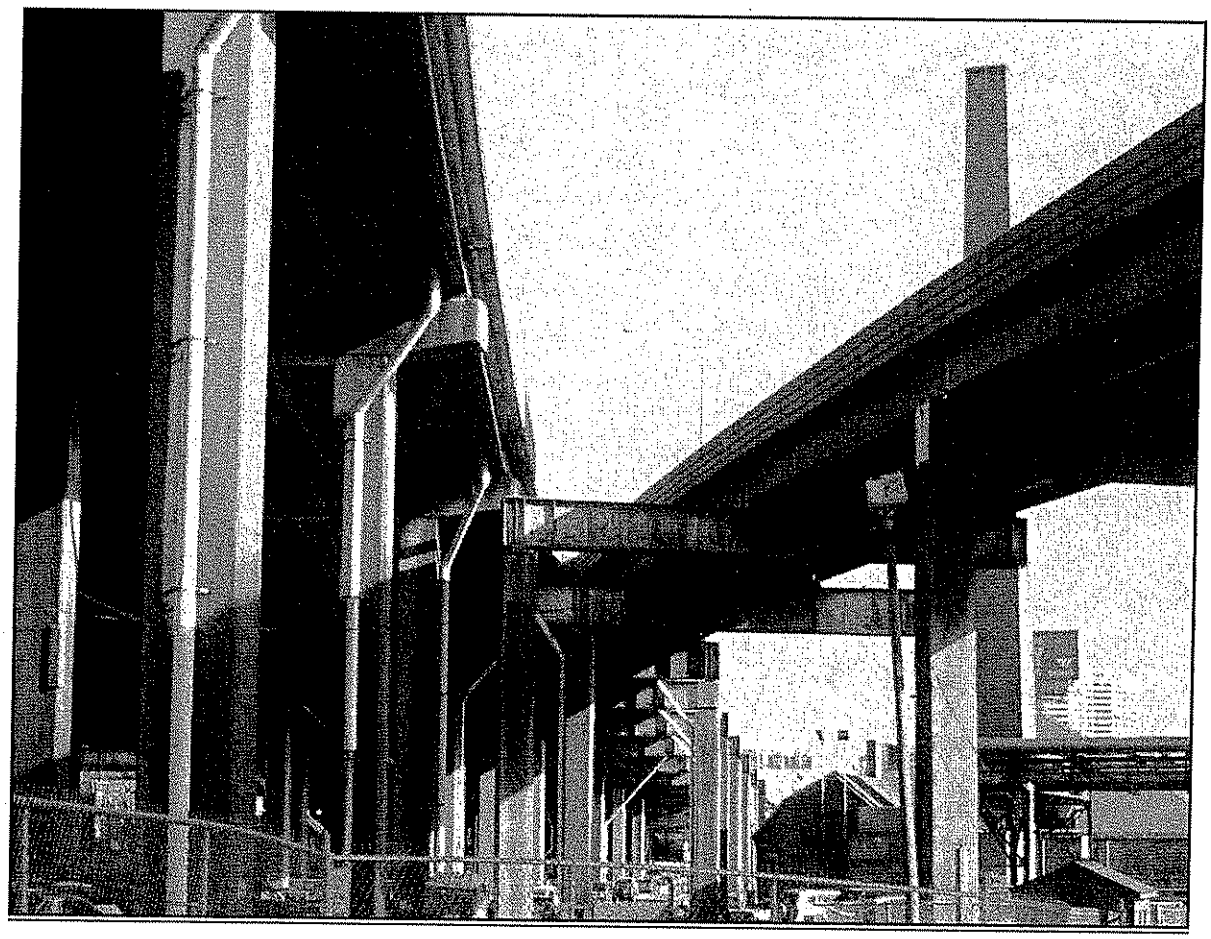
CONNECTICUT
BRIDGES NO. 3160(A, B, C, &D), 3301, 3303, and 3023

A STUDY REPORT FOR THE AETNA VIADUCT



EXCERPTS from the FINAL VERSION

Prepared for:
STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
(*STATE PROJECT No. 63-616*)

Prepared by:
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A. Location Plan

The project limits for this Study include Bridge Nos. 03160A, 03160B, 03160C, 03160D, 03301 and a portion of 03303. Bridge No. 03023 (Sigourney Street) will also be included and addressed as part of this Study Report.

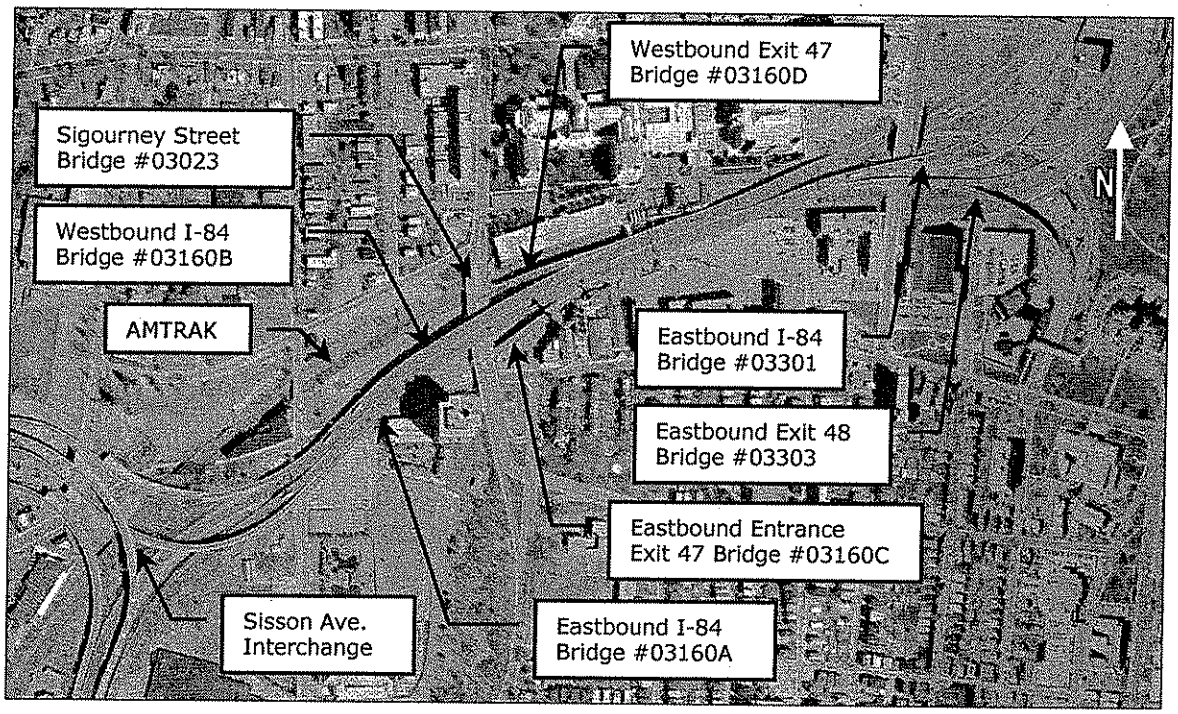


Figure 1 - Aerial Photo of Project Location

B. Introduction

This document is the first phase of Connecticut Department of Transportation Project No. 063-616. This report is intended to provide the Department with a comprehensive structurally based study, which will allow the Department to make management decisions regarding the future allocation of funds relative to the maintenance and serviceability of the structure. The goal is to recommend a feasible, cost effective, and constructible solution to rehabilitate this deteriorating, heavily traveled bridge. Future roadway capacity and serviceability issues, beyond construction impacts, will not be addressed in this Study. Although this report addresses some design parameters and presents options for the future phases, the design of the desired alternative will be performed in subsequent phases of this project.

This Study Report identifies existing deficiencies, short-term repairs required, and evaluates long-term options available to the Department. A range of options from minor rehabilitation to full replacement have been evaluated in terms of cost, schedule, service life, constructability and safety. Due to funding constraints, it is expected that the Department will focus on rehabilitation strategies that extend the service life by 10 years, reduce annual maintenance, and provide a design and construction window for a replacement structure.

The mainline of the Aetna Viaduct carries Interstate I-84 over Amtrak Railroad, parking lots and city streets in Hartford, Connecticut. Bridge No. 03160A (I-84 eastbound) consists of 44 simply supported spans and Bridge No. 03160B (I-84 westbound) consists of 42 simply supported spans. Each structure carries three lanes of mainline I-84 through traffic as well as various operational exit and entrance lanes. This steel multi-girder structure was built in 1965 and has an overall length of approximately 3,200 feet.

Bridge No. 03160C carries the Sigourney Street on-ramp to I-84 eastbound and Bridge No. 03160D carries the I-84 westbound off-ramp to Sigourney Street. In order to include structure limits from abutment to abutment, this project will also include Bridge No. 03301 and a portion of Bridge No. 03303 (I-84 eastbound off-ramps at Asylum Street and Capitol Avenue).

The Sigourney Street Bridge (Bridge No. 03023) runs perpendicular and below the mainline of the Aetna Viaduct (Bridge Nos. 03160A and 03160B). This bridge structure also acts as the final support for the Sigourney Street on-ramp to I-84 eastbound (Bridge No. 03160C) and the I-84 westbound off-ramp to Sigourney Street (Bridge No. 03160D). The project location is as shown in Figure 1.

At this time no safety improvements are deemed necessary. The existing fascia and median parapets were modified in 1999 as part of project 63-565.

The Aetna Viaduct Structure does not possess historical or engineering distinction and is unlikely to be considered a historically significant structure. Therefore it is unlikely that rehabilitation or replacement would be subject to restrictions imposed by the State Historic Preservation Office (SHPO). Nonetheless, the SHPO should be granted the opportunity to preserve existing contract plans in the event that the structure is replaced subsequent to this report.

The bridge is of variable width cross section due to traffic exiting and entering the roadway. The bridge critical cross section is in the eastbound direction where three (3) lanes are provided entering Bridge 03160A and again on Bridge 03301. At this point the roadway width is 42′ from curb to curb. Three (3)-12′ lanes are provided with a 2′ left shoulder and a 4′ right shoulder. These shoulder widths are substandard per the Department's current Highway Design Manual (2003 Edition).

The bridge is of variable vertical clearance. Over the railroad, the cap beams do not meet the recommended 23′ vertical clearance. Over local roadways the minimum vertical clearance has been documented as 13′ over Flower Street, in the Bridge Inspection Reports, which is below the recommended 14′-3″.

The posted speed limit through the project limits is 55mph. Current AADT has not been specifically documented for the main line of I-84 through the project limits, but the nearest continuous count station in West Hartford shows the average weekday daily traffic is 126,300 vehicles. The count station referenced is 0.15 miles west of Eastbound Exit 44. Previous reports for the Aetna Viaduct indicated traffic volumes as high as 172,000 ADT in 2001, but no historical data has been found to support this number.

C. Executive Summary

This study report has been prepared to identify existing deficiencies, recommend short-term repairs, and evaluate long-term options available for the Aetna Viaduct. The mainline of the Aetna Viaduct carries Interstate I-84 over Amtrak Railroad, parking lots and city streets in Hartford, Connecticut. The primary structures that make up the viaduct are Bridge No. 03160A (I-84 eastbound), which consists of 44 simply supported spans and Bridge No. 03160B (I-84 westbound), which consists of 42 simply supported spans. Each structure carries three lanes of mainline I-84 through traffic as well as various operational exit and entrance lanes. This steel multi-girder structure was built in 1965 and has an overall length of approximately 3,200 feet.

CONDITION

Current Bridge Safety Inspection Reports rate the Aetna Viaduct in fair to poor condition. The Documented condition ratings are as follows:

Bridge No. (Report Date)	Numerical Rating		
	Deck	Superstructure	Substructure
03160A (9/22/2004)	4-Poor	5-Fair	4-Poor
03160B (11/11/2004)	4-Poor	4-Poor	4-Poor
03160C (10/16/2004)	7-Good	5-Fair	5-Fair
03160D (10/18/2004)	6-Satisfactory	5-Fair	4-Poor
03301 (4/3/2005)	6-Satisfactory	5-Fair	6-Satisfactory
03303 (10/1/2004)	6-Satisfactory	6-Satisfactory	5-Fair
03023 (6/20/2003)	4-Poor	6-Satisfactory	4-Poor

Primary areas of bridge deck deterioration are the deck ends and the area along the median. Currently the asphaltic plug joints leak throughout, which has caused deterioration to underlying structural elements. In addition to the deterioration to the deck ends, Maintenance Department personnel have noted that extensive bridge deck patching is required on an annual basis.

Deterioration of superstructure and substructure elements is primarily the result of the leaking deck joints. Areas where deterioration is most prevalent are the bearing areas of the stringers and the top flanges of the structural steel cap beams. The paint system has largely failed in these areas and offers little protection to the structural steel.

EVALUATION & ANALYSIS

Existing load ratings are on file with the Department of Bridge Safety and Evaluation. The inventory rating of the main line structures is governed by Bridge 03160B, for which the HS-20 inventory rating is 32 tons. The operating rating of this structure is 53 tons. The governing member for the main line structures is the 3-span group of pin and hanger stringers over Sigourney Street (Spans 11 through 13). Strengthening of the members of this structure group should be performed to restore the inventory rating to 36 tons.

Additional evaluation of the existing structural elements was performed to determine the extent of load carrying capacity of the structure during special construction cases necessary for the completion of work noted in this report. The results of the analysis indicate that the structure is capable of supporting structural loading for the recommended rehabilitation alternatives without supplemental structural support. For other alternatives, including complete deck replacement, supplemental structural support would be necessary. Staged deck construction would be governed by lane layout limitations and may require the inclusion of temporary deck supports.

The primary difficulties and constructability issues associated with the rehabilitation or replacement of the viaduct come from the following facilities:

- Sisson Avenue (Exit 46) Interchange
- Cogeneration Facility South of the Structure at Sigourney Street (Adjacent to the Exit 47 on Ramp)
- Amtrak Railroad
- Proposed New Britain – Hartford Busway
- Park River Conduit
- Tie in to Existing Bridges 01765 and 01766 (I-84 East of Asylum Ave)
- Parking Facilities below the viaduct
- Existing structure width
- Traffic volume
- Percentage of Heavy Vehicles during off peak hours
- Weekend Evening Traffic Volume

Extensive attention to traffic related concerns is mandatory during the Preliminary Design and Final Design Phases subsequent to this report. A traffic study is recommended to aid the designer in determining and best addressing traffic concerns.

As part of this study report, baseline levels of service were calculated for I-84 mainline to determine approximate current conditions and conditions

under a two lane operation. Results indicate that the mainline; three (3) lanes of traffic, presently operates at very congested levels as calculated values of "E" were obtained for the year 2002 for an average day of traffic. A capacity analysis was conducted for a two-lane operation, closing one lane during construction. Results as anticipated reflect a failure of the highway segment. Off peak analyses were conducted to determine approximate levels of service. For off peak conditions during the evening hours of 6pm to 6am, for a three lane configuration results in a level of service of "C". Closing one lane on I-84 for a two-lane operation would result in an approximate level of service of "D".

Nightly construction activities for the Viaduct should be carried out Monday through Thursday between the hours of approximately 6 pm to 6 am. Additional analysis in design is recommended to determine specific work periods and other additional periods that may be suitable. It is recommended that during final design that an in depth traffic and cost benefit analysis be conducted to ascertain the most economically prudent staging option.

RECOMMENDATIONS

The Department should begin preliminary and final design for the short-term repair of the Aetna Viaduct Structures. Since the bridge deck at the joint locations is the primary area where deficiencies are noted, the Department should focus short-term rehabilitation efforts in this area. Bridge deck deterioration requires constant attention of the ConnDOT - District 1 - Maintenance Department. Currently, the expenditures on the viaduct are very high. Rehabilitation is recommended to preserve the current condition for such time as is necessary to design and construct a replacement structure.

The short-term rehabilitation should focus on Partial Deck Replacement and Patching of the bridge deck. The following primary items of work should be included; other recommendations are included in Section I (Conclusions and Recommendations) of this report.

- Perform Partial and Full Depth Patching of the Bridge Deck for Structures 3160A, B, C & D.
- Perform Partial and Full Depth Patching of the Bridge Deck for Structure 3301 and the adjacent end of Bridge 3303.
- Replace the Deck Ends for Structures 3160A & B using precast concrete methods.
- Replace the Median and Parapets on Structures 3301 and 3160A, B, C, & D using cast-in-place concrete methods. As part of this work, widening should be performed to the extent possible without requiring additional substructure.
- Replace the deck adjacent to the median and parapets using cast-in-place concrete methods.

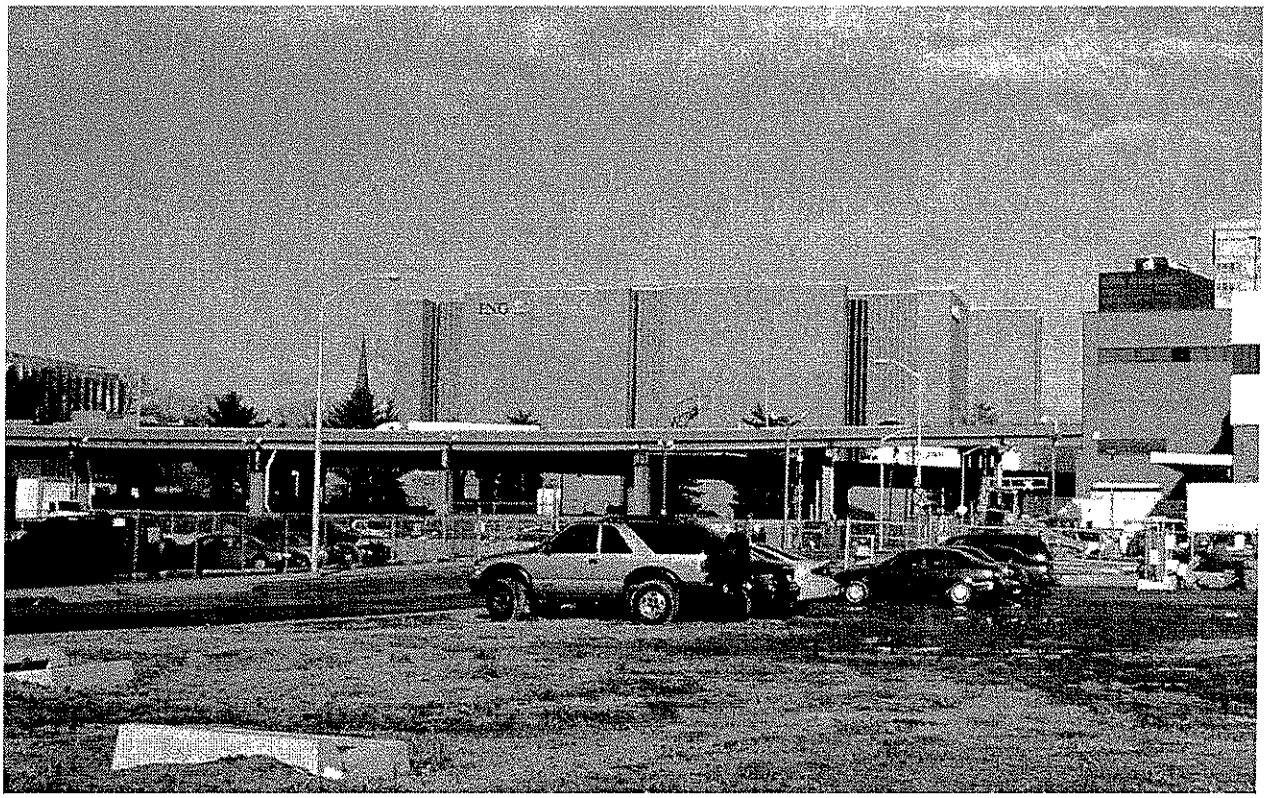
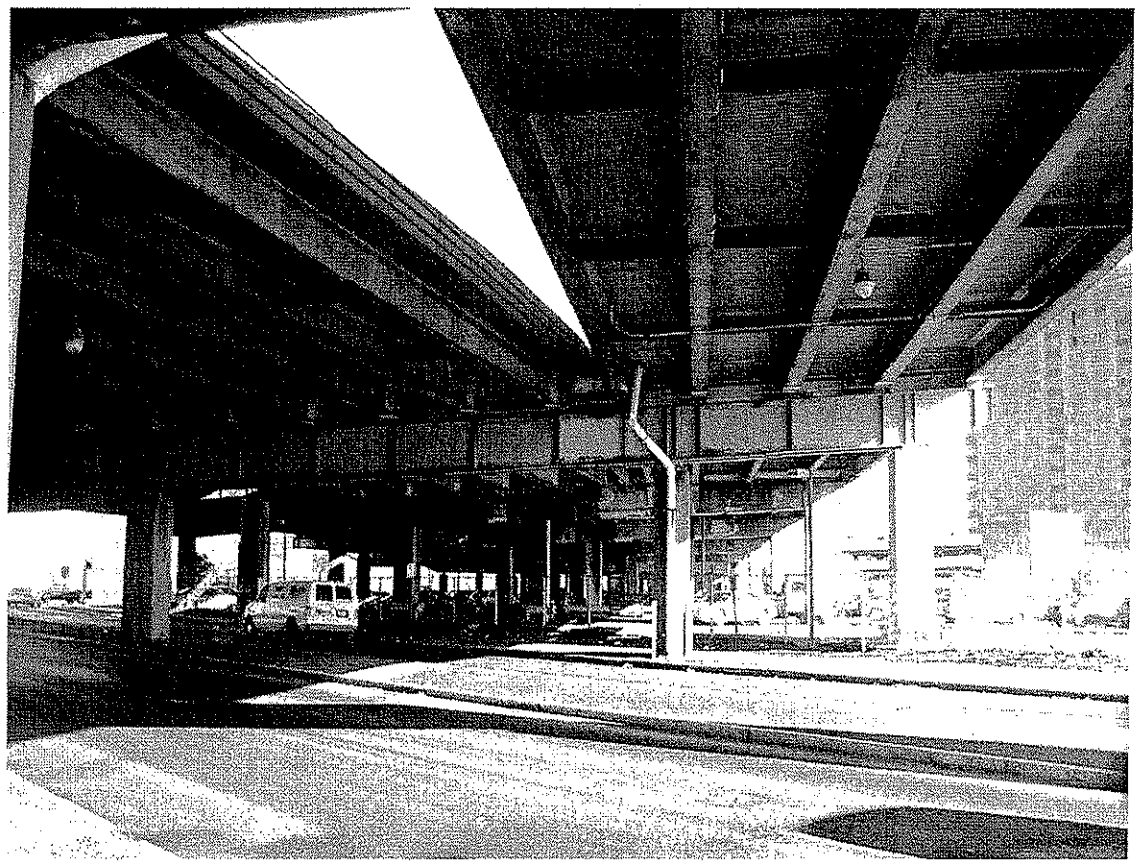
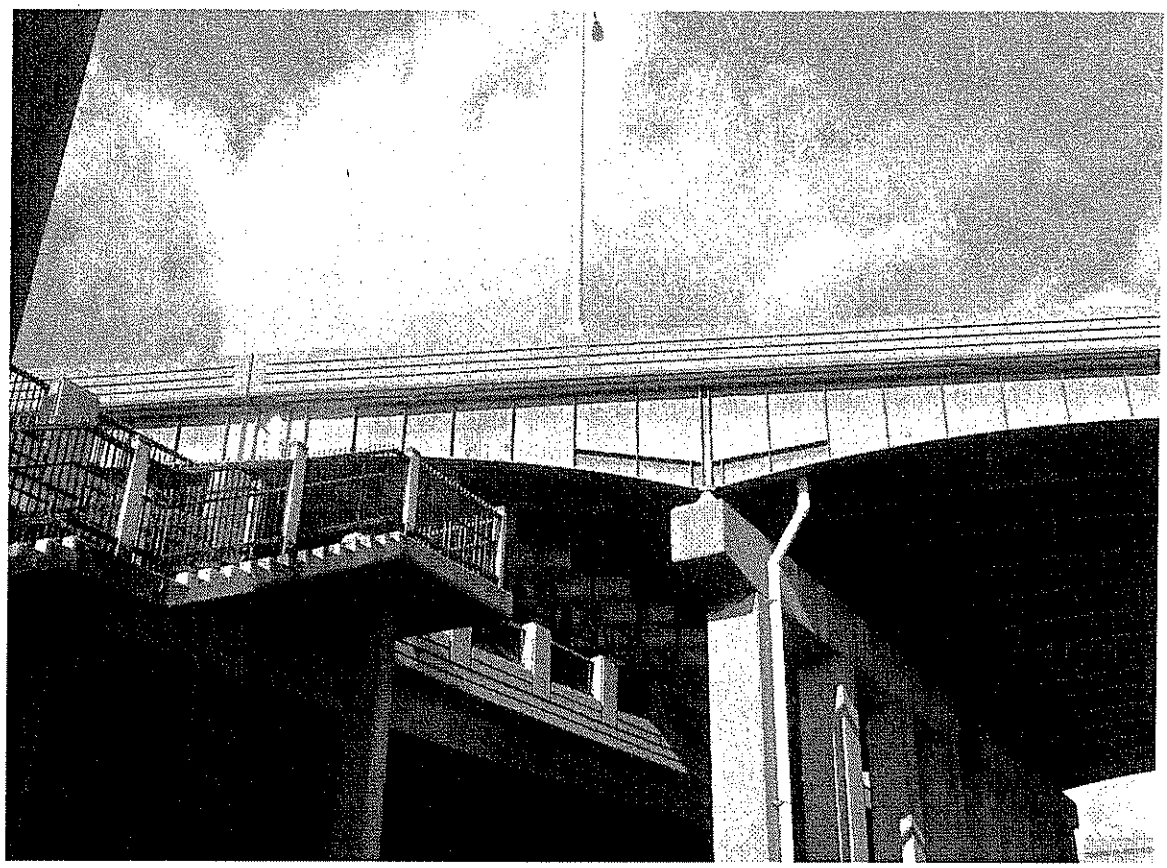
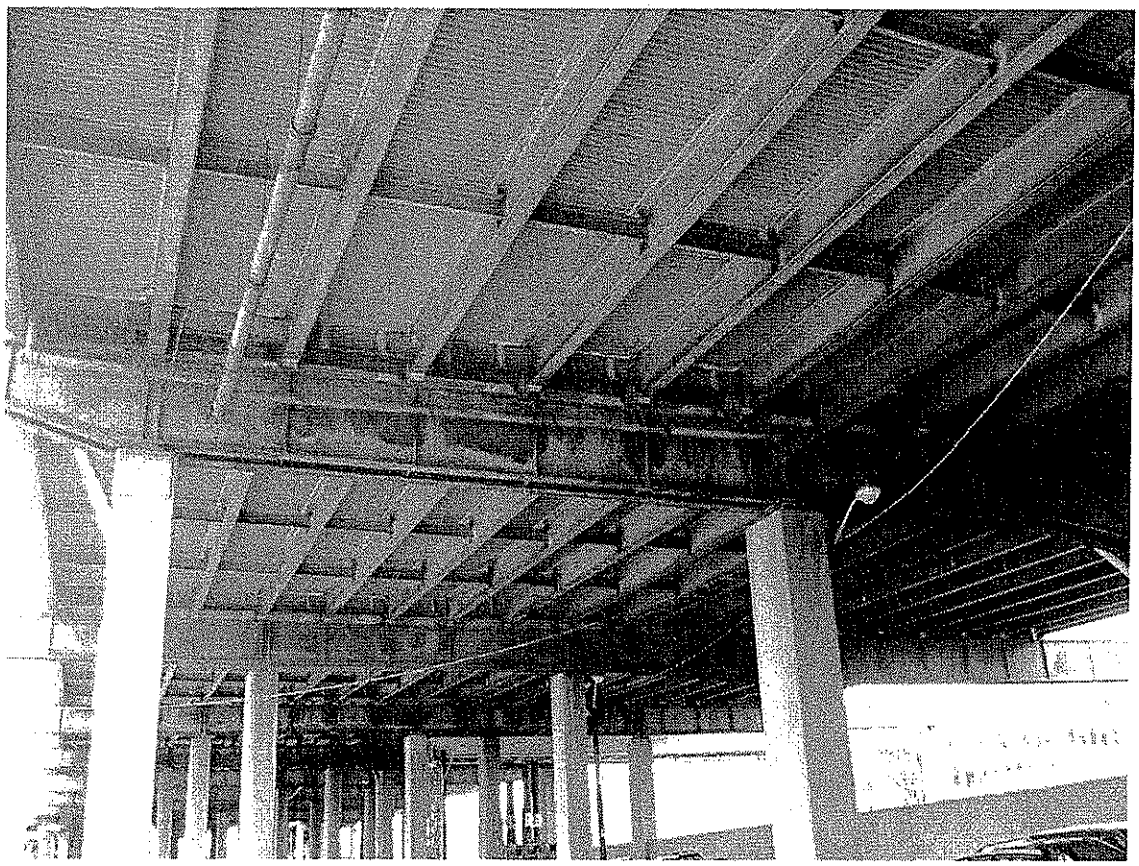
- Install a Waterproofing Membrane and place a minimum 2.5" thick Superpave Overlay on the deck of all structures.
- Rehabilitate the deteriorated structural steel pier caps, stringers, and end diaphragms adjacent to the joints as noted under 'Short Term Repairs'.
- Abrasive Blast Clean and Field Paint structural steel for Bridges 3301 and 3160A, B, C, & D in selected areas to halt further deterioration.
- Replace all deck joints using asphaltic plug joints that incorporate a lateral drain for the removal of accumulated moisture between the deck and the overlay.
- Replace the bridge deck drainage scuppers.
- Replace the Highway Illumination System
- Replace the Overhead Sign Structures
- Rehabilitate the Structural Steel over Sigourney Street to meet a minimum HS20 load rating.
- Develop highly detailed and thorough traffic control plans for the Maintenance and Protection of Traffic during construction.
- Develop highly detailed and restrictive special provisions to guide the Contractor's operations as they relate to the Maintenance and Protection of Traffic and user issues.

As part of final design, inclusion of the following items of work were also requested by the Department:

- Replace the bridge drainage downspouts.
- Provide Bird Netting below all spans.

CONCLUSIONS

The use of innovative rapid construction techniques should be considered to minimize user costs associated with limitations on lane width and the number of travel lanes available during construction. Anticipated user costs associated with construction delays should be determined during Preliminary Design. In most cases, the creation of construction work zones will require narrow travel lanes and restrict traffic, resulting in long queues during peak hours. Thus, construction during peak hours should be limited. The use of temporary deck panels may be required to permit the restoration of a minimum of three (3) active travel lanes during peak hours.

A long-term strategy for replacement of the viaduct structures, with an emphasis on alternative facilities improvement and a general upgrade of the transportation system through the greater Hartford region, should be developed and implementation should proceed within the next 10-15 years. Structure replacement would be, at this time, limited by the existing conditions at either end of the Viaduct, specifically the Sisson Avenue Interchange at the west end of the Viaduct and the horizontal roadway curves on Bridges 01765 and 01766 east of the Viaduct.

The section of I-84 viaduct traffic to be rehabilitated is in the heart of Hartford with ramp exits to the Capitol building and major work centers in downtown Hartford. Reconstruction will be a particularly challenging project from the standpoint of traffic maintenance. This section of highway has extremely high volumes, high speeds, high truck percentages, and entering and exiting roadways. Safety, economic and pollution issues need to be thoroughly addressed in any planned reconstruction of this section of I-84.