December 9, 2015

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Martha Q Keenan
Capital Improvement Program Manager
Burlington Public Works Department
645 Pine Street
Burlington, VT 05402
(802) 540-0701

Re: Bike Path Bridge over the North Beach Access Road
Field Review and Assessment Report

Dear Martha,

At your request, Hoyle, Tanner, & Associates (Hoyle, Tanner) performed a field assessment of Island Line Trail (Burlington Bike Path) Bridge over the North Beach Access Road. This report summarizes our findings and recommendations for the structure based on the understanding that a replacement bridge is scheduled to be constructed within the next five years.

Background:

The bridge is a single-span concrete slab superstructure with a span length of approximately 12 feet. The bridge carries the Island Line Trail over the North Beach Access Road and is oriented primarily in a North-South direction. The bridge has a 9 foot traveled way servicing primarily pedestrian and bicycle traffic. The path and bridge also serve utility and emergency vehicular traffic, the largest of which being a 53,220-lb GVW Truck used by Burlington Electric Department, and a Fire Truck with an 18,900-lb axle weight.

Site Visit Findings:

The bridge has varying levels of deterioration or damage to each component of its structure. The majority of the deterioration to the structural components would require extensive work to repair and may not be practical from a cost perspective when considering the current schedule for the replacement of this structure, but may be required if the existing structure is to remain in use beyond 2019. Hoyle, Tanner performed a hammer sounding investigation at the exposed surfaces of the bridge, including; North and South Abutment Walls and Wingwalls and on the underside of the superstructure. The purpose of this sounding was to get a general understanding of the structural issues on the bridge, and not for a detailed concrete inspection/mapping.

Bridge Deck

Underside: Efflorescence is visible at longitudinal cracks which are evenly distributed throughout the underside of the deck. This indicates that water is migrating through the deck section. Delamination and spalling was found at the east and west ends of the deck, partially exposing embedded steel rails at both ends.

General locations of delaminated/spalled concrete on the underside of the bridge deck were identified during the site visit (reference Detail 2 on Sheet S-1 in Appendix A).

Bridge Faces: The east and west faces of the deck have significant spalling and erosion of the concrete deck slab (reference Photo 2 in Appendix B). This issue appears to be associated with surface drainage from the bike path

Bridge Deck Recommendations

Though the existing concrete bridge deck is in relatively poor condition, it did not show visible signs of structural distress. The end bearing condition appears sound, and there was no visible sag in the slab span. However, the spalling concrete does present a safety hazard for pedestrians and vehicles passing under the bridge with overhead falling concrete. We recommend the following (budgetary costs are summarized later in this report):

- Remove loose concrete on all surfaces of the bridge structure by use of hydrodemolition (hydroblasting).
- Exposed concrete surfaces should be sealed with Sika FerroGard 908 or equivalent sealer/corrosion inhibitor product.
- Patching of larger voids including the west curb line where it meets the bridge slab should be considered. Incorporate weep holes to allow for water to relieve from behind the curb line.
- Bike path drainage should be diverted away from sheeting over the bridge structure to stone lined swales located beyond the limits of the wingwalls (4 in total).

Abutments

North Abutment: The north abutment was found to have spalled concrete along the toe of the wall. A vertical crack, located at the abutment's midpoint, extends from the top to the toe of the wall (reference Photo 5 in Appendix B). Sounding revealed spalling has occured at the top of the abutment wall/deck bearing. (Reference Sheet S-2 in Appendix A for general locations)

South Abutment: The south abutment was found to have spalled concrete along the toe of the wall. Sounding revealed spalling has occured at the top of the abutment wall/deck bearing (Reference Sheet S-2 in Appendix A for general locations).

Abutment Recommendations

The abutments are in relatively good condition and did not show visible signs of structural distress. However, both abutments have spalling at the wall/deck bearing which may cause future bearing issues. We recommend the following:

- Continue to monitor the North Abutment crack and development of future concrete spalling/delamination
- Remove loose concrete on all surfaces of the substructure by use of hydrodemolition (hydroblasting)
- Remove spalled concrete and patch with vertical patching material. (Steel bar dowel anchors may be necessary with patching repair.)

Wingwalls

Deflections were measured along each of the wingwalls using a laser level to determine the plumbness of each wall (Reference Sheet S-2 in Appendix A for results).

Northeast Wingwall: The northeast wingwall has significant spalling at the wall cap. The wall is in a generally plumb condition.

Northwest Wingwall: The northwest wingwall has significant spalling at the wall cap. The wall is in a generally plumb condition.

Southeast Wingwall: The southeast wingwall has significant spalling that occurs throughout the wall face and cap (reference Photo 7 in Appendix B). A vertical crack was also found at the abutment wall/wingwall interface. The wall is generally offset toward the access road. Both the spalling and crack indicate that this is an older issue is with no evidence of recent movement.

Southwest Wingwall: The southwest wingwall has a large crack at the South Abutment/Southwest Wingwall interface and spalling that occurs at the wall cap (reference Photo 10 and 11 in Appendix B). The wall offsets toward the access road. It appears that this is an older issue with no evidence of recent movement.

Wingwall Recommendations
The Northeast and Northwest Wingwalls are in relatively good condition and did not show visible signs of structural distress. However, the Southeast and Southwest wingwalls are in poor condition. We recommend the following:

- Continue to monitor the cracks found on Southeast and Southwest wingwalls
- Continue to monitor the plumbness of each wingwall, in particular, the Southeast and Southwest wingwall
- Remove loose concrete on all surfaces of the wingwalls by use of hydrodemolition (hydroblasting)
- *Southeast and Southwest Wingwalls*: Remove and patch spalled concrete areas with vertical concrete patch material and steel bar dowel anchors may be necessary.

Recommendation Summary

The following is a summary of the recommendations provided earlier in this report. To assist the City we have provided budgetary cost estimates for each task. These are for planning purposes only and were not developed through detailed measurements or engineering analysis. Note: Understanding that some of the work may be phased, highlighted tasks are recommended for completion in Spring of 2016. Continued monitoring may allow for the delay of completing other tasks listed.

<u>General Recommendations</u>

- Hydroblast structure to remove loose/delaminated concrete ($8,000)
- Install swales to direct stormwater runoff away from bridge and wingwalls ($2,000)
    - *Subtotal: $10,000*

<u>Superstructure</u>

1. Continue to monitor for development of future concrete spalling/delamination and potential overhead loose concrete
    - Remove and patch spalls and reform East and West faces, including curbs ($5,000)
    - Install corrosion inhibitor and concrete sealer ($3,000)
        - *Subtotal: $8,000*

<u>Substructure</u>

1. Continue to monitor the plumbness of each wingwall. (reference sheet S2)
2. Continue to monitor for development of future concrete spalling/delamination
3. Continue to monitor the cracks found on the southwest, southeast wingwall and north abutment.
    - North Abutment, South Abutment – Patch Spall areas ($5,000)
    - SW Wingwall – Patch spall areas and add stainless steel pins, as necessary ($8,000)

- SE Wingwall – Patch spall areas and add stainless steel pins, as necessary ($8,000)
    - *Subtotal: $21,000*

Total Repair Cost: $39,000

The findings summarized in this report are based on a limited site review and do not guarantee that all damage locations on the structure have been identified. The intent of this investigation and report was to assess and respond to the more evident issues as they relate to the continued use of this structure. The condition of the structure should continue to be monitored until its eventual replacement.

We would be happy to assist the City with construction inspection, detailed design, or continuing monitoring services for this structure. Please contact me if you have any questions regarding this project.

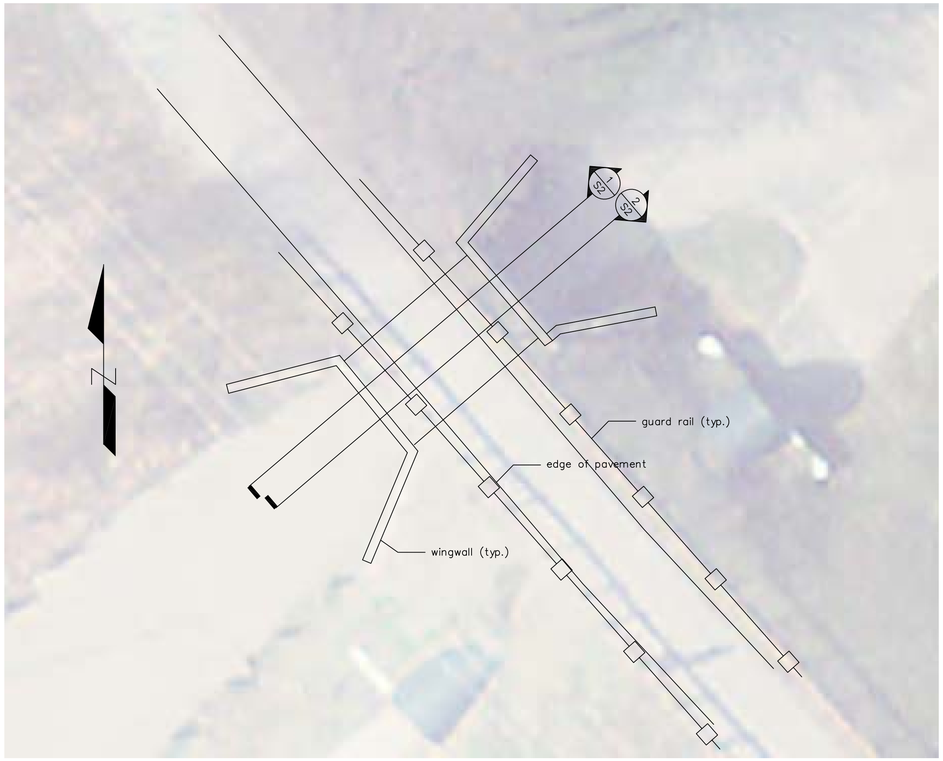
Sincerely,
Hoyle, Tanner & Associates, Inc.

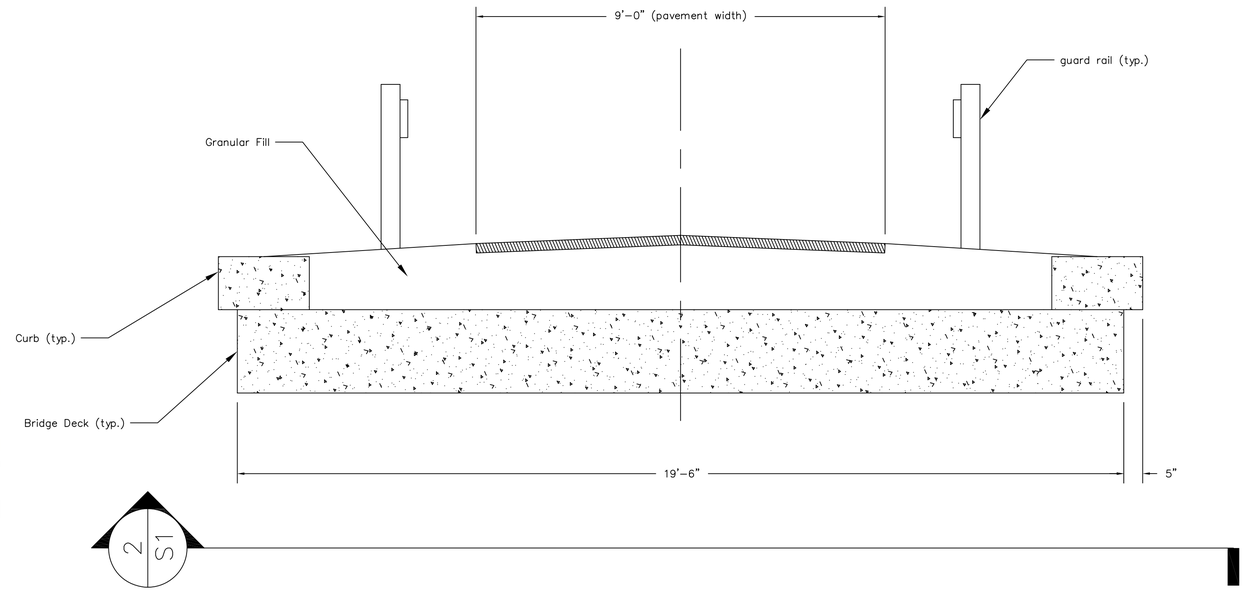
Jon A. Olin, P.E.
Group Manager - Vermont Transportation Services

Enclosures

Appendix A: Deterioration Plans
Appendix B: Site Visit Photos

Appendix A
Deterioration Plans





1 / S1 **TYPICAL CROSS-SECTION**

SCALE: 1=20

GENERAL NOTES

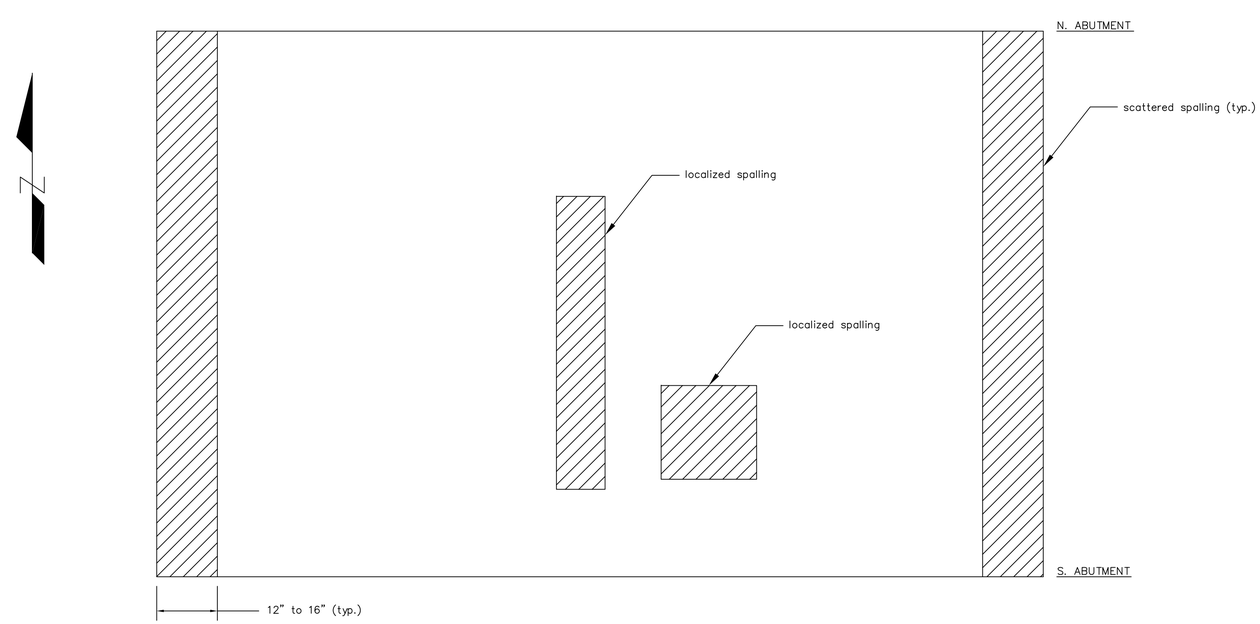
1. GENERAL NOTES SHALL APPLY TO ALL DRAWINGS PREPARED BY HOYLE, TANNER & ASSOCIATES (HOYLE, TANNER).
2. ALL DIMENSIONS, ELEVATIONS AND CONDITIONS ARE SHOWN FOR GENERAL USE AND SHALL NOT BE USED FOR CONSTRUCTION.
3. ALL ESTIMATED QUANTITIES WERE BASED OFF OF GENERAL FIELD MEASUREMENTS AND SHALL NOT BE USED FOR CONSTRUCTION.

LEGEND

SPALL

CRACK

NOTE: THESE PLANS WERE DEVELOPED TO ASSIST WITH THE EXISTING BRIDGE CONDITIONS DESCRIPTION. THEY ARE NOT TO BE USED FOR CONSTRUCTION PURPOSES



2 / S1 **DECK UNDERSIDE**

SCALE: 1=20

NOT FOR CONSTRUCTION

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DESIGNED BY	DRAWN BY	CHECKED BY
JJO	JJO	JJO

NORTH BEACH ACCESS ROAD OVERPASS

NORTH BEACH ACCESS ROAD OVERPASS

SCALE: 1=20

DATE: Nov. 2015

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

DO NOT SCALE DRAWING

PROJ. No.: 909046

DRAWING NO.

S1

SHEET 1 OF 2

File Path

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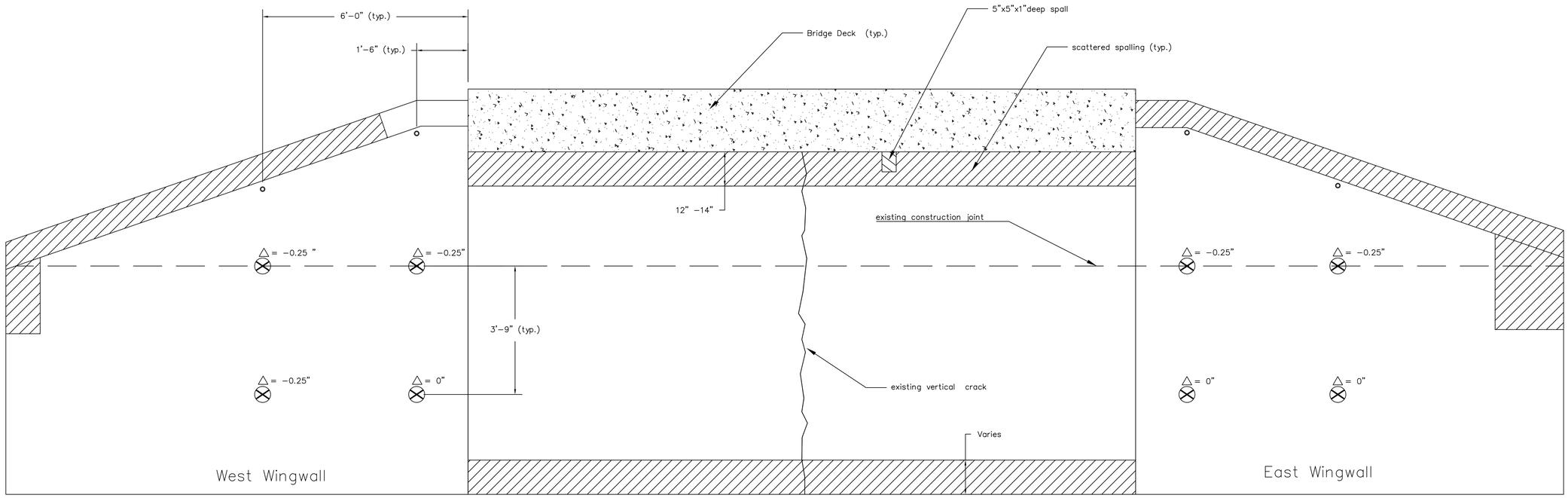


LEGEND

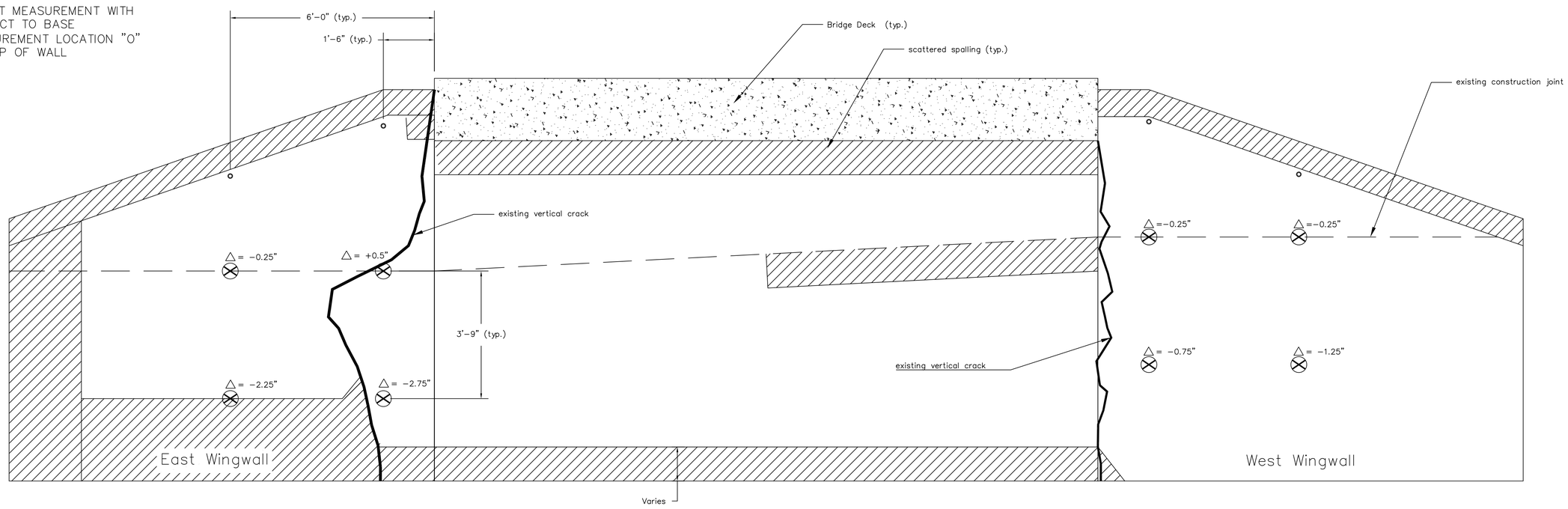
⊗ WINGWALL OFFSET MEASUREMENT LOCATION

o BASE MEASUREMENT LOCATION/LASER LEVEL SET UP

△ OFFSET MEASUREMENT WITH RESPECT TO BASE MEASUREMENT LOCATION "O" AT TOP OF WALL

1 / S2 **NORTH ABUTMENT & WINGWALLS**

SCALE: 1=20



2 / S2 **SOUTH ABUTMENT & WINGWALLS**

SCALE: 1=20

NOTE: THESE PLANS WERE DEVELOPED TO ASSIST WITH THE EXISTING BRIDGE CONDITIONS DESCRIPTION. THEY ARE NOT TO BE USED FOR CONSTRUCTION PURPOSES

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DESIGNED BY	DRAWN BY	CHECKED BY
JJD	JJD	JJD

NORTH BEACH ACCESS ROAD OVERPASS

NORTH - SOUTH ABUTMENTS

DATE: Nov. 2015

SCALE: 1=20

REVISIONS

REV. NO.	DATE	DESCRIPTION	BY

DO NOT SCALE DRAWING

PROJ. No.: 909046

DRAWING NO.

S2

SHEET 2 OF 2

File Path

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Appendix B
Site Visit Photos

Photo 1: General View of Bridge - Looking East

Photo 2: General View of Deck's West Face

Photo 3: General view of Deck's East Face

Photo 4: General view of Deck's underside

Photo 5: North Abutment

Photo 6: South Abutment

Photo 7: Southeast Wingwall

Photo 8: Northeast Wingwall

Photo 9: Northwest Wingwall

Photo 10: Southwest Wingwall

Photo 11: Crack Found at Southwest Wingwall