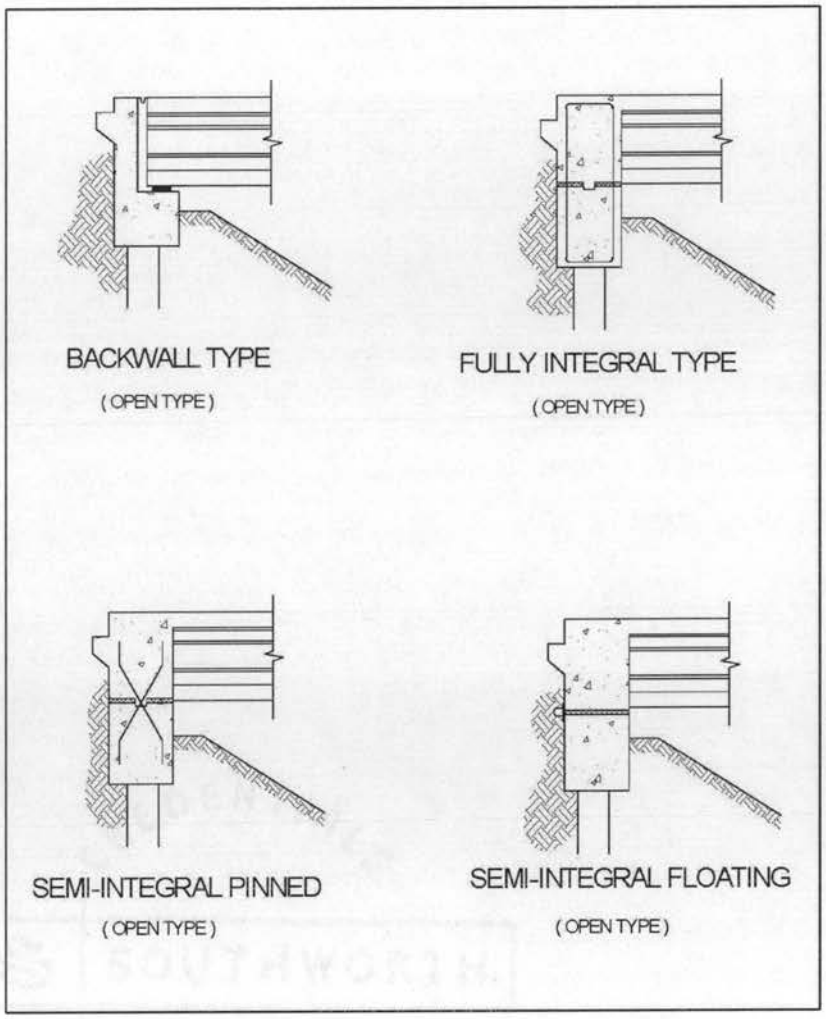


Figure 8. Illustration of various open abutment types, from New Mexico Department of Transportation Bridge Procedures and Design Guide

INDEX TO PHOTOGRAPHS

General Sullivan Bridge Road over Little Bay
Newington and Dover
Rockingham and Strafford Counties
New Hampshire

Photographer: Charley Freiberg
July 2009 and June 2011

NH-703-1 Northernmost pier at Dover (north) side of bridge, taken from west side of bridge. Looking north.

NH-703-2 Bridge piers from Dover (north) side, taken from west side of bridge. Looking southeast.

NH-703-3 West wall of north abutment, taken from beneath bridge. Looking northwest.

NH-703-4 West wall of north abutment. Looking southeast.

NH-703-5 Underside of bridge and north abutment. Looking northwest.

NH-703-6 U.S. Public Works Project plaque on railing at north side of bridge. Looking east.

NH-703-7 Northernmost pier at Dover (north) side of bridge, taken from the east side of the bridge. Looking southwest.

NH-703-8 Bridge piers from Dover (north) side, taken from the east side of the bridge. Looking south.

NH-703-9 East wall of north abutment. Looking northwest.

NH-703-10 West wall of south abutment. Looking north.

NH-703-11 Underside of bridge and south abutment. Looking southeast.

NH-703-12 Underside of bridge and south abutment. Looking south.

NH-703-13 Underside of bridge deck from west side of south abutment. Looking northwest.

NH-703-14 Underside of bridge deck of central span (Span 5 on original drawings) underside. Looking west.

NH-703-15 South end of central span (Span 5 on original drawings). Looking west.

NH-703-16 Span 6 (span south of central span) underside. Looking west-southwest.

NH-703-17 Close-up view of pier and truss elements between Span 7 (on left) and Span 6 (on right). Looking west

NH-703-18 Span 7 (on left) and Span 6 (on right). Looking west-northwest.

NH-703-19 Span 7. Looking west.

NH-703-20 Span 7. Looking south.

NH-703-21 Span 7. Looking south-southwest.

NH-703-22 Spans 7, 8, and 9. Looking south-southwest.

NH-703-23 Span 7. Looking south-southwest.

NH-703-24 South abutment in Newington. Looking south-southwest.

NH-703-25 Close-up view of south abutment, showing connection of truss to concrete abutment. Looking south-southwest.

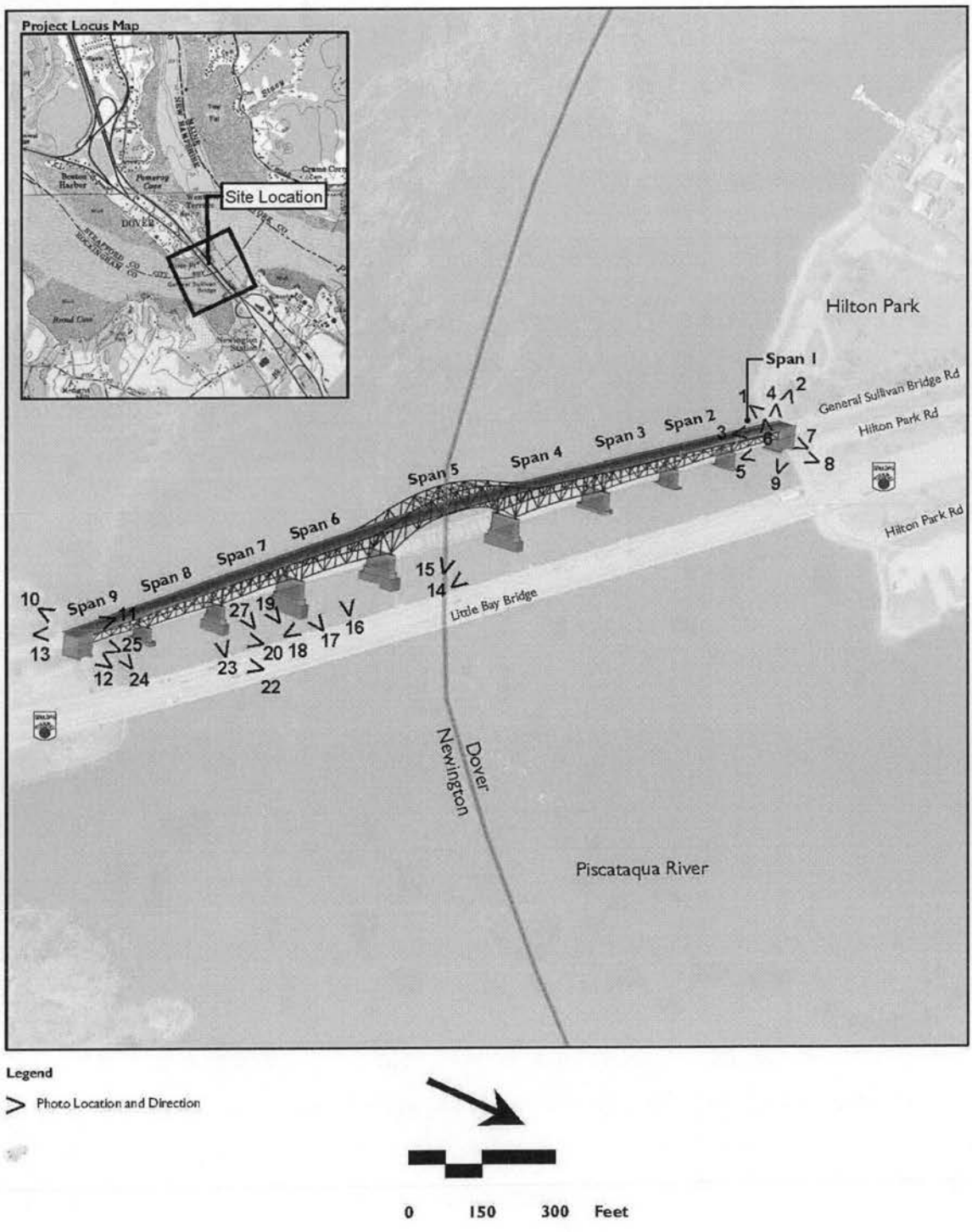


Figure 9. Site Plan and Location of Photos 1 - 25

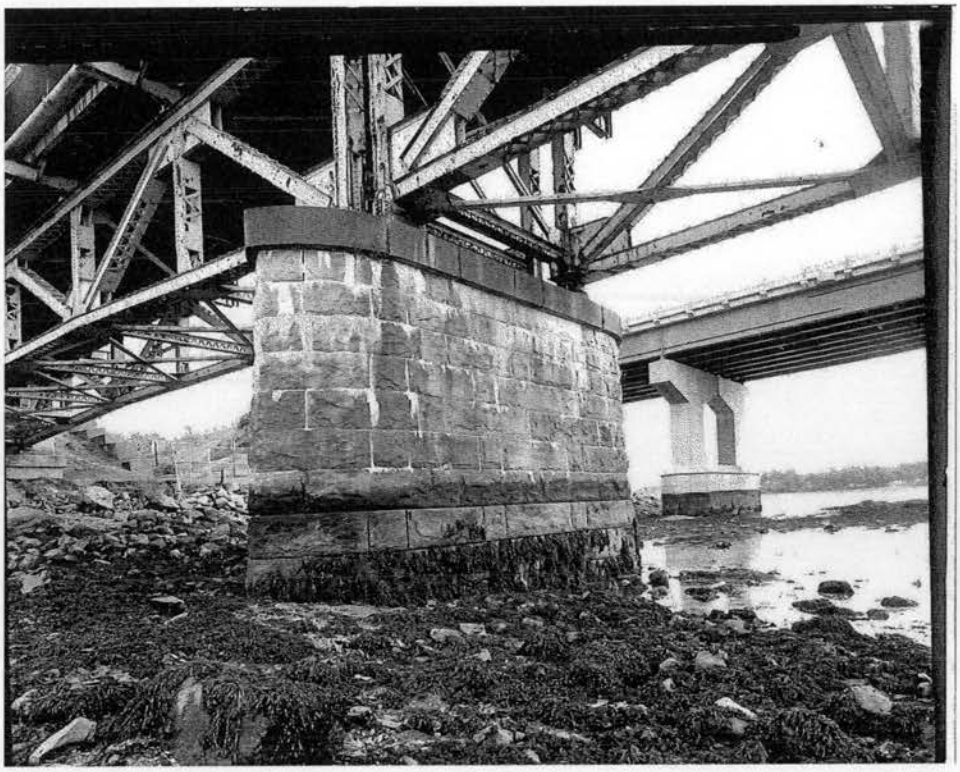


Photo NH-703-1

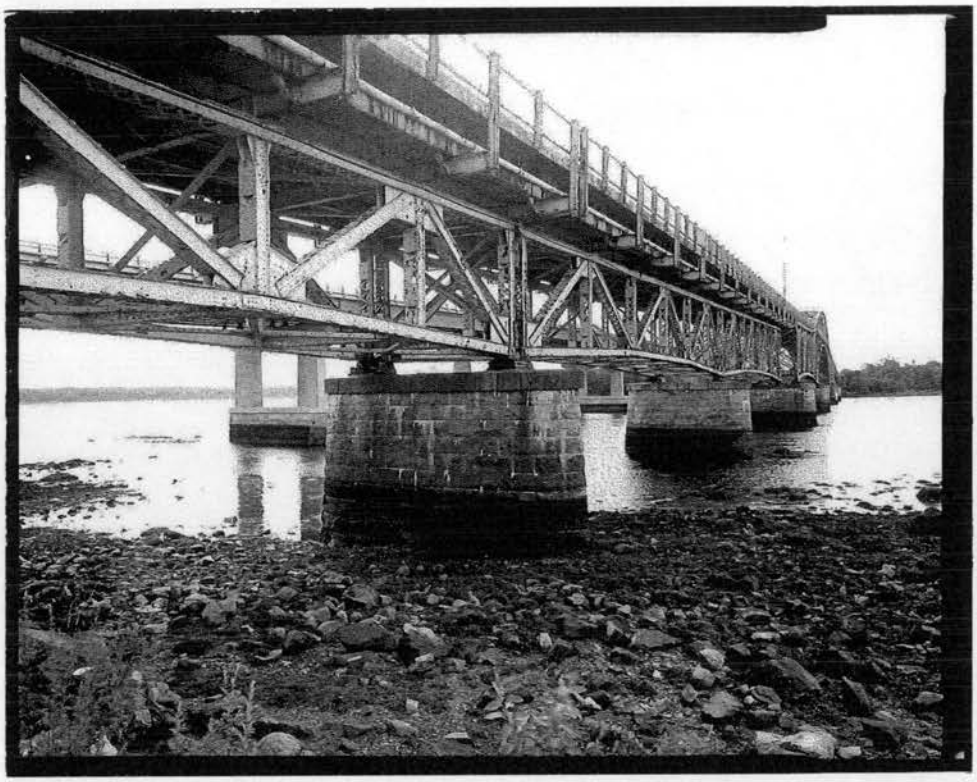


Photo NH-703-2

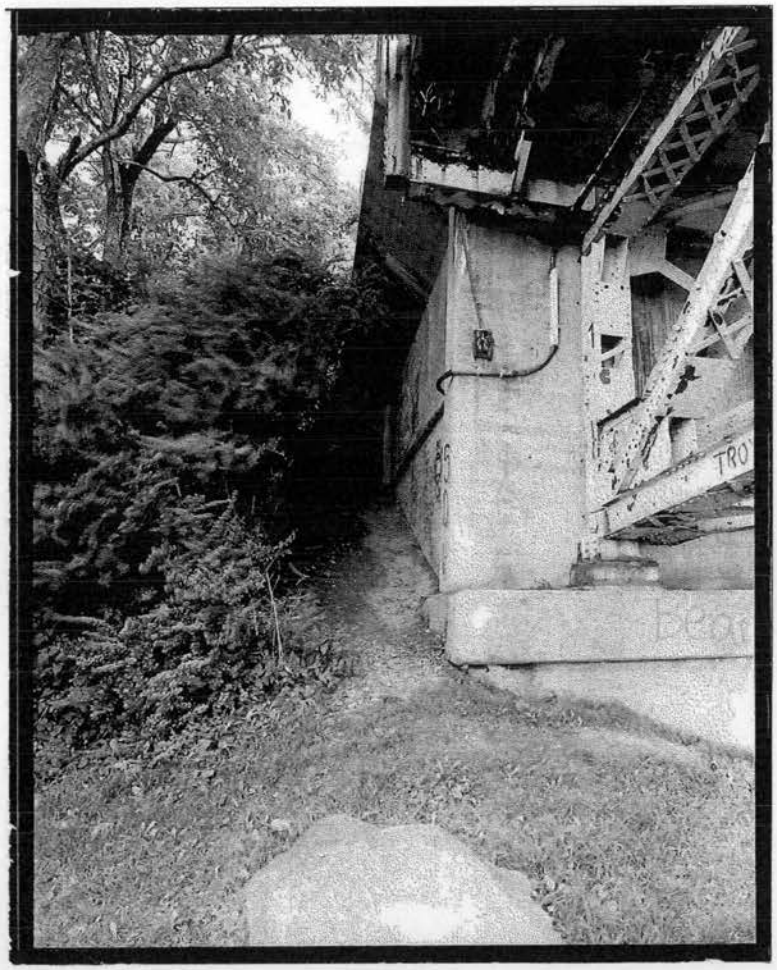
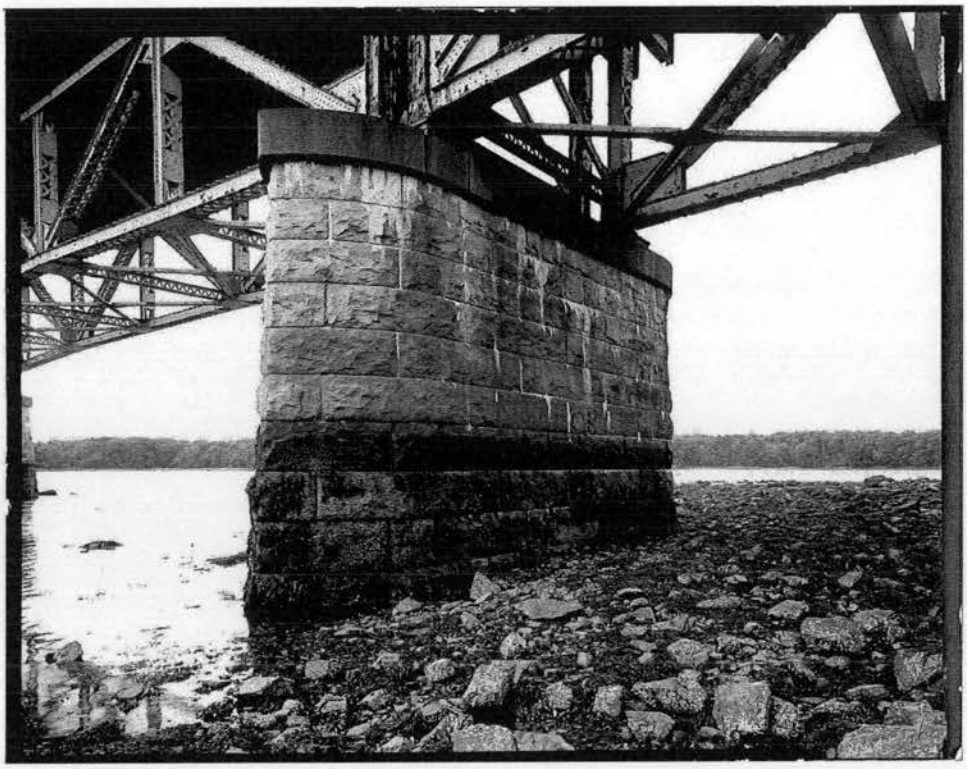


Photo NH-703-3

NH-703-4

NH-703-5

NH-703-6



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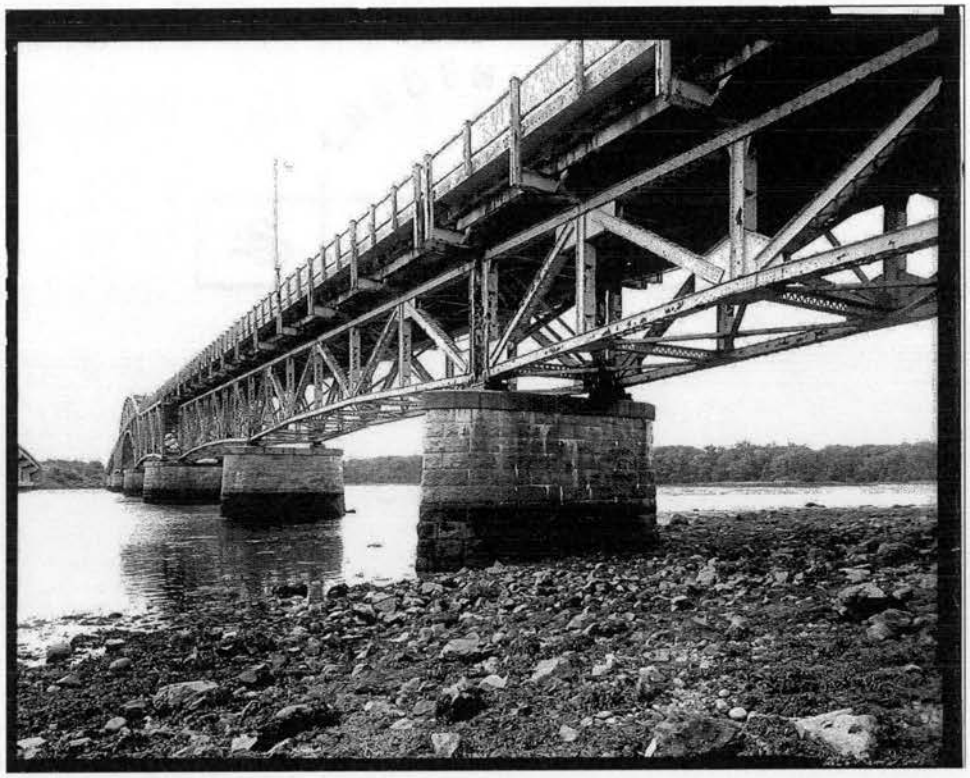

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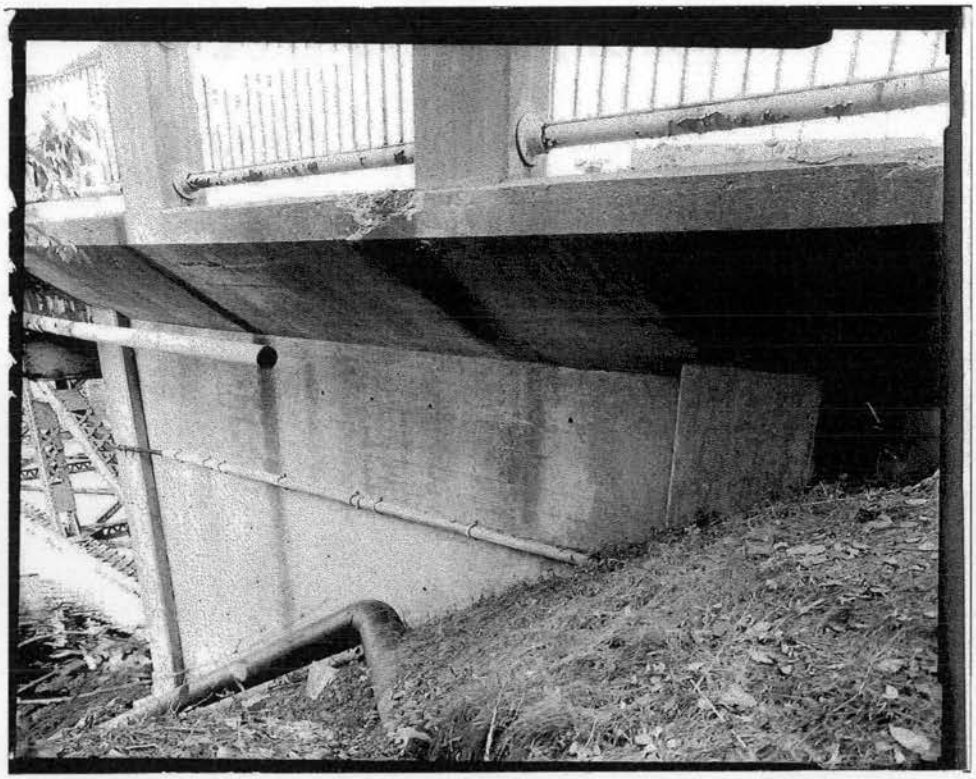
NH-703-9



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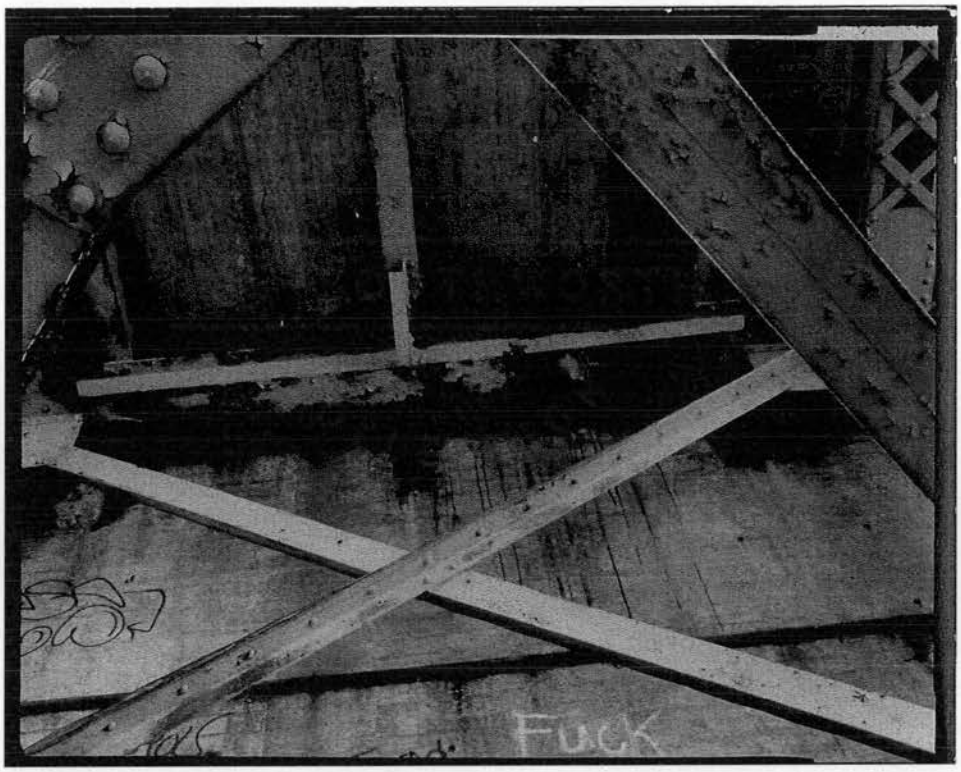

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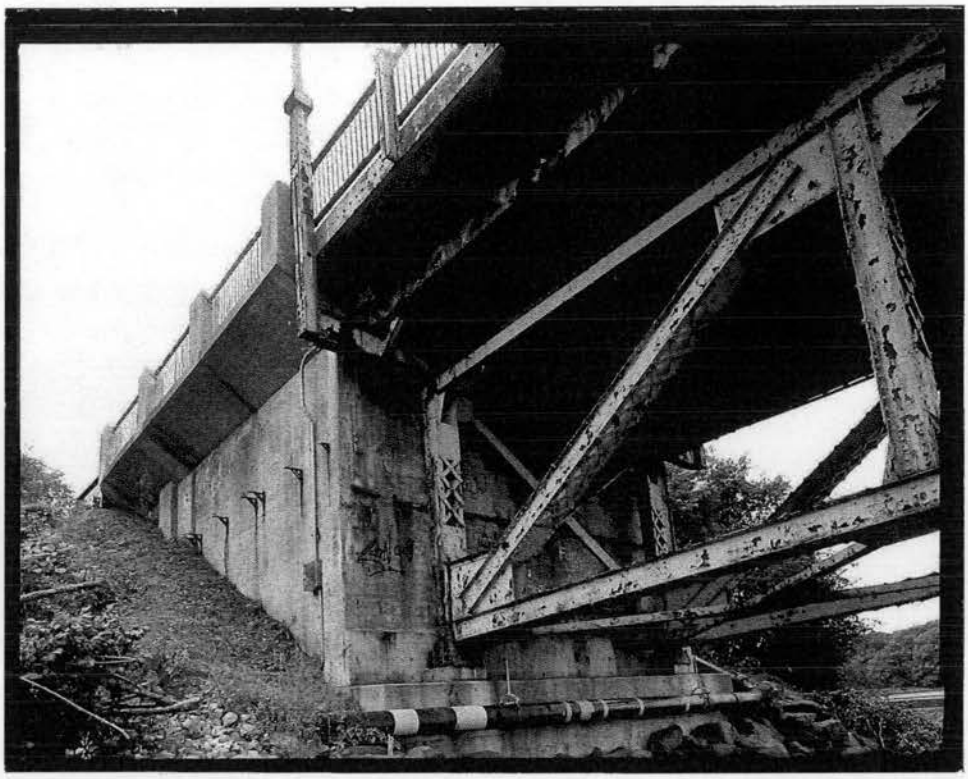

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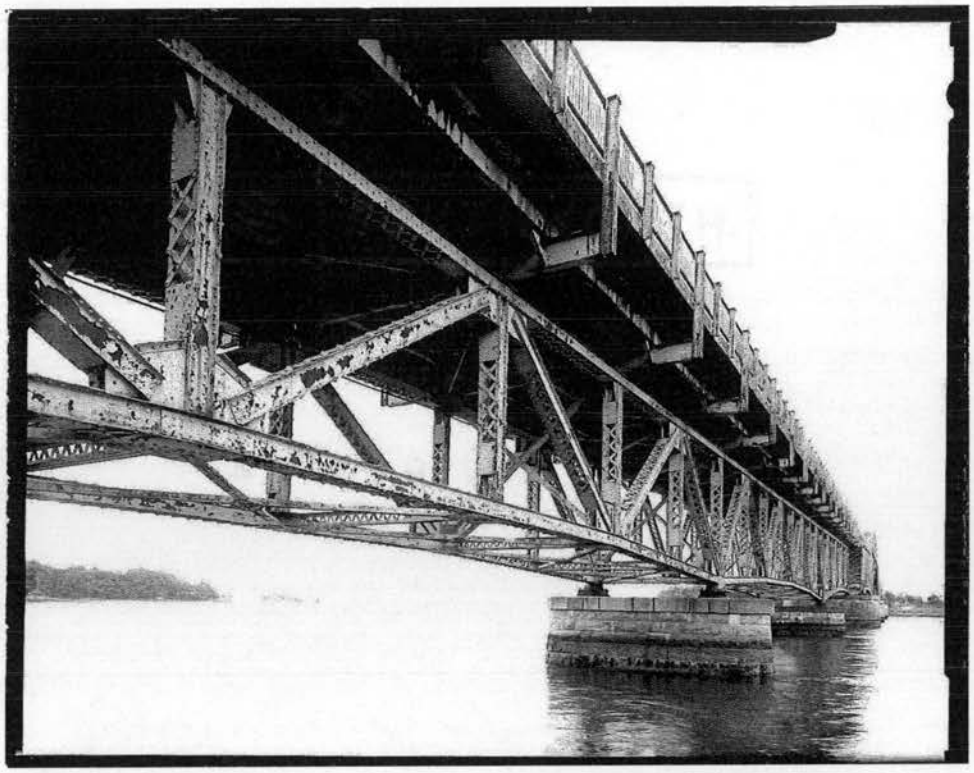

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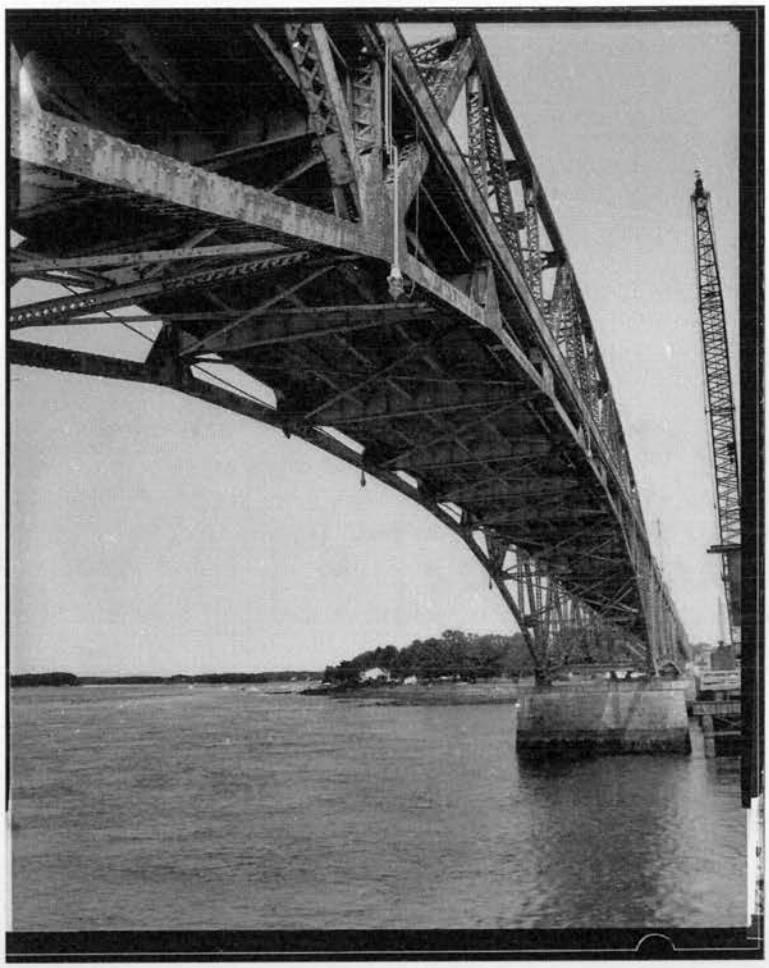

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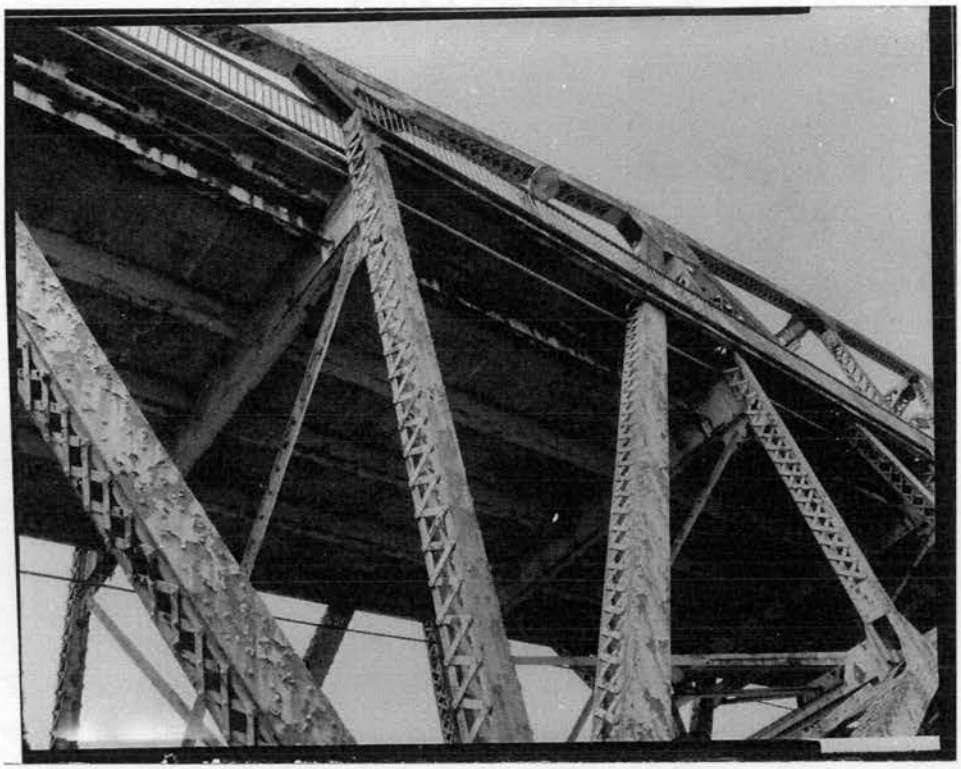

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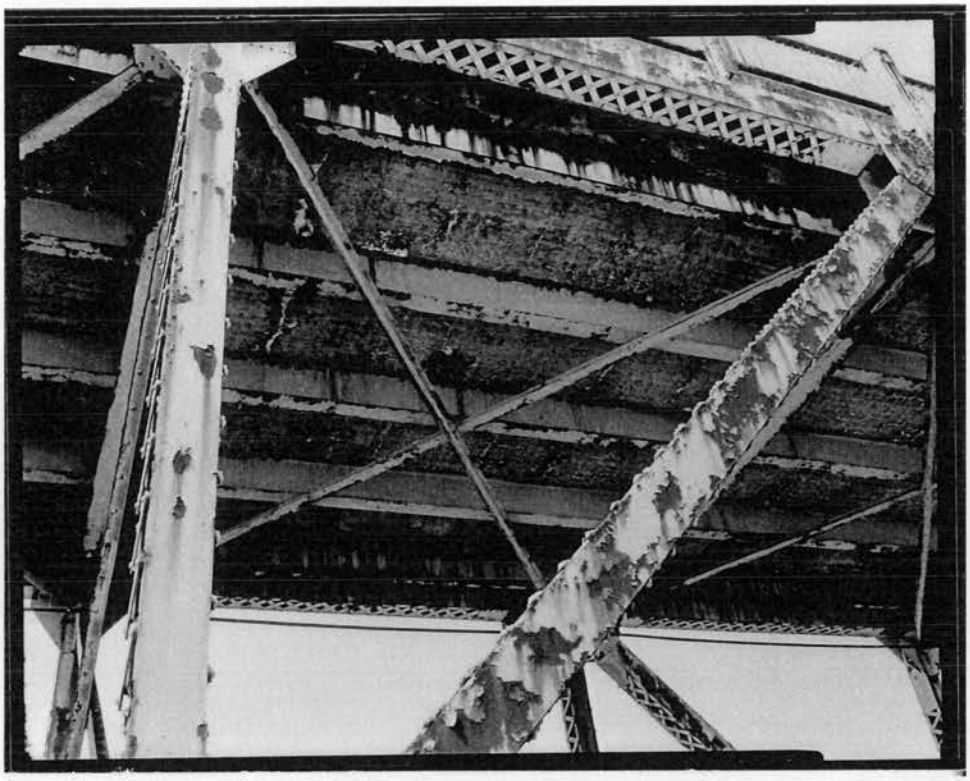

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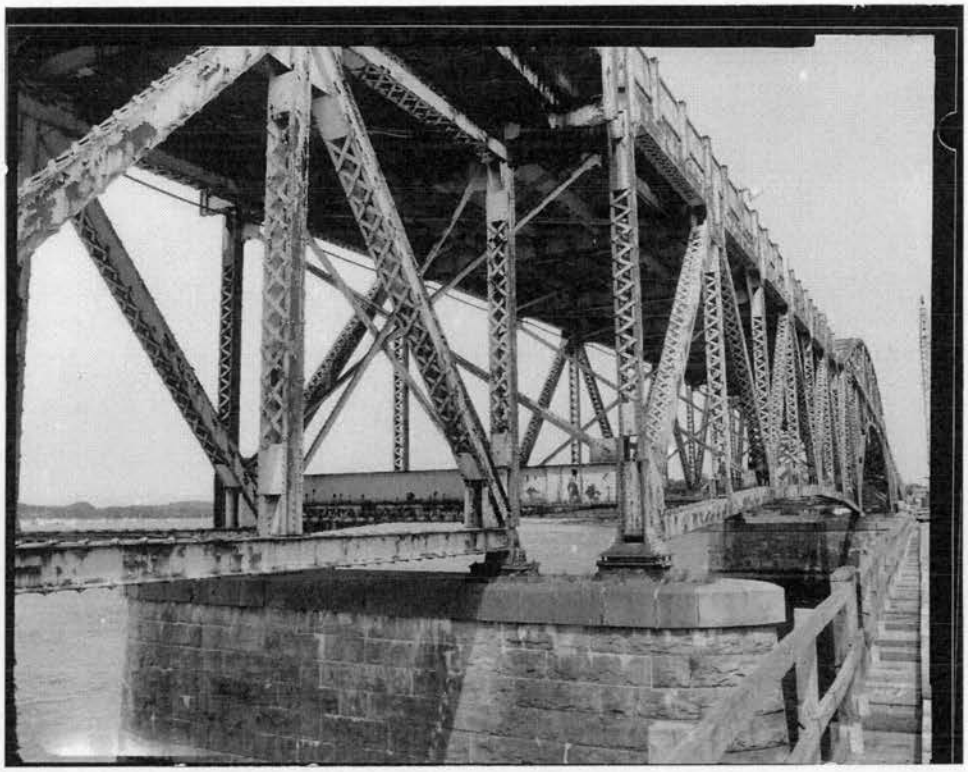
NH-703-17



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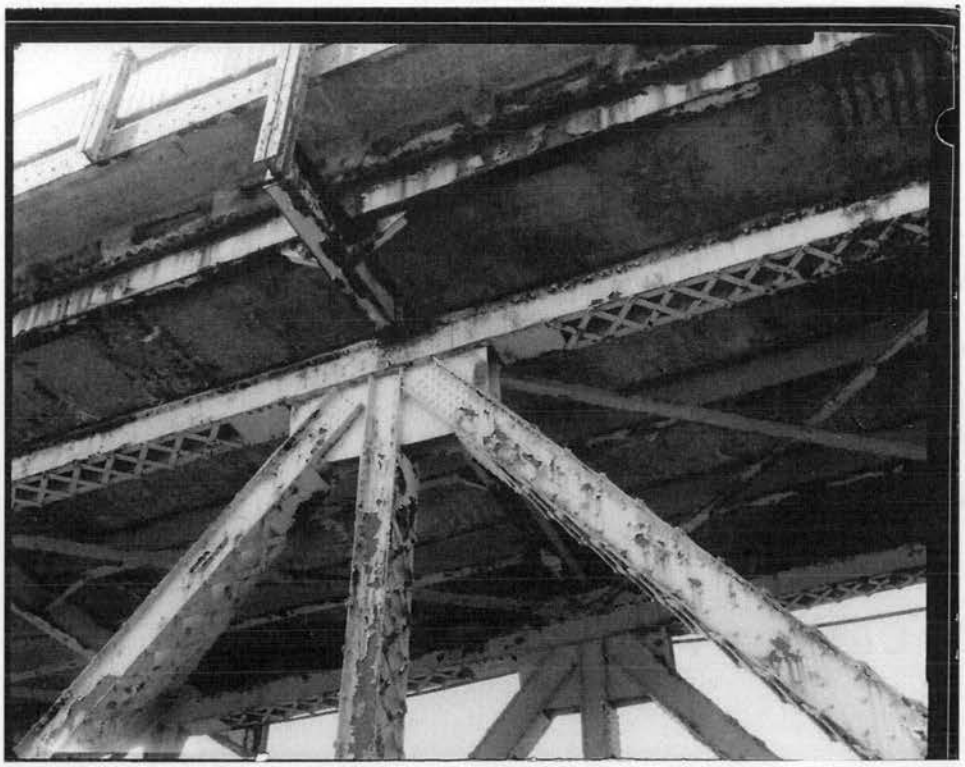
NH-703-21

NH-703-22



NH-703-23

NH-703-24

NH-703-25

THE COMMONWEALTH OF MASSACHUSETTS
MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
10 Park Plaza, Boston, MA

CERTIFIED NARRATIVE

CONSULTANT NAME: Vanasse Hangen Brustlin
INVOICE NO.: 55947-39
CONT. DESCRIPTION: MassDOT Statewide Environmental Permitting Support
CONTRACT NO.: 55947
COMPL. DATE: 06/30/12
PROJECTINFO NO.: 10829
DATES OF SERVICE: FROM: 3/18/2012 TO: 4/14/2012
FEDERAL AID NO.: Non-Federal

Progress Report for Assignment #1
Museum of Fine Arts Individual Section 4(f) Evaluation
Assignment #1 has been completed.

Progress Report for Assignment #2
Northampton Signal and Intersection Improvements Programmatic Section 4(f) Evaluation
Assignment #2 has been completed.

Progress Report for Assignment #3
Development of a USACE PIP for MassDOT Bridges
Assignment #3 is complete.

Progress Report for Assignment #4
100% Plans and PS&E for the Little River Bank Stabilization Project in Westfield
Assignment #4 is complete.

Progress Report for Assignment #5
Intelligent Transportation System Improvements
Assignment #5 is complete.

Progress Report for Assignment #6
Preparation of an ENF for the Westfield Bank Stabilization Project
Assignment #6 is complete.

Progress Report for Assignment #7
Route 128 Highway Medial Soil Project
Assignment #7 is complete.

Progress Report for Assignment #8
Damon Road Drainage Project
Assignment #8 is complete.

Progress Report for Assignment #9
Water Quality Specialist
Assignment # 9 is complete. All further work is being completed under contract #63998

Progress Report for Assignment #10
Preparation of a CE Checklist and Section 4(f) Advisory Opinion for the North Bank Bridge Project
Assignment #10 is complete.

Progress Report for Assignment #11
Mansfield Acoustical Analysis
Assignment #11 is complete.

Progress Report for Assignment #12
Quincy Acoustical Analysis
Assignment #12 is complete.

Progress Report for Assignment #13
University Ave Individual Section 4(f) Evaluation
Assignment #13 is complete

THE COMMONWEALTH OF MASSACHUSETTS
MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
10 Park Plaza, Boston, MA

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Progress Report for Assignment #14
General MEPA/NEPA Services

Assignment #14 is complete

Progress Report for Assignment #15
I-95 Waltham Resurfacing Project ENF
Assignment #15 is complete.

Progress Report for Assignment #16
Two Programmatic Section 4(f) Evaluations
Assignment #16 is complete.

Progress Report for Assignment #17
Major Document Review- ABP
Assignment #17 is complete

Progress Report for Assignment #18
Morton Street Bridge Individual Section 4(f) Evaluation
Assignment #18 is complete

Progress Report for Assignment #19
Drainage Design Improvements - 3 locations
Assignment #19 is complete

Progress Report for Assignment #20
Needham Programmatic Section 4(f) Evaluation
This assignment is complete

Progress Report for Assignment #21
Wayland Programmatic Section 4(f) Evaluation

Assignment #21 is complete

Progress Report for Assignment #22
Northborough - Route 20 Individual Section 4(f) Evaluation
Assignment #22 is complete.

Progress Report for Assignment #23
Methuen Rotary Project - Review of Federal and State Wetland Permits
Assignment #23 is complete.

Progress Report for Assignment #24
Development of a Storm Severity Index

There was no work on this assignment this period.

Progress Report for Assignment #25
Millbury - Dorothy Pond EV Permitting

During this period, VHB continued preparation of the various required environmental permits including the NOI, Section 401/404 permits, and Chapter 91. VHB also completed the preparation of the dredging plans and details for the permit applications.

I hereby certify, under the pains and penalties of perjury, that all costs and all work for which payment is hereby requested have been performed in accordance with the contract terms.

Michael Palewonsky		4/26/2012
CONSULTANT'S NAME	CONSULTANT SIGNATURE	DATE
	Project Manager	
	TITLE	

General Sullivan Bridge
NH State No. 703
Photo No. 1

General Sullivan Bridge
NH State No. 703
Photo No. 2


TRO
Bear

General Sullivan Bridge
NH State No. 703
Photo No. 3


Welcome
to
BELL

General Sullivan Bridge
NH State No. 703
Photo No. 4


MALI 94
CAT
S.D.V.

General Sullivan Bridge
NH State No. 703
Photo No. 5


U.S. PUBLIC WORKS PROJECT
DOCKET No. 752

General Sullivan Bridge
NH State No. 703
Photo No. 6

General Sullivan Bridge
NH State No. 703
Photo No. 7

General Sullivan Bridge
NH State No. 703
Photo No. 8


SDN

General Sullivan Bridge
NH State No. 703
Photo No. 9

General Sullivan Bridge
NH State No. 703
Photo No. 10

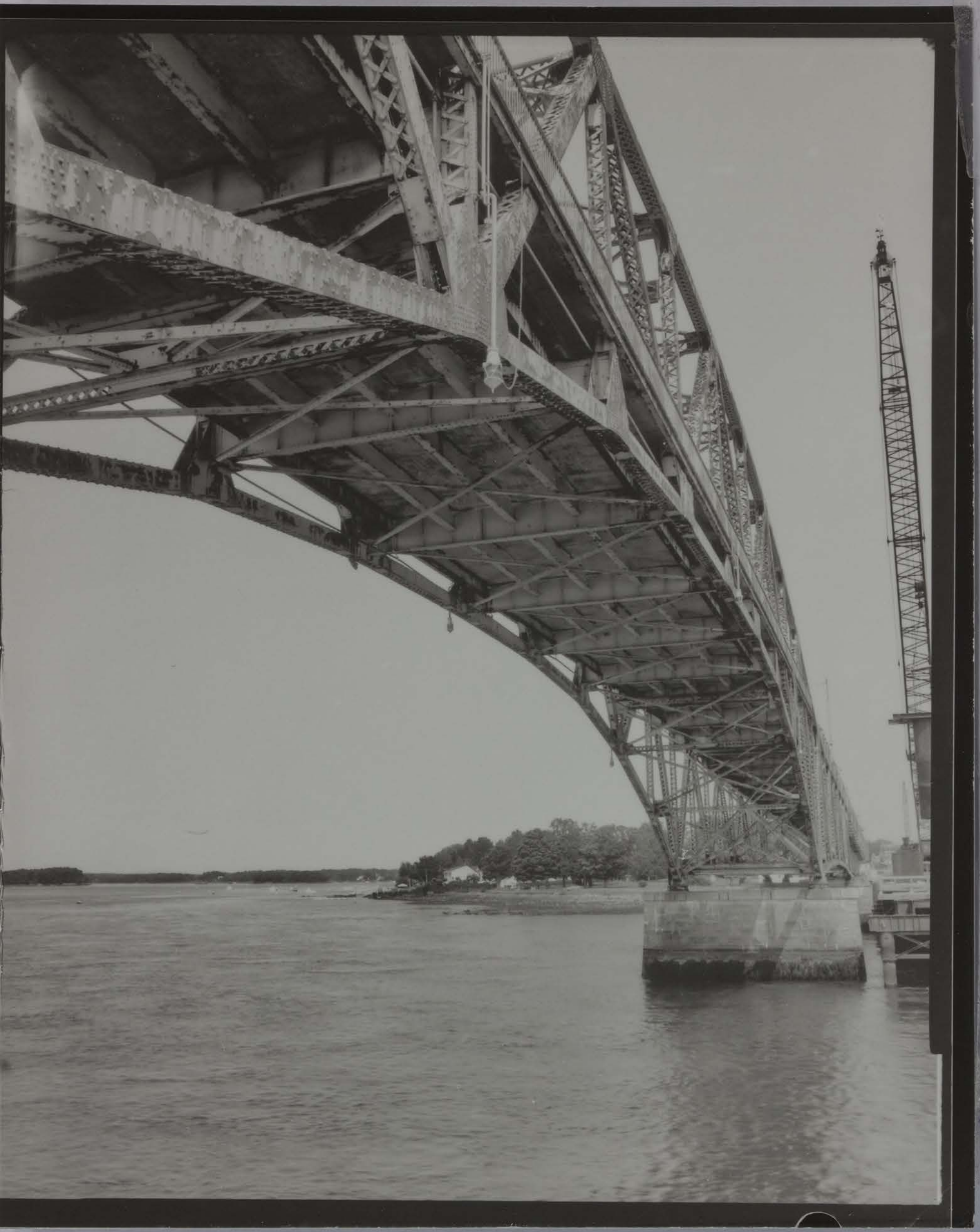

FUCK

General Sullivan Bridge
NH State No. 703
Photo No. 11


Fuck

General Sullivan Bridge
NH State No. 703
Photo No. 12

General Sullivan Bridge
NH State No. 703
Photo No. 13



General Sullivan Bridge
NH State No. 703
Photo No. 14

General Sullivan Bridge
NH State No. 703
Photo No. 15

General Sullivan Bridge
NH State No. 703
Photo No. 16

General Sullivan Bridge
NH State No. 703
Photo No. 17

General Sullivan Bridge
NH State No. 703
Photo No. 18

General Sullivan Bridge
NH State No. 703
Photo No. 19

General Sullivan Bridge
NH State No. 703
Photo No. 20

General Sullivan Bridge
NH State No. 703
Photo No. 21

General Sullivan Bridge
NH State No. 703
Photo No. 22

General Sullivan Bridge
NH State No. 703
Photo No. 23


PYTHON

General Sullivan Bridge
NH State No. 703
Photo No. 24

General Sullivan Bridge
NH State No. 703
Photo No. 25