

Appendix M – Detailed Bridge Condition Survey of Ellis Creek Bridge (Orbit Engineering)

FINAL REPORT

Detailed Bridge Condition Survey of
Site Number 3801, Maple Grove Road over Ellis Creek Bridge

IBI Group

OE18761AC

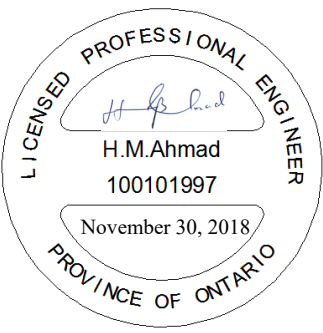
October 24, 2018



CONTENTS

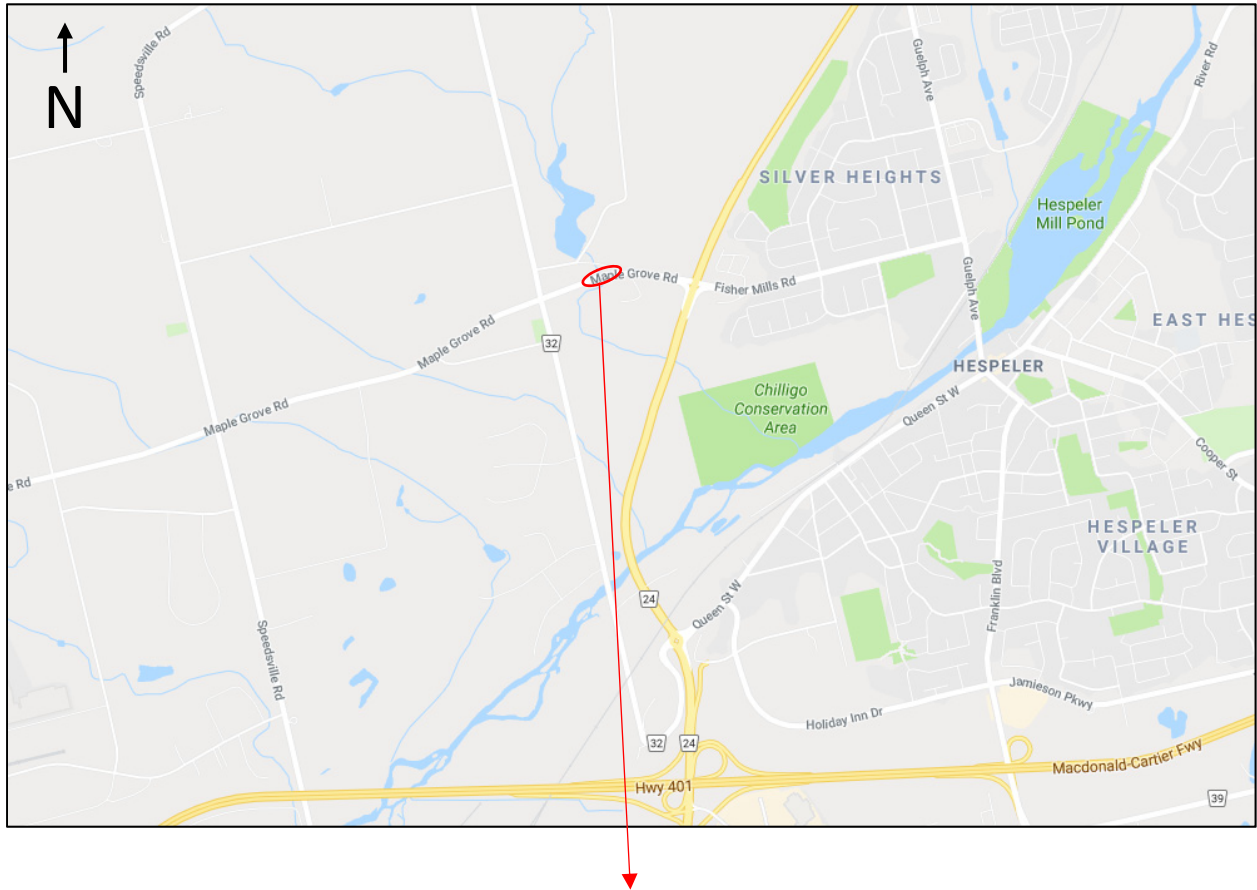
1	Structure Identification Sheet
2	Key Plan
3	Summary of Significant Findings
4	Detailed Condition Survey Summary Sheets – Asphalt-Covered Deck
5	Detailed Condition Survey Summary Sheets – Exposed Concrete Components
6	Detailed Condition Survey Summary Sheet – Drainage
7	Survey Equipment and Calibration Procedures
8	Core Photographs and Sketches
9	Core Logs
10	Asphalt Sawn Sample Photographs
11	Asphalt Sawn Sample Logs
12	Site Photographs
13	Laboratory Test Results
14	ACAD Drawings
	No. 1 Surface Deterioration of Asphalt on Deck & Concrete Barrier Walls
	No. 2 Asphalt Thickness of Deck at Core and Sawn Sample Locations and Concrete Cover of Barrier Walls & Concrete Cover of Sidewalks
	No. 3 Surface Deterioration of Soffit
	No. 4 Surface Deterioration of Abutments and Retaining Walls

1 Structure Identification Sheet

STRUCTURE IDENTIFICATION SHEET			
GENERAL INFORMATION			
STRUCTURE NAME	Site Number 3801, Maple Grove Road over Ellis Creek Bridge		
SITE NUMBER	3801	DISTRICT NUMBER	N/A
ROAD	above Maple Grove Road	Below	Ellis Creek
TYPE OF STRUCTURE	Rigid Frame Bridge		
NUMBER OF SPANS	1	SPAN LENGTH	27.0 m
ROADWAY WIDTH	20.0 m (overall 20.9 m)	YEAR BUILT	1991
DIRECTION OF STRUCTURE	East-to-West		
SEQUENCE NUMBER	N/A	TOWNSHIP NUMBER	N/A
LHRS NUMBER	N/A	MUNICIPAL BRIDGE NUMBER	N/A
LOCATION	43.435260, -80.332996	JURISDICTION	Region of Waterloo
INSPECTOR'S NAME	Hafiz Muneeb Ahmad, P.Eng.		
PARTY MEMBERS	Hafiz Muneeb Ahmad, P.Eng., Jari Peikari, Haseeb Hasan, Abdul Tawab		
DATE OF INSPECTION	September 29, 2018		
TEMPERATURE	10 °C	WEATHER	Sunny
MTO REGION	N/A	AADT	N/A
DECK RIDING SURFACE	Asphalt		
LAST YEAR REHABILITATED	N/A		
ENGINEER'S STAMP			

2 Key Plan

KEY PLAN



Site Number 3801, Maple Grove Road over Ellis Creek Bridge

3 Summary of Significant Findings

SUMMARY OF SIGNIFICANT FINDINGS

Site Number 3801, Maple Grove Road over Ellis Creek Bridge

1.0 INTRODUCTION

Site Number 3801, Maple Grove Road over Ellis Creek Bridge in Cambridge, ON was built in 1991 and is a single span rigid frame structure, with an asphalt wearing surface. The structure is located on Maple Grove Road and carries 2 lane of traffic in each direction over Ellis Creek. The span length of the bridge is 27.0 m, and the roadway width is 20.0 m (overall width = 20.9 m). The structure is in an East-to-West orientation. Concrete barrier walls adorn the outer limits of the structure. A general overview photograph of Structure ID: 3801 is shown in Photo 1 below.



Photo P1: General View of Structure ID: 3801 Maple Grove Road / Chiligo / Fisher Mills Creek Bridge

2.0 METHODOLOGY

In August 2018, IBI Group contracted Orbit Engineering Limited to perform a detailed condition survey for this structure. This report summarizes the findings of the detailed condition survey carried out at Site Number 3801, Maple Grove Road over Ellis Creek Bridge in Cambridge, ON. In general, the procedures followed to conduct the condition survey were those defined in Part 1 of the MTO Structural Rehabilitation Manual. This involved the observation and recording of surface defects, grid layouts (as per MTO SRM), delaminations, surface deterioration, asphalt sawn samples, concrete cores and physical testing of concrete cores; for the items listed hereafter.

Delaminations in concrete were detected by striking the surface and noting the change in sound being emitted. It should be mentioned, that while this method is quite reliable, it may not detect delamination at a depth greater than 100 millimetres. The chain drag method was used for all horizontal surfaces inspected and the hammer sounding method was used for all vertical surfaces inspected. The areas and locations of patches, spalls, delaminations, exposed reinforcement, honey-combing, wet areas, scaling and other observed defects and deteriorations were recorded. The surface deterioration survey was conducted on the following components: asphalt covered bridge deck, concrete barrier walls, soffit, abutments and retaining walls.

A corrosion potential survey was not conducted on the deck and barrier wall, since the top, upper layer of reinforcing steel contained epoxy-coated reinforcing steel.

Thirteen (13) cores *{12 from the deck and 1 from the approach}* and eleven (11) sawn samples were randomly extracted from this structure, in order to fulfill the requirements of selecting cores and sawn samples from deteriorated and sound areas. The inside of the core holes were examined carefully for cracks and the condition of the concrete, the exposed surface of the concrete was also carefully examined for evidence of distress

All test locations that were physically altered by the condition survey, were repaired to its original state using MTO-approved products. The field investigation portion of this assignment was conducted on October 1 & 2, 2018.

3.0 SUMMARY OF SIGNIFICANT FINDINGS

3.1 Asphalt-Covered Bridge Deck

General overview photographs of Site Number 3801, Maple Grove Road over Ellis Creek Bridge are shown in Photos P1 (north elevation), P2 (south elevation), P3 (aerial overview) and P4 (aerial overview). The asphalt-covered riding surface was typically in fair condition exhibiting evidence of unsealed (179.5 m), as summarized on Drawing No. 1. Asphalt thicknesses ranged from 70 to 110 mm, with an average asphalt thickness of 87 mm. The concrete cover in the cores and sawn samples ranged from 70 to 95 mm, with an average concrete cover of 77 mm. The typical condition of the asphalt riding surface is shown in Photo P9 to P10.

3.2 Waterproofing

Evidence of a hot rubberized asphalt water-proofing membrane, with protection board, was found on this structure ranging in thickness from 6 to 8 mm and was in good condition.

3.3 Approaches

The asphalt wearing surface of the approaches were typically in fair condition, exhibiting evidence of cracking, as shown in Photos P11 (east) and P12 (west). Core C1 confirmed the existence of concrete approach slabs below the asphalt.

3.4 Deck Drainage

No evidence of deck drainage was found on this structure. However, catchbasins were located at the south-east, south-west and north-east quadrant, outside the structure limits, as shown in Photos P34 to P36.

3.5 Cores & Sawn Samples

Core photographs are shown in Photos C1-C13 and core locations are given on the accompanying drawings. The epoxy-coated reinforcing steel exposed during the coring operation on the deck was in good condition, with no evidence of surface corrosion or pitting. The bond between the asphalt, water-proofing and concrete was typically good. The concrete in the cores was typically in good condition. AC Resistance and IR Voltage Drop measurements of the epoxy-coated rebar are summarized on the Detailed Condition Survey Summary Sheet – Asphalt Covered Deck – Deck Riding Surface. The calculated AC Resistance values were less than 10,000 ohms and represent a fair-to-poor condition of ECR.

The concrete in the cores was typically in good condition. In total, 5 cores were tested for chlorides on the deck, 4 cores were tested for compressive strength and 2 cores were tested for air void analysis.

Asphalt Sawn Sample photographs are shown in Photos S1-S11 and Sawn Sample locations are given on the accompanying drawings. The bond between the asphalt, water-proofing and concrete was typically good. The exposed concrete surfaces were typically in good condition.

3.6 Laboratory Testing of Concrete Core Results

Cores C3, C6, C11 and C13 were tested for compressive strength in accordance with CSA A23.2-14C. The compressive strength of the deck concrete ranged from 39.1 to 51.0 MPa, with an average compressive strength of 44.5 MPa. Chloride ion content was determined using MTO LS-417 "Method of Test for Determination of Total Chloride Ion in Concrete – Acid Soluble" on five (5) cores. Corrected chloride content values, at the rebar level, are summarized below:

Deck

Core No.	C2	C4	C7	C8	C10
Chloride Content*	0.004	0.009	0.008	0.016	0.011
Corrosion Potential	N/A	N/A	N/A	N/A	N/A

* Background chloride ion content was assumed to be 0.022% - lowest value from all horizons tested.

The chloride threshold value necessary to depassivate embedded steel and to permit corrosion (in the presence of oxygen and moisture) is generally taken as 0.025% by mass of concrete. The "background" chlorides do not contribute to corrosion, and thus the results are corrected for the background chloride content. The chloride content, at the rebar level, was below the chloride threshold level of 0.025% in all the cores tested.

Core C5 and C12 were tested to determine the air void system of the hardened concrete in accordance with ASTM C457 using the Modified Point Count Method. Test results are summarized below:

Core No.	Air Content (%)	Specific Surface (mm ⁻¹)	Spacing Factor (mm)
C5	9.6	22.1	0.128
C12	6.6	20.7	0.213

Concrete is normally considered to be properly air entrained if the air content exceeds 3.0%, the spacing factor does not exceed 230 µm and the specific surface is greater than 24 mm⁻¹. This air void system would be considered adequate, with the exception of the marginally lower specific surface.

Based on the "Concrete Removal Criteria for Bridge Deck Rehabilitation" Memo (dated May 12, 2004), the following comments can be made:

- Concrete removal for decks with average chloride content at the top reinforcement level less than 0.05% by mass of concrete will include delaminated concrete only.

3.7 Deck Soffit

The soffit was typically in fair-to-good condition exhibiting evidence of a spall (0.02 m²) and wet areas (1.7 m²) as shown in Photos P13 to P16. The soffit exhibited efflorescence coming from the construction joint in the centre where the wet areas are located.

3.8 Barrier Walls

The north and south barrier walls were typically in fair-to-good condition exhibiting evidence of unstained cracking (20.6 m), spalls (0.06 m²) and patch (0.09 m²) as shown in Photos P17 to P19 (north) and P20 to P22 (south).

3.9 Guide Rails

All the galvanized steel guiderails located on each of the quadrants of the structure were typically in fair condition, as shown in Photos P39 to P43. There was some minor impact damage on the guide rails and the connection to the barrier wall end posts was separating.

4.0 SUBSTRUCTURE COMPONENTS

4.1 East & West Abutments

The east abutment was typically in fair-to-good condition exhibiting evidence of unstained cracking (11.7 m) as shown in Photos P23 to P24.

The west abutment was typically in fair-to-good condition exhibiting evidence of unstained cracking (19.6 m) and spall (0.04 m²) as shown in Photos P25 to P26.

4.2 Retaining Walls

The retaining walls were typically in fair-to-good condition exhibiting evidence of unstained cracking (23.4 m) as shown in Photos P27 to P33. The North-East, North-West and South-West retaining walls exhibited rotational movement of approximately 25mm.

4.3 Embankments/Slopes/Waterways

The slopes and waterways were in fair-to-good condition as shown in Photos P7 to P8 and P37 to P38.

5.0 HAZARDOUS MATERIALS INVESTIGATION

A documentation review was conducted on this structure to determine the presence of any embedded ductwork and/or other hazardous materials. Based on our documentation review, there were no hazardous material present.

6.0 GENERAL CONDITION RATINGS FOR EACH ELEMENT

The following table summarizes the findings from Orbit Engineering Limited's 2018 Condition Survey for each element.

6.1 Superstructure

ELEMENT	RATING
Asphalt-Covered Bridge Deck	Riding Surface = FAIR {unsealed cracking (179.5 m)} Waterproofing = GOOD {hot rubberized asphalt with protection board, 7-9 mm} Concrete Deck = GOOD Concrete Cores = GOOD {low chlorides and good compressive strength}
Soffit	Soffit = FAIR-TO-GOOD {spalls (0.02 m ²) and wet areas (1.7 m ²)}
Approaches	Approaches = FAIR-TO-GOOD {concrete below asphalt, asphalt wearing surface exhibited unstained cracking throughout}
Exposed Concrete Components on Deck	Barrier Walls = FAIR-TO-GOOD { unstained cracking (20.6 m) delaminations, spalls (0.06 m ²) and patch (0.09 m ²)}

6.2 Substructure

ELEMENT	RATING
Substructure	East Abutment = FAIR-TO-GOOD {unstained cracking (11.7 m)} West Abutment = FAIR-TO-GOOD {unstained cracking (19.6 m) and spall (0.04 m ²)} Retaining Walls = FAIR-to-GOOD {unstained cracking (23.4 m)}

7.0 CLOSURE

We trust that this submission is complete. Should you have any further questions, please do not hesitate to contact this office.

For and on behalf of Orbit Engineering Limited

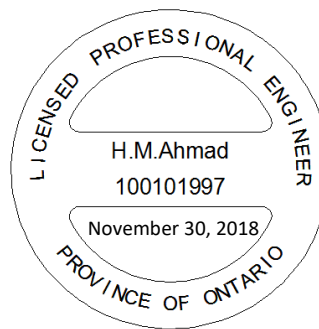


Jari Peikari

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Senior Principal Engineer



4 Detailed Condition Survey Summary Sheets Asphalt-Covered Deck

**DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE**

Page 1 of 4

Site No. **3801**
OSIM Identifier

1. Dimensions and Area of Survey

Width between E abutment curbs 20.0 m

Width between W abutment curbs 20.0 m

Length between abutment joints 27.0 m

Area of deck riding surface 540.0 m²

Remarks

2. Asphalt Surface Cracks

Orientation	Unsealed	Sealed	
Transverse	54.6	0.0	m
Longitudinal	124.9	0.0	m
Random	0.0	0.0	m

3. Asphalt Depth

Condition *	Depth			
	Min	Max	Avg.	
Fair-to-Good	70	110	87	mm

* G – Good, F – Fair, P – Poor, V - Variable Good to Poor

4. Waterproofing

Type	Condition *	Conc. Bond *	Thickness (mm)**		
			Min	Max	Avg
Hot rubberized asphalt with protection board	G	G	6	8	7

* G – Good, F – Fair, P – Poor, V - Variable Good to Poor

** Report only thickness of waterproofing membrane but note presence of protection board.

**DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE**

Page 2 of 4

Site No. **3801**
OSIM Identifier

5. Concrete Cover – Cores and Sawn Samples

Minimum	Maximum	Average
70	95	77

mm

Note: Only include covers for top upper layer of rebars.

6. Corrosion Activity

Total Area m²

Minimum	Maximum	Average
N/A	N/A	N/A

V

0 to -0.199	-0.200 to -0.299	-0.300 to -0.349	-0.350 to -0.449	< -0.450	V
N/A	N/A	N/A	N/A	N/A	m ²
N/A	N/A	N/A	N/A	N/A	%

7. Defective Cores and Sawn Samples

Corrosion Activity (Volts)	Cores and Sawn Samples						
	Total in Each Area	Delaminated, Spalled, Severe Scaling and Disintegration *			Medium Scaling *		
		No.	m ²	%	No.	m ²	%
0 to -0.199	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-0.200 to -0.349	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-0.350 to -0.449	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<-0.450	N/A	N/A	N/A	N/A	N/A	N/A	N/A

* The percent calculation should be of the entire deck area investigated. The values obtained should be used with caution as large errors may occur when a small number of samples are used for the calculation or when the samples are not randomly distributed over the entire deck area.

**DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE**

Page 3 of 4

Site No. **3801**
OSIM Identifier

8. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (volts)		0 to -0.199	-0.200 to -0.349	≤ -0.350
Chloride Content*	0-10 mm	N/A	N/A	N/A
	20-30 mm	N/A	N/A	N/A
	40-50 mm	N/A	N/A	N/A
	60-70 mm	N/A	N/A	N/A
	80-90 mm	N/A	N/A	N/A
	140-150 mm	N/A	N/A	N/A

* Average chloride content as % chloride by weight of concrete after deducting background chlorides for all cores taken in each range of corrosion potential.

9. Chloride Content at Rebar Level

*Background chloride content = 0.022%

Core No.	C2	C4	C7	C8	C10
Chloride Content*	0.004	0.009	0.008	0.016	0.011
Corrosion Potential	N/A	N/A	N/A	N/A	N/A

* Chloride content as % chloride by weight of concrete after deducting background chlorides.

10. AC Resistance Test Data of Epoxy Coated Rebar

Measured AC Resistance between Connection #1 and #2						Calculated AC Resistance *
Connection #1	Connection #2					
	Core C8	Core C10	Core C11	Core C12	-	
Core C8	N/A	5400	5900	6300	-	2900
Core C10	5400	N/A	5500	6300	-	2500
Core C11	5900	5500	N/A	6600	-	3000
Core C12	6300	6300	6600	N/A	-	3400
-	-	-	-	-	N/A	

* See Appendix 1E in SRM appendices for calculating AC resistance contributed by individual rebar.

**DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE**

Page 4 of 4

Site No. **3801**
OSIM Identifier

11. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar

IR Drop Between Connection #1 and #2						True Half Cell Potential *
Connection #1 (positive)	Connection #2 (negative)					
	G1	G2	G3	G4	G5	
G1	N/A	1.0	0.8	0.9	-	-
G2	1.0	N/A	1.0	1.0	-	-
G3	0.8	1.0	N/A	1.1	-	-
G4	0.9	1.0	1.1	N/A	-	-
G5	-	-	-	-	N/A	-

* Half cell reading taken on the same rebar with the ground connection.

12. Concrete Air Entrainment

Concrete Air Entrained? Yes

13. Compressive Strength

Average Compressive Strength 44.5 MPa

5 Detailed Condition Survey Summary Sheets Exposed Concrete Components

DETAILED CONDITION SURVEY SUMMARY SHEET Page 1 of 4
EXPOSED CONCRETE COMPONENTS (Exposed Deck, Deck Soffit, Sidewalks, Medians,
Sidewalks, Barrier/Parapet Walls, etc.): Use separate form for each component

Site No. 3801

Component Type & Location Barrier Walls {north/south} OSIM Identifier _____

1. Dimensions and Area

Width - m Length 30.9 m x 2 Height 0.91 – 1.16 m
Diameter - m Total Area Surveyed 67.9 m²

2. Cracks (medium and wide)

Remarks

Type		Vertical	Longitudinal	Other	Total	
Medium Width	Clean	20.6	0.0	0.0	20.6	m
	Stained	0.0	0.0	0.0		
Wide Width	Clean	0.0	0.0	0.0	0.0	m
	Stained	0.0	0.0	0.0		

3. Alkali Aggregate Reaction

Area of component with severe to very severe aggregate reaction 0.0 m²

4. Concrete Cover

Minimum	Maximum	Average	
66	83	74	mm

0 – 20 mm	0.0	40 – 60 mm	0.0	m ²
	0.0		0.0	%
20 – 40 mm	0.0	over 60 mm	67.9	m ²
	0.0		100	%

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 2 of 4

Site No. **3801**

Component Type & Location: Barrier Walls {north/south}

5. Corrosion Activity

Minimum	Maximum	Average	V
N/A	N/A	N/A	

0 to -0.199	-0.200 to -0.299	-0.300 to -0.349	-0.350 to -0.449	< -0.450	V
N/A	N/A	N/A	N/A	N/A	m ²
N/A	N/A	N/A	N/A	N/A	%

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m ²)	0.0	0.06	0.09
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ -0.350 V	
0.06 m ²	0.09 %	0.0 m ²	0.0 %

7. Scaling

Light	Medium	Severe to Very Severe	m ²
0.0	0.0	0.0	
0.0	0.0	0.0	%

8. Honeycombing

Total Area 0.0 m²

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 3 of 4

Site No. **3801**

Component Type & Location: Barrier Walls {north/south}

9. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (volts)		0 to -0.199	-0.200 to -0.349	≤ -0.350
Chloride Content*	0-10 mm	-	-	-
	20-30 mm	-	-	-
	40-50 mm	-	-	-
	60-70 mm	-	-	-
	80-90 mm	-	-	-
	100-110 mm	-	-	-

* Average chloride content as % chloride by weight of concrete after deducting background chlorides for all cores taken in each range of corrosion potential.

10. Chloride Content at Rebar Level

Core No.	-	-	-	-
Corrosion Potential	-	-	-	-
Chloride Content *	-	-	-	-

* Chloride content as % chloride by weight of concrete after deducting background chlorides.

11. AC Resistance Test Data of Epoxy Coated Rebar

Measured AC Resistance between Connection #1 and #2						Calculated AC Resistance *
Connection #1	Connection #2					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* See Appendix 1E for calculating AC resistance contributed by individual rebar.

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 4 of 4

Site No. **3801**

Component & Location: Barrier Walls {north/south}

12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar

IR Drop Between Connection #1 and #2						True Half Cell Potential *
Connection #1 (positive)	Connection #2 (negative)					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* Half cell reading taken on the same rebar with the ground connection.

13. Concrete Air Entrainment

Concrete Air Entrained? not tested

14. Compressive Strength

Average Compressive Strength not tested

DETAILED CONDITION SURVEY SUMMARY SHEET Page 1 of 4
EXPOSED CONCRETE COMPONENTS (Exposed Deck, Deck Soffit, Curbs, Medians, Sidewalks, Barrier/Parapet Walls, etc.): Use separate form for each component

Site No. 3801

Component Type & Location _____ Soffit _____ OSIM Identifier _____

1. Dimensions and Area

Width 20.9 m Length 27.0 m Height - m
 Diameter - m Total Area Surveyed 564.6 m²

2. Cracks (medium and wide)

Remarks

Type		Transverse	Longitudinal	Other	Total	
Medium Width	Clean	0.0	0.0	0.0	0.0	m
	Stained	0.0	0.0	0.0		
Wide Width	Clean	0.0	0.0	0.0	0.0	m
	Stained	0.0	0.0	0.0		

3. Alkali Aggregate Reaction

Area of component with severe to very severe aggregate reaction 0.0 m²

4. Concrete Cover

Minimum	Maximum	Average	
N/A	N/A	N/A	mm

0 – 20 mm	N/A	40 – 60 mm	N/A	m ²
	N/A		N/A	%
20 – 40 mm	N/A	over 60 mm	N/A	m ²
	N/A		N/A	%

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 2 of 4

Site No. **3801**
Component Type & Location: **Soffit**

5. Corrosion Activity

Minimum	Maximum	Average
N/A	N/A	N/A

V

0 to -0.199	-0.200 to -0.299	-0.300 to -0.349	-0.350 to -0.449	< -0.450
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A

V

m²

%

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m ²)	0.0	0.02	0.0
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ -0.350 V	
0.02 m ²	0.004 %	N/A m ²	N/A %

Wet area = 1.7 m².

7. Scaling

Light	Medium	Severe to Very Severe
0.0	0.0	0.0
0.0	0.0	0.0

m²

%

8. Honeycombing

Total Area 0.0 m²

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 3 of 4

Site No. **3801**
Component Type & Location: **Soffit**

9. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (volts)		0 to -0.199	-0.200 to -0.349	≤ -0.350
Chloride Content*	0-10 mm	-	-	-
	20-30 mm	-	-	-
	40-50 mm	-	-	-
	60-70 mm	-	-	-
	80-90 mm	-	-	-
	100-110 mm	-	-	-

* Average chloride content as % chloride by weight of concrete after deducting background chlorides for all cores taken in each range of corrosion potential.

10. Chloride Content at Rebar Level

Core No.	-	-	-	-
Corrosion Potential	-	-	-	-
Chloride Content *	-	-	-	-

* Chloride content as % chloride by weight of concrete after deducting background chlorides.

11. AC Resistance Test Data of Epoxy Coated Rebar

Measured AC Resistance between Connection #1 and #2						Calculated AC Resistance *
Connection #1	Connection #2					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* See Appendix 1E for calculating AC resistance contributed by individual rebar.

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 4 of 4

Site No. 3801
Component Type & Location: Soffit

12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar

IR Drop Between Connection #1 and #2						True Half Cell Potential *
Connection #1 (positive)	Connection #2 (negative)					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* Half cell reading taken on the same rebar with the ground connection.

13. Concrete Air Entrainment

Concrete Air Entrained? not tested

14. Compressive Strength

Average Compressive Strength not tested

DETAILED CONDITION SURVEY SUMMARY SHEET Page 1 of 4
EXPOSED CONCRETE COMPONENTS (Exposed Deck, Deck Soffit, Curbs, Medians, Sidewalks, Barrier/Parapet Walls, etc.): Use separate form for each component

Site No. 3801

Component Type & Location Abutments {east/west} OSIM Identifier _____

1. Dimensions and Area

Width -m Length 22.25 – 24.25 / 22.25 – 25.25 m Height 3.7 – 5.6 / 4.7 – 7.0 m
 Diameter - m Total Area Surveyed 98.0 / 129.0 m²

2. Cracks (medium and wide)

Remarks

Type		Vertical	Longitudinal	Other	Total	
Medium Width	Clean	11.7 / 19.6	0.0 / 0.0	0.0 / 0.0	11.7 / 19.6	m
	Stained	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0		
Wide Width	Clean	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	m
	Stained	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0		

3. Alkali Aggregate Reaction

Area of component with severe to very severe aggregate reaction 0.0 / 0.0 m²

4. Concrete Cover

Minimum	Maximum	Average	
N/A	N/A	N/A	mm

0 – 20 mm	N/A	40 – 60 mm	N/A	m ²
	N/A		N/A	%
20 – 40 mm	N/A	over 60 mm	N/A	m ²
	N/A		N/A	%

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 2 of 4

Site No. 3801

Component Type & Location: Abutments {east/west}

5. Corrosion Activity

Minimum	Maximum	Average
N/A	N/A	N/A

V

0 to -0.199	-0.200 to -0.299	-0.300 to -0.349	-0.350 to -0.449	< -0.450
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A

V

m²

%

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m ²)	0.0 / 0.0	0.0 / 0.04	0.0 / 0.0
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ -0.350 V	
0.0 / 0.04 m ²	0.0 / 0.03 %	N/A m ²	N/A %

Wet area = 0.0 / 0.0 m².

7. Scaling

Light	Medium	Severe to Very Severe
0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
0.0 / 0.0	0.0 / 0.0	0.0 / 0.0

m²

%

8. Honeycombing

Total Area 0.0 / 0.0 m²

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 3 of 4

Site No. 3801

Component Type & Location: Abutments {east/west}

9. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (volts)		0 to -0.199	-0.200 to -0.349	≤ -0.350
Chloride Content*	0-10 mm	-	-	-
	20-30 mm	-	-	-
	40-50 mm	-	-	-
	60-70 mm	-	-	-
	80-90 mm	-	-	-
	100-110 mm	-	-	-

* Average chloride content as % chloride by weight of concrete after deducting background chlorides for all cores taken in each range of corrosion potential.

10. Chloride Content at Rebar Level

Core No.	-	-	-	-
Corrosion Potential	-	-	-	-
Chloride Content *	-	-	-	-

* Chloride content as % chloride by weight of concrete after deducting background chlorides.

11. AC Resistance Test Data of Epoxy Coated Rebar

Measured AC Resistance between Connection #1 and #2						Calculated AC Resistance *
Connection #1	Connection #2					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* See Appendix 1E for calculating AC resistance contributed by individual rebar.

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 4 of 4

Site No. 3801

Component Type & Location: Abutments {east/west}

12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar

IR Drop Between Connection #1 and #2						True Half Cell Potential *
Connection #1 (positive)	Connection #2 (negative)					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* Half cell reading taken on the same rebar with the ground connection.

13. Concrete Air Entrainment

Concrete Air Entrained not tested

14. Compressive Strength

Average Compressive Strength not tested

DETAILED CONDITION SURVEY SUMMARY SHEET Page 1 of 4
EXPOSED CONCRETE COMPONENTS (Exposed Deck, Deck Soffit, Curbs, Medians, Sidewalks, Barrier/Parapet Walls, etc.): Use separate form for each component

Site No. 3801

Component Type & Location Retaining Walls {N/E, S/E, S/W & N/W} OSIM Identifier _____

1. Dimensions and Area

Width - m Length 12.0 – 27.0 m Height 5.6 – 6.95 m
 Diameter - m Total Area Surveyed 244.4 m²

2. Cracks (medium and wide)

Remarks

Type		Vertical	Longitudinal	Other	Total	
Medium Width	Clean	23.4	0.0	0.0	23.4	m
	Stained	0.0	0.0	0.0		
Wide Width	Clean	0.0	0.0	0.0	0.0	m
	Stained	0.0	0.0	0.0		

3. Alkali Aggregate Reaction

Area of component with severe to very severe aggregate reaction 0.0 m²

4. Concrete Cover

Minimum	Maximum	Average	
N/A	N/A	N/A	mm

0 – 20 mm	N/A	40 – 60 mm	N/A	m ²
	N/A		N/A	%
20 – 40 mm	N/A	over 60 mm	N/A	m ²
	N/A		N/A	%

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 2 of 4

Site No. 3801

Component Type & Location: Retaining Walls

5. Corrosion Activity

Minimum	Maximum	Average	V
N/A	N/A	N/A	

0 to -0.199	-0.200 to -0.299	-0.300 to -0.349	-0.350 to -0.449	< -0.450	V
N/A	N/A	N/A	N/A	N/A	m ²
N/A	N/A	N/A	N/A	N/A	%

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m ²)	0.0	0.0	0.0
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ -0.350 V	
0.0 m ²	0.0 %	N/A m ²	N/A %

7. Scaling

Light	Medium	Severe to Very Severe	m ²
0.0	0.0	0.0	
0.0	0.0	0.0	%

8. Honeycombing

Total Area 0.0 m²

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 3 of 4

Site No. 3801

Component Type & Location: Retaining Walls

9. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (volts)		0 to -0.199	-0.200 to -0.349	≤ -0.350
Chloride Content*	0-10 mm	-	-	-
	20-30 mm	-	-	-
	40-50 mm	-	-	-
	60-70 mm	-	-	-
	80-90 mm	-	-	-
	100-110 mm	-	-	-

* Average chloride content as % chloride by weight of concrete after deducting background chlorides for all cores taken in each range of corrosion potential.

10. Chloride Content at Rebar Level

Core No.	-	-	-	-
Corrosion Potential	-	-	-	-
Chloride Content *	-	-	-	-

* Chloride content as % chloride by weight of concrete after deducting background chlorides.

11. AC Resistance Test Data of Epoxy Coated Rebar

Measured AC Resistance between Connection #1 and #2						Calculated AC Resistance *
Connection #1	Connection #2					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* See Appendix 1E for calculating AC resistance contributed by individual rebar.

**DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS**

Page 4 of 4

Site No. 3801

Component Type & Location: Retaining Walls

12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar

IR Drop Between Connection #1 and #2						True Half Cell Potential *
Connection #1 (positive)	Connection #2 (negative)					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

* Half cell reading taken on the same rebar with the ground connection.

13. Concrete Air Entrainment

Concrete Air Entrained? not tested

14. Compressive Strength

Average Compressive Strength not tested

6 Detailed Condition Survey Summary Sheet – Drainage

DRAINAGESite No. 3801

Deck Drains	Number	Type	Length	Angle	Depth *
	N/A	N/A	N/A	N/A	N/A

* For asphalt covered decks, recess depth in mm between top of asphalt and top of drain.

Catch Basins	Yes	S/E x 1, S/W x 2 N/E X 1
--------------	-----	-----------------------------

* Identify location of catch basins as N/E, N/W, S/E etc. using the same direction of north as shown on the drawings.

Drainage Tubes	No	Void Drains	No
----------------	----	-------------	----



Typical Condition of Catchbasin @ South-West

7 Survey Equipment and Calibration Procedures

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Asphalt Covered Bridge Deck **Site Number:** 3801

1. Delaminations:

Weight of Chain: 2.2 **kg/m**
Other Equipment: Hammer

2. Concrete Cover:

Covermeter Make and Model: ELCOMETER 331
Battery Check: **Reading at Start of Test:** OK
Reading at End of Test: OK
Concrete Cover Check: **Location of Check:** @ 'SS1'
Actual Depth and Rebar Diameter: -
Reading Before Test: 75 mm
Readings Each 30 minutes During Test: 75 mm
Reading at End of Test: 75 mm

3. Corrosion Activity: **A corrosion potential survey was not conducted since the TUL contained epoxy-coated reinforcing steel.*

Half Cell Make and Model: MC MILLER Electrode RE – 7
Multimeter Make and Model: Mastercraft Digital Multimeter 3R93
Length and Gauge of Lead Wires: 150 m of 20 gauge
Deck Temperature: **Start of Test:** 8 °C **End of Test:** 8 °C
Ambient Temperature: **Start of Test:** 10 °C **End of Test:** 10 °C
Battery Check: O.K.
Ground Check: **Method of Connection:** N/A
Ground Location: N/A **Check Location:** N/A
Lead Resistance: N/A **Voltage Drop (mV's):** N/A
Resistance ^c: N/A **Resistance Reversed:** N/A

Grid Point Potential Readings Check – See Table Below

Location	Initial Reading	Check Reading ^a	Check Reading – Latex Concrete Overlay ^b
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

^a Check at least five readings at beginning of test and each change in ground.

^b On decks with latex modified concrete overlay, check at least five locations by drilling holes through the latex concrete overlay into the original concrete substrate.

^c Resistance is the net resistance after deducting the lead resistance.

8 Core Photographs and Sketches

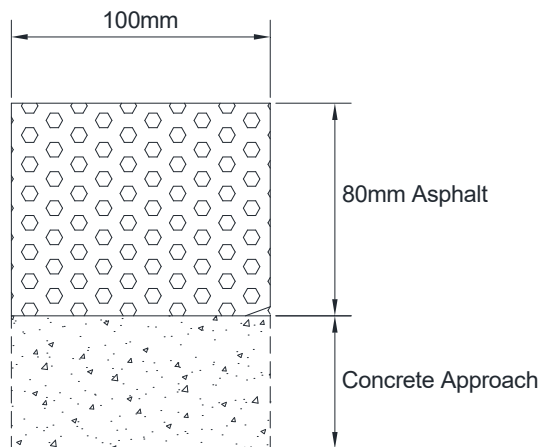
CORE C1



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

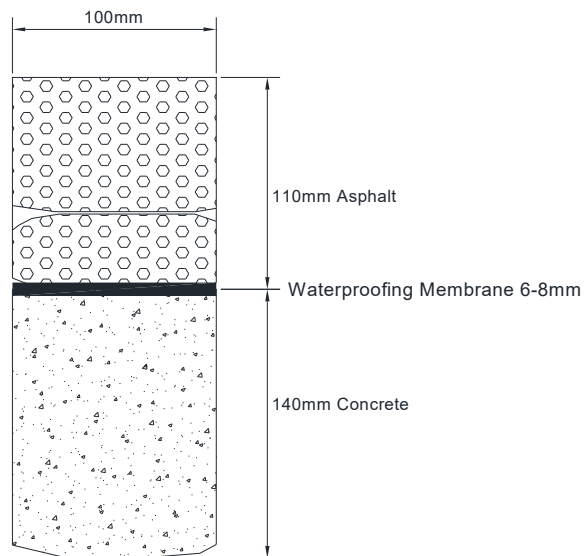
CORE C2



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

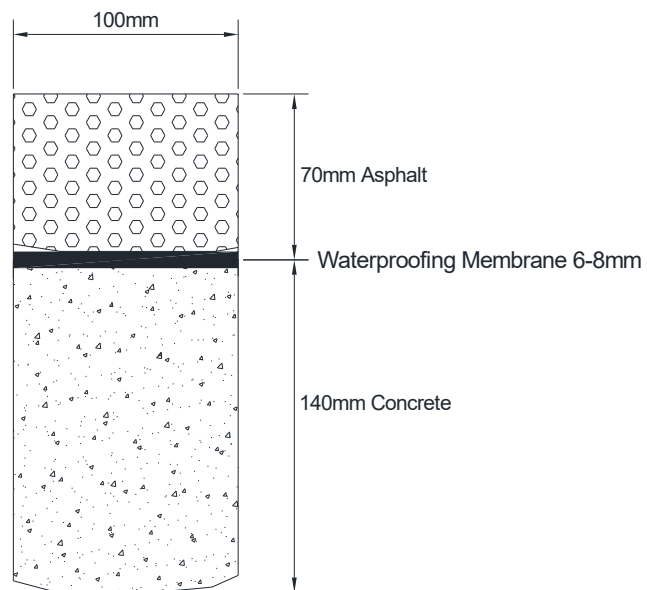
CORE C3



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

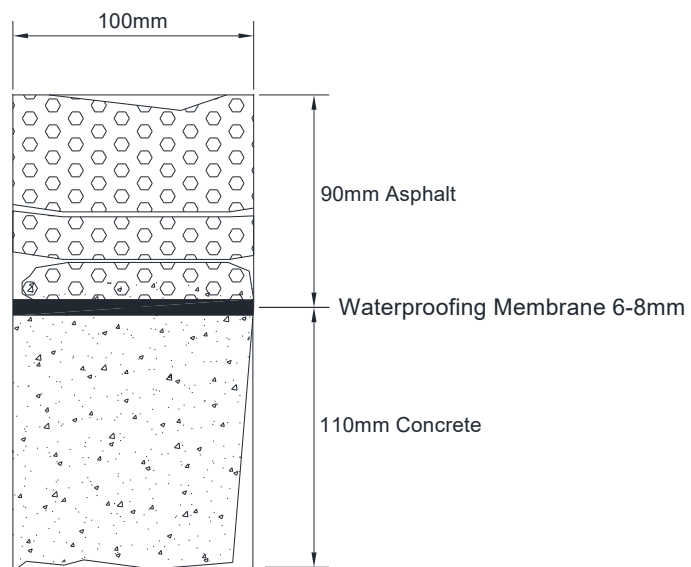
CORE C4



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

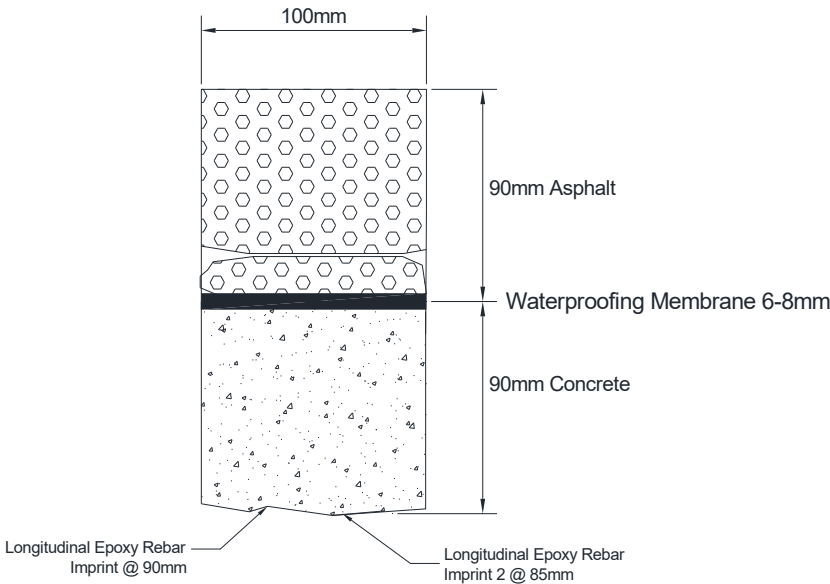
CORE C5



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

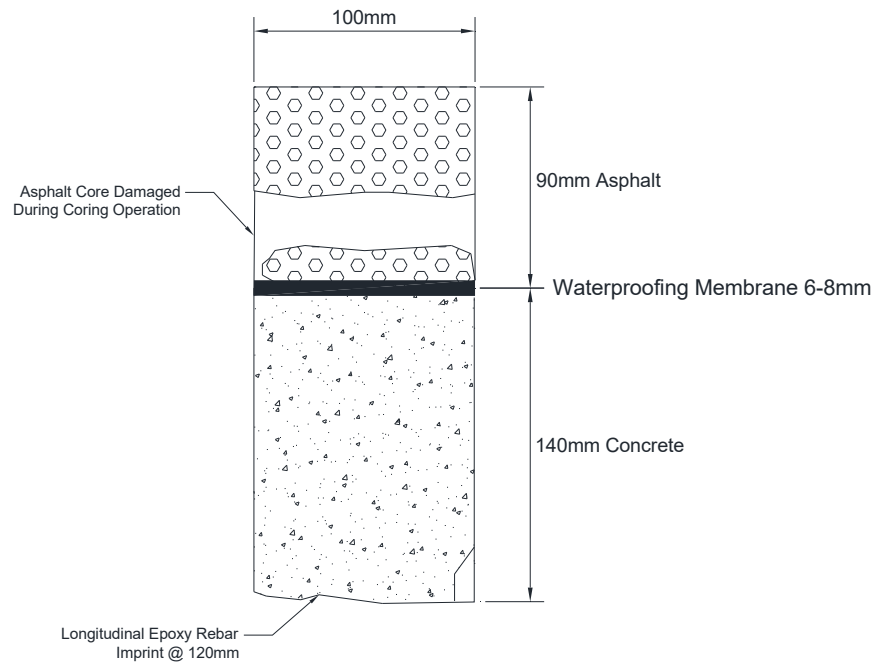
CORE C6



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

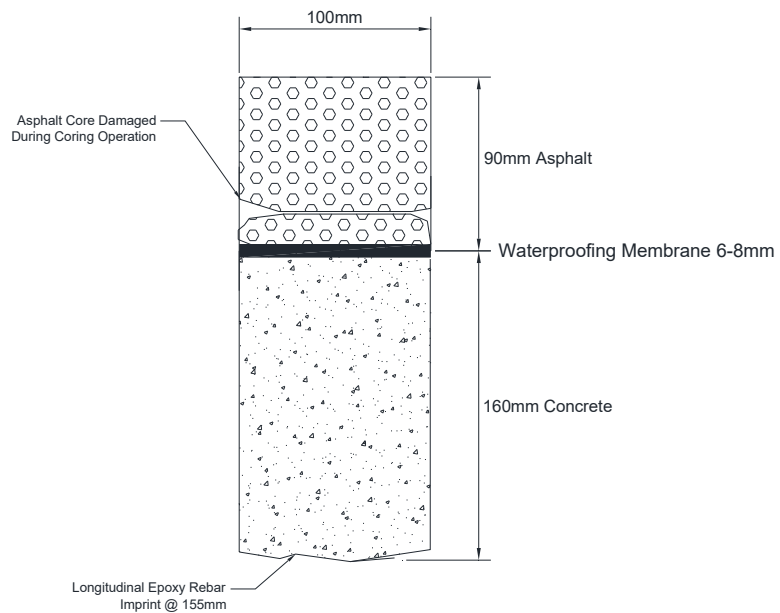
CORE C7



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

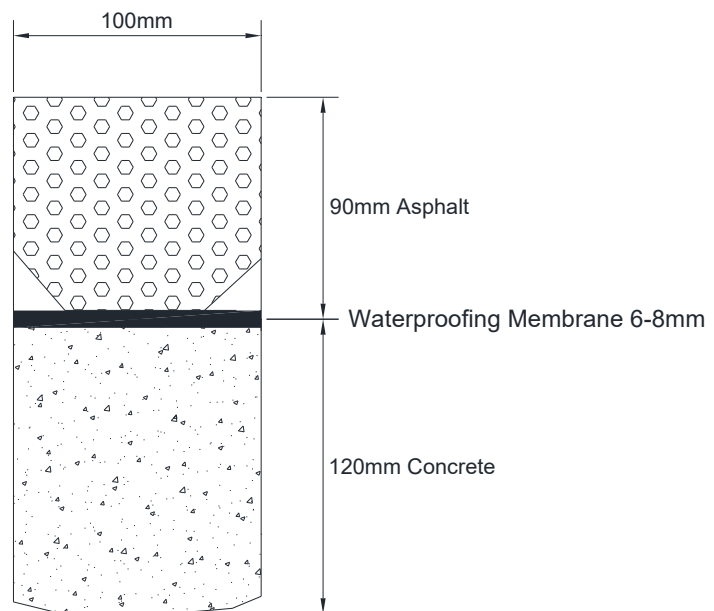
CORE C8



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

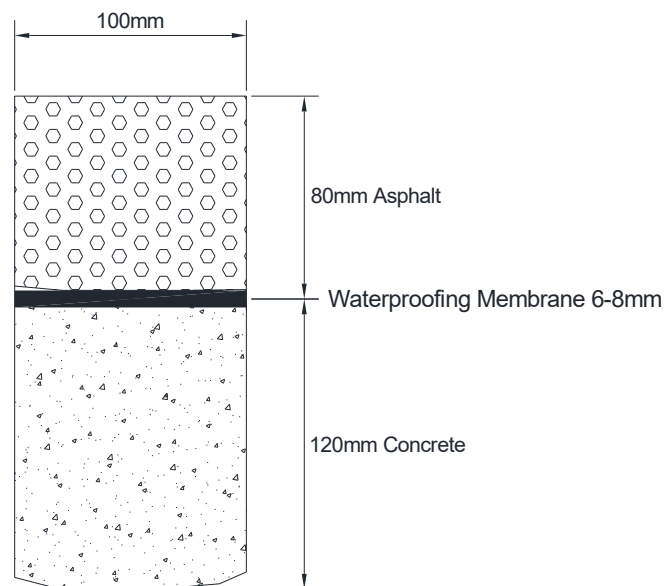
CORE C9



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

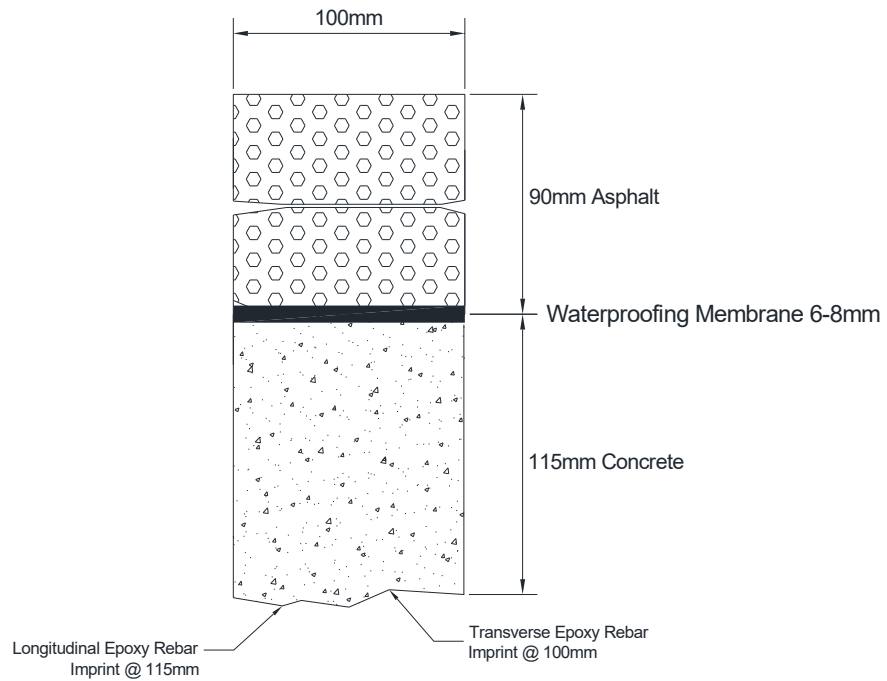
CORE C10



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

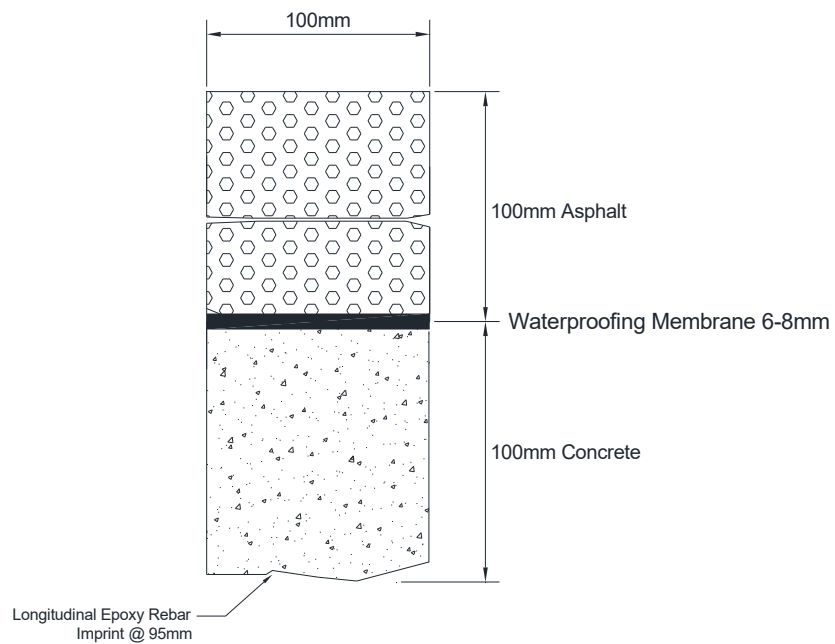
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INSIDE CORE HOLE



CORE SKETCH

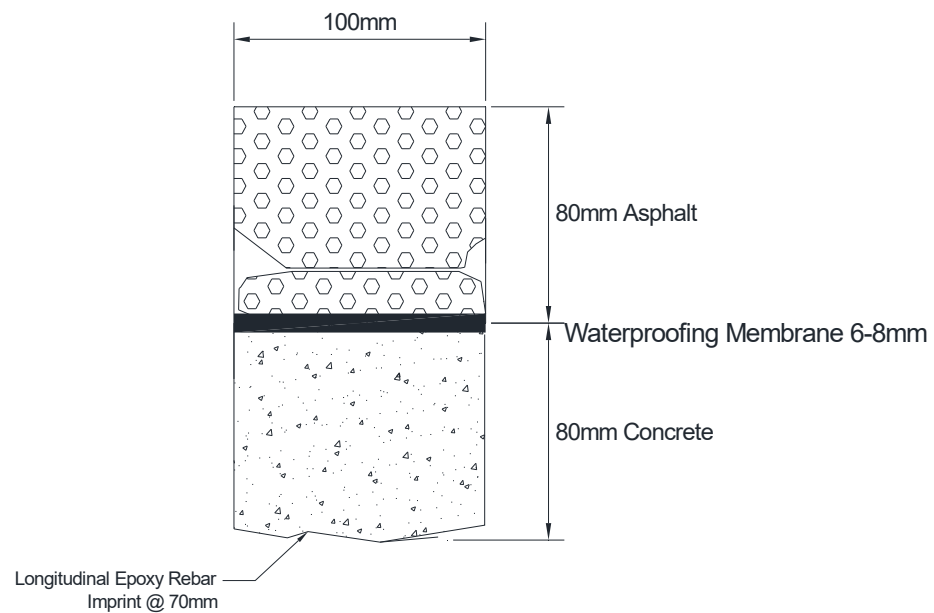
CORE C12



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

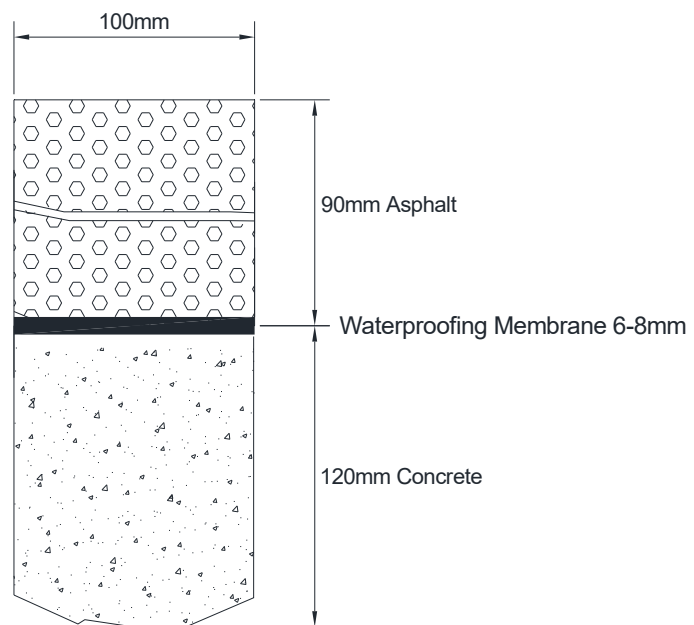
CORE C13



CORE PHOTO



INSIDE CORE HOLE



CORE SKETCH

9 Core Logs

Core No.		C1		C2		C3	
Location (between gridlines)		West Approach		'O' and '2'		'M' and '6'	
Diameter, mm		100		100		100	
Thickness of Asphalt, mm		80		110		70	
Thickness of Asphalt @ nearest grid point		N/A		N/A		N/A	
Thickness of Concrete, mm		N/A		140		140	
Full Depth (yes/no)		No		No		No	
Condition of Asphalt ⁽¹⁾		Fair		Fair		Fair	
Waterproofing (W/P) Type				Hot rubberized asphalt with protection board			
Condition of W/P ⁽¹⁾		N/A		G		G	
W/P Thickness, mm		N/A		6 – 8		6 – 8	
Bond of Asphalt or W/P to Concrete		G		G		G	
Defects in Concrete ⁽²⁾		N/A		-		-	
Condition of Rebar ⁽³⁾		N/A		N/A		N/A	
Corrosion Potential		N/A		N/A		N/A	
Compressive Strength, MPa		-		-		43.6	
Chloride Content % Chloride by Weight of Concrete	0-10 mm 20-30 mm 40-50 mm 60-70 mm 80-90 mm	Total -	Corrected -	Total 0.022 0.032 0.028 0.026 0.023	Corrected 0.000 0.010 0.006 0.004 0.001	Total -	Corrected -
AIR VOIDS	Air Content,% Spec. Surf.,mm²/mm³ Spacing Factor, mm	-		-		-	
TEST LABORATORY		-		BME		Orbit	
REMARKS		*Concrete approach slab					
- orientation of rebars and cover - presence of overlay, patch and thickness - other observed defects							

1. Condition-G=Good, F=Fair, P=Poor.
2. Defects-C= Cracked, D= Delamination, R= Rough, Sc= Scaling, S= Spalling
3. Condition Rebar-LR= Light Rust, SR= Severe Rust, N/A= No rebar exposed
Condition of Epoxy Coating – ECG=Good, ECF=Fair, ECP=Poor-rusted & debonded areas

Core No.		C4		C5		C6	
Location (between gridlines)		'J' and '10'		'O' and '13'		'J' and '16'	
Diameter, mm		100		100		100	
Thickness of Asphalt, mm		90		90		90*	
Thickness of Asphalt @ nearest grid point		N/A		N/A		N/A	
Thickness of Concrete, mm		110		90		140	
Full Depth (yes/no)		No		No		No	
Condition of Asphalt ⁽¹⁾		Fair		Fair		Fair	
Waterproofing (W/P) Type		Hot rubberized asphalt with protection board					
Condition of W/P ⁽¹⁾		G		G		G	
W/P Thickness, mm		6 – 8		6 – 8		6 – 8	
Bond of Asphalt or W/P to Concrete		G		G		G	
Defects in Concrete ⁽²⁾		-		-		-	
Condition of Rebar ⁽³⁾		N/A		ECG		ECG	
Corrosion Potential		N/A		N/A		N/A	
Compressive Strength, MPa		-		-		39.1	
Chloride Content % Chloride by Weight of Concrete	0-10 mm	Total	Corrected	Total	Corrected	Total	Corrected
	20-30 mm	0.026	0.004				
	40-50 mm	0.025	0.003				
	60-70 mm	0.026	0.004	-	-	-	-
	80-90 mm	0.031	0.009				
		0.029	0.007				
AIR VOIDS	Air Content,% Spec. Surf.,mm ² /mm ³ Spacing Factor, mm	-		-		-	
TEST LABORATORY		BME		-		Orbit	
REMARKS							
- orientation of rebars and cover - presence of overlay, patch and thickness - other observed defects		-		Longitudinal epoxy rebar imprint @ 90mm		Longitudinal epoxy rebar imprint @ 120mm	
				Longitudinal epoxy rebar imprint 2 @ 85mm		*Asphalt core damaged during coring operation	

1. Condition-G=Good, F=Fair, P=Poor.
2. Defects-C= Cracked, D= Delamination, R= Rough, Sc= Scaling, S= Spalling
3. Condition Rebar-LR= Light Rust, SR= Severe Rust, N/A= No rebar exposed
Condition of Epoxy Coating – ECG=Good, ECF=Fair, ECP=Poor-rusted & debonded areas

Core No.		C7		C8		C9	
Location (between gridlines)		'O' and '19'		'A' and '1'		'D' and '4'	
Diameter, mm		100		100		100	
Thickness of Asphalt, mm		90		90		80	
Thickness of Asphalt @ nearest grid point		N/A		N/A		N/A	
Thickness of Concrete, mm		160		120		120	
Full Depth (yes/no)		No		No		No	
Condition of Asphalt ⁽¹⁾		Fair		Fair		Fair	
Waterproofing (W/P) Type		Hot rubberized asphalt with protection board					
Condition of W/P ⁽¹⁾		G		G		G	
W/P Thickness, mm		6 – 8		6 – 8		6 – 8	
Bond of Asphalt or W/P to Concrete		G		G		G	
Defects in Concrete ⁽²⁾		-		-		-	
Condition of Rebar ⁽³⁾		ECG		N/A		N/A	
Corrosion Potential		N/A		N/A		N/A	
Compressive Strength, MPa		-		-		-	
Chloride Content % Chloride by Weight of Concrete	0-10 mm	Total	Corrected	Total	Corrected	Total	Corrected
	20-30 mm	0.045	0.023	0.046	0.024		
	40-50 mm	0.040	0.018	0.040	0.018		
	60-70 mm	0.038	0.016	0.041	0.019		
	80-90 mm	0.029	0.007	0.038	0.016		
	140-150 mm	0.030	0.008	0.040	0.018		
		0.038	0.016	-	-		
AIR VOIDS	Air Content,% Spec. Surf.,mm²/mm³ Spacing Factor, mm	-		-		-	
TEST LABORATORY		BME		BME		-	
REMARKS		Longitudinal epoxy rebar imprint @ 155mm					

1. Condition-G=Good, F=Fair, P=Poor.
2. Defects-C= Cracked, D= Delamination, R= Rough, Sc= Scaling, S= Spalling
3. Condition Rebar-LR= Light Rust, SR= Severe Rust, N/A= No rebar exposed
Condition of Epoxy Coating – ECG=Good, ECF=Fair, ECP=Poor-rusted & debonded areas

Core No.		C10		C11		C12	
Location (between gridlines)		'C' and '8'		'A' and '12'		'E' and '13'	
Diameter, mm		100		100		100	
Thickness of Asphalt, mm		90		100		80	
Thickness of Asphalt @ nearest grid point		N/A		N/A		N/A	
Thickness of Concrete, mm		115		100		80	
Full Depth (yes/no)		No		No		No	
Condition of Asphalt ⁽¹⁾		Fair		Fair		Fair	
Waterproofing (W/P) Type		Hot rubberized asphalt with protection board					
Condition of W/P ⁽¹⁾		G		G		G	
W/P Thickness, mm		6 – 8		6 – 8		6 – 8	
Bond of Asphalt or W/P to Concrete		G		G		G	
Defects in Concrete ⁽²⁾		-		-		-	
Condition of Rebar ⁽³⁾		ECG		ECG		ECG	
Corrosion Potential		N/A		N/A		N/A	
Compressive Strength, MPa		-		44.2		-	
Chloride Content % Chloride by Weight of Concrete	0-10 mm	Total	Corrected	Total	Corrected	Total	Corrected
	20-30 mm	0.038	0.016				
	40-50 mm	0.037	0.015				
	60-70 mm	0.031	0.009	-	-		
	80-90 mm	0.033	0.011				
		0.031	0.009				
AIR VOIDS	Air Content,% Spec. Surf.,mm ² /mm ³ Spacing Factor, mm	-		-		6.6 20.7 0.213	
TEST LABORATORY		BME		Orbit		Orbit	
REMARKS - orientation of rebars and cover - presence of overlay, patch and thickness - other observed defects		Longitudinal epoxy rebar imprint @ 115mm Transverse epoxy rebar imprint @ 100mm		Longitudinal epoxy rebar imprint @ 95mm		Longitudinal epoxy rebar imprint @ 70mm	

1. Condition-G=Good, F=Fair, P=Poor.
2. Defects-C= Cracked, D= Delamination, R= Rough, Sc= Scaling, S= Spalling
3. Condition Rebar-LR= Light Rust, SR= Severe Rust, N/A= No rebar exposed
Condition of Epoxy Coating – ECG=Good, ECF=Fair, ECP=Poor-rusted & debonded areas

Core No.		C13		-	-
Location (between gridlines)		'A' and '19'		-	-
Diameter, mm		100		-	-
Thickness of Asphalt, mm		90		-	-
Thickness of Asphalt @ nearest grid point		N/A		-	-
Thickness of Concrete, mm		120		-	-
Full Depth (yes/no)		No		-	-
Condition of Asphalt ⁽¹⁾		Fair		-	-
Waterproofing (W/P) Type		Hot rubberized asphalt with protection board		-	-
Condition of W/P ⁽¹⁾		G		-	-
W/P Thickness, mm		6 – 8		-	-
Bond of Asphalt or W/P to Concrete		G		-	-
Defects in Concrete ⁽²⁾		-		-	-
Condition of Rebar ⁽³⁾		N/A		-	-
Corrosion Potential		N/A		-	-
Compressive Strength, MPa		51.0		-	-
Chloride Content % Chloride by Weight of Concrete	0-10 mm	Total	Corrected	Total	Corrected
	20-30 mm	-	-	-	-
	40-50 mm	-	-	-	-
	60-70 mm	-	-	-	-
	80-90 mm	-	-	-	-
AIR VOIDS	Air Content,% Spec. Surf.,mm²/mm³ Spacing Factor, mm	-		-	
TEST LABORATORY		Orbit		-	-
REMARKS - orientation of rebars and cover - presence of overlay, patch and thickness - other observed defects		-		-	-

1. Condition-G=Good, F=Fair, P=Poor.
2. Defects-C= Cracked, D= Delamination, R= Rough, Sc= Scaling, S= Spalling
3. Condition Rebar-LR= Light Rust, SR= Severe Rust, N/A= No rebar exposed
Condition of Epoxy Coating – ECG=Good, ECF=Fair, ECP=Poor-rusted & debonded areas

10 Asphalt Sawn Sample Photographs



PHOTO S1 – SAWN SAMPLE SS1



PHOTO S2 – SAWN SAMPLE SS2



PHOTO S3 – SAWN SAMPLE SS3



PHOTO S4 – SAWN SAMPLE SS4



PHOTO S5 – SAWN SAMPLE SS5



PHOTO S6 – SAWN SAMPLE SS6



PHOTO S7 – SAWN SAMPLE SS7



PHOTO S8 – SAWN SAMPLE SS8



PHOTO S9 – SAWN SAMPLE SS9



PHOTO S10 – SAWN SAMPLE S S10



PHOTO S11 – SAWN SAMPLE SS11

11 Asphalt Sawn Sample Logs

Sample No.	SS1	SS2	SS3
Location (between gridlines)	'K' and '5'	'O' and '7'	'M' and '10'
Size, mm X mm	300 x 270	270 x 290	270 x 290
Thickness of Asphalt, mm	90	100	70
Thickness of Asphalt @ nearest grid point	N/A	N/A	N/A
Condition of Asphalt (1)	Fair	Fair	Fair
Waterproofing (W/P) Type	Hot rubberized asphalt with protection board		
W/P Thickness, mm	6 - 8	6 - 8	6 - 8
Condition of W/P (1)	G	G	G
Bond of W/P to Asphalt	G	G	G
Bond of Asphalt or W/P to Concrete	G	G	G
Concrete Cover to Reinf., mm (Note orientation of rebar)	75 long.	73 long.	81 long.
Defects in Concrete Surface (2)	-	-	-
Corrosion Potential @ Nearest Grid Point	N/A	N/A	N/A
Remarks	-	-	-

1. Condition - G = Good, F = Fair, P = Poor.
2. Defects - C = Cracked, D = Delamination, R = Rough, Sc = Scaling, S = Spalling

Sample No.	SS4	SS5	SS6
Location (between gridlines)	'K' and '13'	'M' and '16'	'K' and '19'
Size, mm X mm	270 x 270	280 x 270	290 x 270
Thickness of Asphalt, mm	95	75	80
Thickness of Asphalt @ nearest grid point	N/A	N/A	N/A
Condition of Asphalt (1)	Fair	Fair	Fair
Waterproofing (W/P) Type	Hot rubberized asphalt with protection board		
W/P Thickness, mm	6 - 8	6 - 8	6 - 8
Condition of W/P (1)	G	G	G
Bond of W/P to Asphalt	G	G	G
Bond of Asphalt or W/P to Concrete	G	G	G
Concrete Cover to Reinf., mm (Note orientation of rebar)	80 long.	72 long.	75 long.
Defects in Concrete Surface (2)	-	-	-
Corrosion Potential @ Nearest Grid Point	N/A	N/A	N/A
Remarks	-	-	-

1. Condition - G = Good, F = Fair, P = Poor.
2. Defects - C = Cracked, D = Delamination, R = Rough, Sc = Scaling, S = Spalling

Sample No.	SS7	SS8	SS9
Location (between gridlines)	'D' and '2'	'A' and '7'	'E' and '10'
Size, mm X mm	280 x 300	270 x 300	290 x 300
Thickness of Asphalt, mm	80	100	80
Thickness of Asphalt @ nearest grid point	N/A	N/A	N/A
Condition of Asphalt (1)	Fair	Fair	Fair
Waterproofing (W/P) Type	Hot rubberized asphalt with protection board		
W/P Thickness, mm	6 - 8	6 - 8	6 - 8
Condition of W/P (1)	G	G	G
Bond of W/P to Asphalt	G	G	G
Bond of Asphalt or W/P to Concrete	G	G	G
Concrete Cover to Reinf., mm (Note orientation of rebar)	77 long.	73 long.	70 long.
Defects in Concrete Surface (2)	-	-	-
Corrosion Potential @ Nearest Grid Point	N/A	N/A	N/A
Remarks	-	-	-

1. Condition - G = Good, F = Fair, P = Poor.
2. Defects - C = Cracked, D = Delamination, R = Rough, Sc = Scaling, S = Spalling

Sample No.	SS10	SS11	-
Location (between gridlines)	'A' and '15'	'D' and '17'	-
Size, mm X mm	300 x 330	260 x 300	-
Thickness of Asphalt, mm	100	70	-
Thickness of Asphalt @ nearest grid point	N/A	N/A	-
Condition of Asphalt (1)	Fair	Fair	-
Waterproofing (W/P) Type	Hot rubberized asphalt with protection board		
W/P Thickness, mm	6 - 8	6 - 8	-
Condition of W/P (1)	G	G	-
Bond of W/P to Asphalt	G	G	-
Bond of Asphalt or W/P to Concrete	G	G	-
Concrete Cover to Reinf., mm (Note orientation of rebar)	79 long.	73 long.	-
Defects in Concrete Surface (2)	-	-	-
Corrosion Potential @ Nearest Grid Point	N/A	N/A	-
Remarks	-	-	-

1. Condition - G = Good, F = Fair, P = Poor.
2. Defects - C = Cracked, D = Delamination, R = Rough, Sc = Scaling, S = Spalling

12 Site Photographs



Photo P1 – North Elevation



Photo P2 – South Elevation



Photo P3 – Aerial Overview of Structure



Photo P4 – Aerial Overview of Structure



Photo P5 – General Overview Looking West



Photo P6 – General Overview Looking East



Photo P7 – General Overview Looking South (downstream)



Photo P8 – General Overview Looking North (upstream)



Photo P9 – Typical Condition of Asphalt Riding Surface (fair condition – unsealed cracking)



Photo P10 – Typical Condition of Asphalt Riding Surface (fair condition – unsealed cracking)



Photo P11 – Typical Condition of East Approach (fair condition – unsealed cracking)



Photo P12 – Typical Condition of West Approach (fair condition – unsealed cracking)



Photo P13 – Typical Condition of Soffit from West (fair-to-good condition – wet areas and efflorescence staining at construction joint)



Photo P14 – Typical Condition of Soffit @ West (fair-to-good condition – wet areas and efflorescence staining at construction joint)



Photo P15 – Typical Condition of Soffit from East (fair-to-good condition – wet areas and efflorescence staining at construction joint)



Photo P16 – Typical Condition of Soffit @ South-East (fair-to-good condition – wet areas and efflorescence staining at construction joint)



Photo P17 – Typical Condition of North Barrier Wall (fair-to-good condition – cracking, spalls and patch)



Photo P18 – Typical Condition of North Barrier Wall (fair-to-good condition – cracking, spalls and patch)



Photo P19 – Typical Condition of North Barrier Wall (fair-to-good condition – cracking)



Photo P20 – Typical Condition of South Barrier Wall (fair-to-good condition – cracking and spalls)



Photo P21 – Typical Condition of South Barrier Wall (fair-to-good condition – cracking and spalls)



Photo P22 – Typical Condition of South Barrier Wall (fair-to-good condition – cracking and spalls)



Photo P23 – Typical Condition of East Abutment (fair-to-good condition – cracking)



Photo P24 – Typical Condition of East Abutment (fair-to-good condition – cracking)



Photo P25 – Typical Condition of West Abutment (fair-to-good condition – cracking)



Photo P26 – Typical Condition of West Abutment (fair-to-good condition – cracking)



Photo P27 – Typical Condition of North-East Retaining Wall (fair condition - cracking)



Photo P28 – Typical Condition of North-East Retaining Wall (fair condition - movement)



Photo P29 – Typical Condition of North-West Retaining Wall (fair condition)



Photo P30 – Typical Condition of North-West Retaining Wall (fair condition - movement)



Photo P31 – Typical Condition of South-East Retaining Wall (fair condition)



Photo P32 – Typical Condition of South-West Retaining Wall (fair condition – cracking)

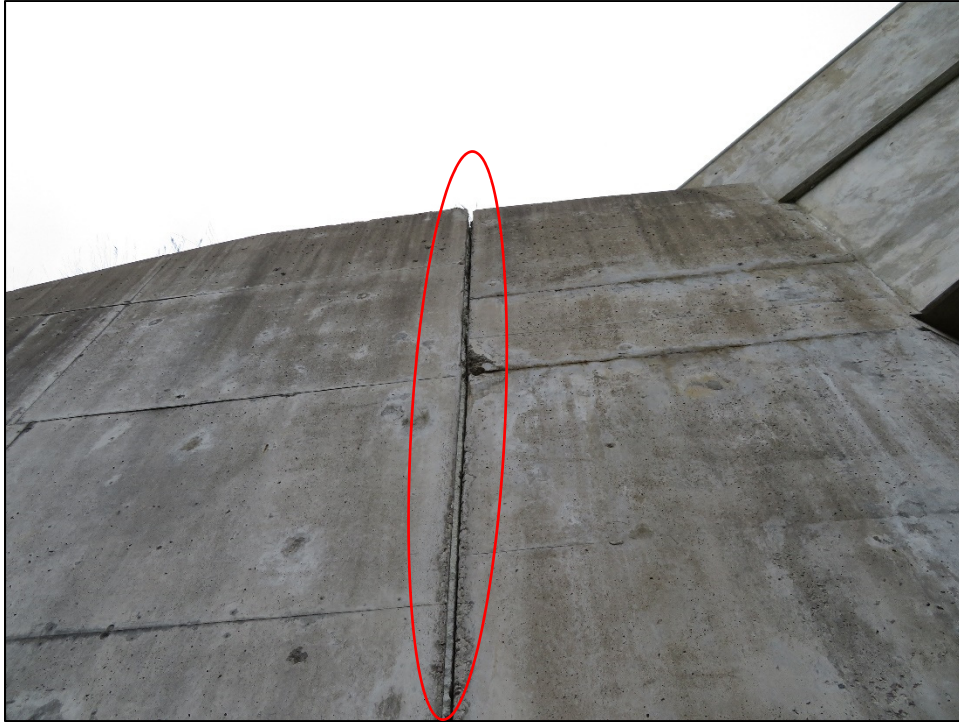


Photo P33 – Typical Condition of South-West Retaining Wall (fair condition – movement)



Photo P34 – Typical Condition of South-East Catchbasin



Photo P35 – Typical Condition of South-West Catchbasin



Photo P36 – Typical Condition of North-East Catchbasin



Photo P37 – Typical Condition of West Slope



Photo P38 – Typical Condition of East Slope



Photo P39 – Typical Condition of South-West Guiderail (connection to end post is separating)



Photo P40 – Typical Condition of South-East Guiderail (connection to end post is separating)



Photo P41 – Typical Condition of North-West Guiderail (connection to end post is separating)



Photo P42 – Typical Condition of North-West Guiderail (minor impact damage)



Photo P43 – Typical Condition of North-East Guiderail (connection to end post is separating)



Photo P44 – Bridge Date Stamp on South Barrier Wall and Site Number Sign

13 Laboratory Test Results

COMPRESSIVE STRENGTH OF CONCRETE CORES

Project Number:	OE18761AC
Site Number:	3801
Location:	Maple Grove Road over Ellis Creek Bridge

Core Number	C3	C6	C11	C13
Location	'M' and '6'	'J' and '16'	'A' and '12'	'A' and '19'
Maximum Nominal Size of Coarse Aggregate (mm)	20	20	20	20
Date Cast	N/A	N/A	N/A	N/A
Date Cored	Sept. 29, 2018	Sept. 29, 2018	Sept. 29, 2018	Sept. 29, 2018
Date Tested	Oct. 5, 2018	Oct. 5, 2018	Oct. 5, 2018	Oct. 5, 2018
Capped Height (mm)	146	100	100	110
Average Diameter (mm)	100	100	100	100
Density (kg/m ³)	2328	2264	2303	2332
Corrected Compressive Strength (MPa)	43.6	39.1	44.2	51.0
* Direction of Loading	Same	Same	Same	Same
Moisture Condition at time of Test	Moist	Moist	Moist	Moist
REMARKS	Average = 44.5 Mpa			

Tested in accordance with CSA A23.2-14C unless otherwise noted.

*Relative to the direction of original placement.



Hafiz Muneeb Ahmad, M.Sc., M.Eng., P.Eng.
Senior Principal

AIR VOID TEST RESULTS

Project Number:	OE18761AC
Site Number:	3801
Location:	Maple Grove Road over Ellis Creek Bridge

Core ID	Air Content (%)	Aggregate Content (%)	Paste Content (%)	Specific Surface (mm ⁻¹)	Spacing Factor (mm)	No. of Void /mm
C5	9.6	63.2	27.2	22.1	0.128	0.533
C12	6.6	63.3	30.1	20.7	0.213	0.344
MTO and CSA A23.1-09 Specifications	3% Minimum				0.230 Maximum (Average)*	

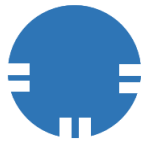
*Clause 4.3.3.3 of CSA A23.1-09 states that the concrete will be considered to have a satisfactory air-void system when the average of all tests shows a spacing factor not exceeding 230 µm, with no single test greater than 260 µm, and air content greater than or equal to 3.0% in the hardened concrete. For concrete with water-to-cementing materials ratio of 0.36 or less, the average spacing factor shall not exceed 250 µm, with no single value greater than 300 µm.

Date Tested: October 16, 2018

Tested By: Jari H. Peikari



Hafiz Muneeb Ahmad, M.Sc., M.Eng., P.Eng.
Senior Principal



BRAMPTON MATERIALS ENGINEERING

8 Automatic Road, Unit 10A, Brampton, ON, L6S 5N4

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C: 647-984-0247 / T: 905-230-0247

Table No. 1: Acid Soluble Chloride Ion in Concrete (MTO Test Method LS - 417)

Client: Orbit Engineering Limited

Date: October 11, 2018

Project Ref.: 3801 Maple Grove Road / OE18761AC

BME Project No.: 1894-OE-CT

Structure: Maple Grove Road over Ellis Creek Bridge

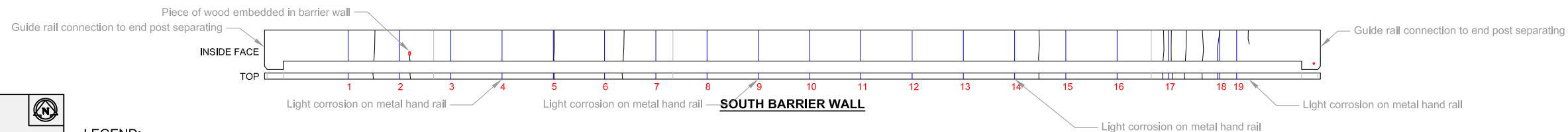
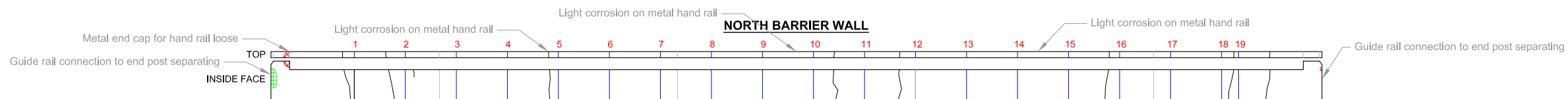
Date Received: October 3, 2018

Core No.	Horizon from the Top of the Core (mm)	Percent Chloride Ion (%)	Percent Chloride Ion Corrected for Background (%)
C2	0-10	0.022	0.000
	20-30	0.032	0.010
	40-50	0.028	0.006
	60-70	0.026	0.004
	80-90	0.023	0.001
C4	0-10	0.026	0.004
	20-30	0.025	0.003
	40-50	0.026	0.004
	60-70	0.031	0.009
	80-90	0.029	0.007
C7	0-10	0.045	0.023
	20-30	0.040	0.018
	40-50	0.038	0.016
	60-70	0.029	0.007
	80-90	0.030	0.008
	140-150	0.038	0.016
C8	0-10	0.046	0.024
	20-30	0.040	0.018
	40-50	0.041	0.019
	60-70	0.038	0.016
	80-90	0.040	0.018
C10	0-10	0.038	0.016
	20-30	0.037	0.015
	40-50	0.031	0.009
	60-70	0.033	0.011
	80-90	0.031	0.009

*The threshold concentration of chloride ion generally regarded to be able to initiate reinforcing bar corrosion is 0.025%

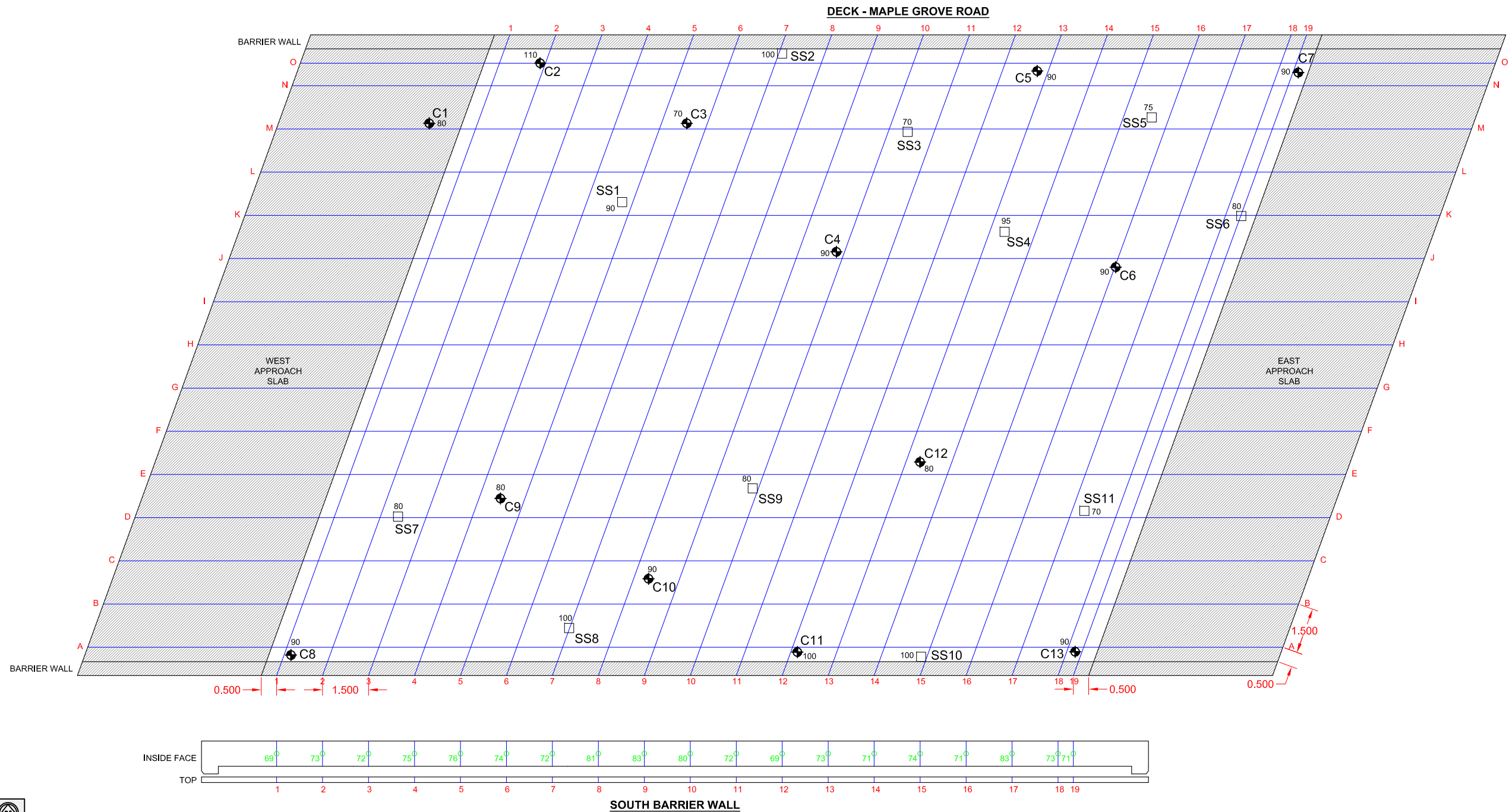
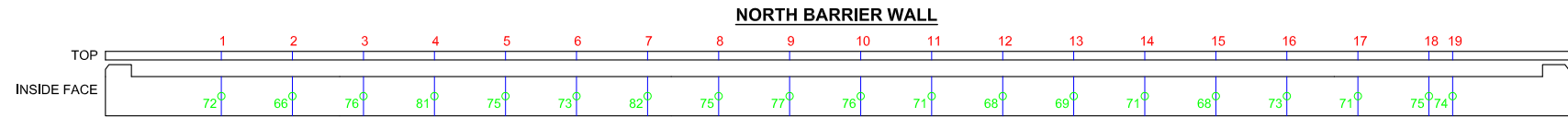
** Background chloride = 0.022%

14 ACAD Drawings



- | | | | | | | | |
|---|------------------------|---|------------------------|---|------------------------------------|---|---|
|  | Core Sample Location |  | Honey-combed Area |  | Concrete cover (Longitudinal) (mm) |  | Ground Location |
|  | Sawn Sample Location |  | Spall |  | Concrete cover (Transverse) (mm) |  | Ground Check Location |
|  | Drain |  | Patched Spall |  | Asphalt Thickness (mm) |  | 0.000 to -0.199 volts |
|  | Wet Area |  | Pot Hole/Asphalt Patch |  | Cover over 60mm |  | -0.200 to -0.299 volts |
|  | Delamination |  | Unsealed Asphalt Crack |  | Cover from 40mm to 60mm |  | -0.300 to -0.349 volts |
|  | Light Scaling |  | Sealed Asphalt Crack |  | Cover from 20mm to 39mm |  | -0.350 to -0.449 volts |
|  | Medium Scaling |  | Medium Stained Crack |  | Cover less than 20mm |  | more negative than -0.450 volts |
|  | Severe Scaling |  | Medium Concrete Crack | | |  | Copper-Copper Sulphate Half-Cell Potential (negative volts $\times 10^{-3}$) |
|  | Light Pattern Cracking |  | Wide Concrete Crack | | | | |

drawn	JP	 ORBITENGINEERING Consulting Engineers	client:		IBI GROUP	
approved	HA		project:		MAPLE GROVE ROAD OVER ELLIS CREEK BRIDGE SITE NUMBER 3801 CAMBRIDGE, ON GPS LOCATION: 43.435260, -80.332996	
date	OCT 2018		title:		SURFACE DETERIORATION OF ASPHALT ON DECK AND CONCRETE BARRIER WALLS	
scale	1:150		project no:		OE18761AC	drawing no://figure no:
original size	TABLOID					1



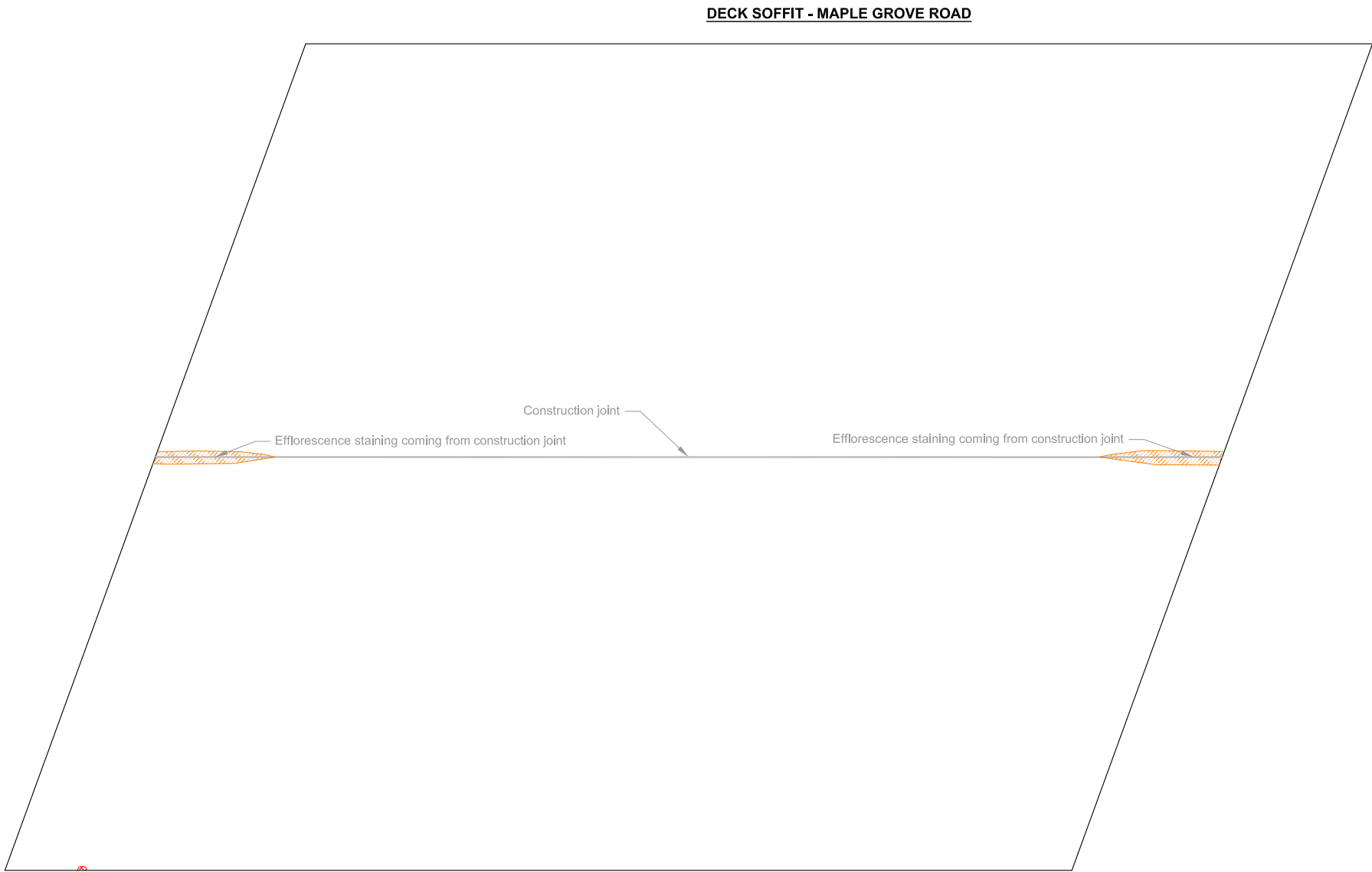
LEGEND:

- | | | | |
|------------------------|------------------------|------------------------------------|--|
| Core Sample Location | Honey-combed Area | Concrete cover (Longitudinal) (mm) | Ground Location |
| Sawn Sample Location | Spall | Concrete cover (Transverse) (mm) | Ground Check Location |
| Drain | Patched Spall | Asphalt Thickness (mm) | 0.000 to -0.199 volts |
| Wet Area | Pot Hole/Asphalt Patch | Cover over 60mm | -0.200 to -0.299 volts |
| Delamination | Unsealed Asphalt Crack | Cover from 40mm to 60mm | -0.300 to -0.349 volts |
| Light Scaling | Sealed Asphalt Crack | Cover from 20mm to 39mm | -0.350 to -0.449 volts |
| Medium Scaling | Medium Stained Crack | Cover less than 20mm | more negative than -0.450 volts |
| Severe Scaling | Medium Concrete Crack | | Copper-Copper Sulphate Half-Cell Potential (negative volts x10 ⁻³) |
| Light Pattern Cracking | Wide Concrete Crack | | |

drawn	JP
approved	HA
date	OCT 2018
scale	1:150
original size	TABLOID

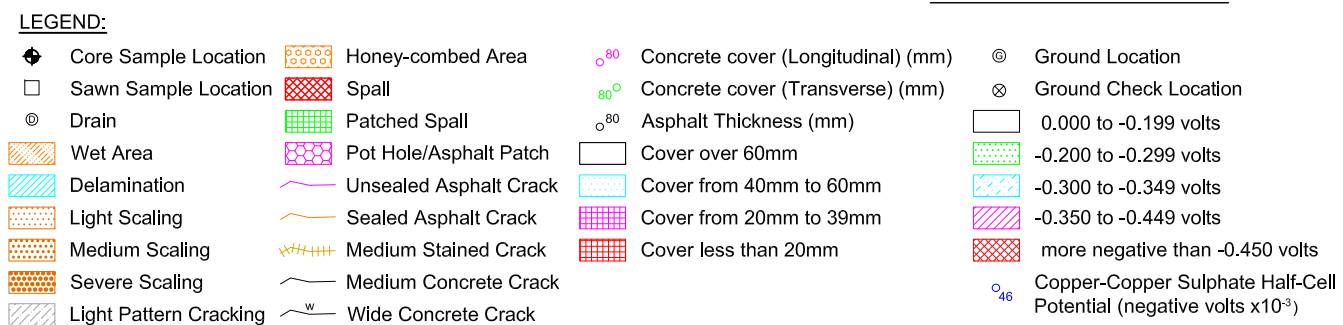
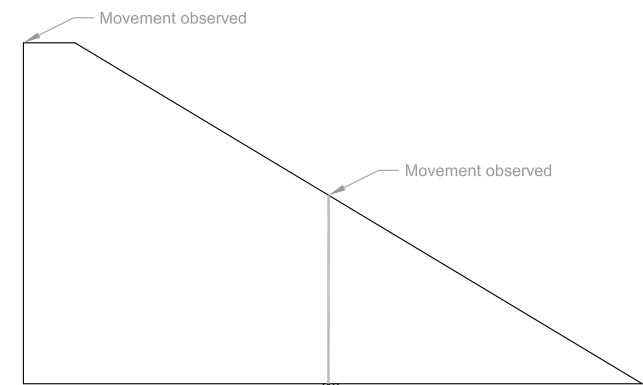
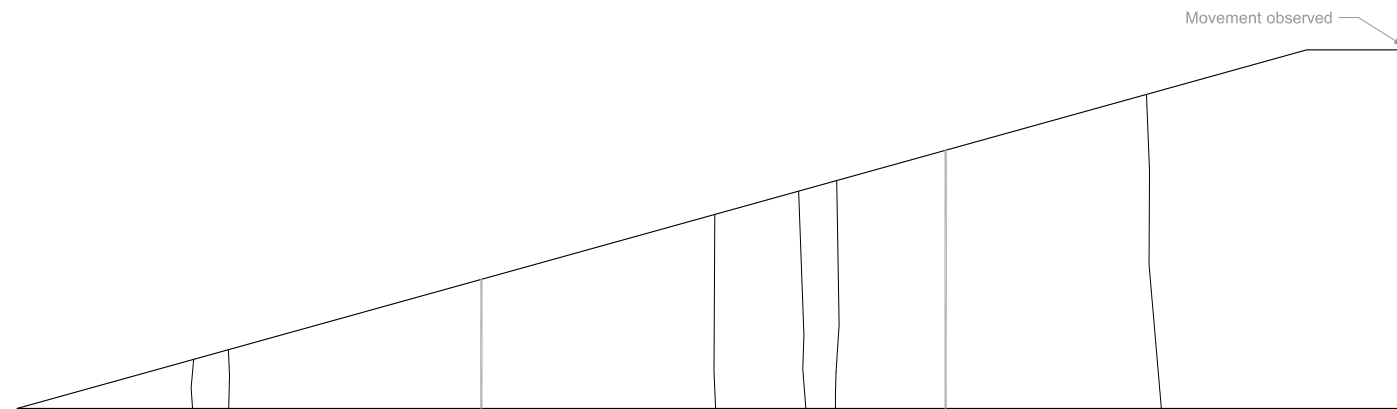
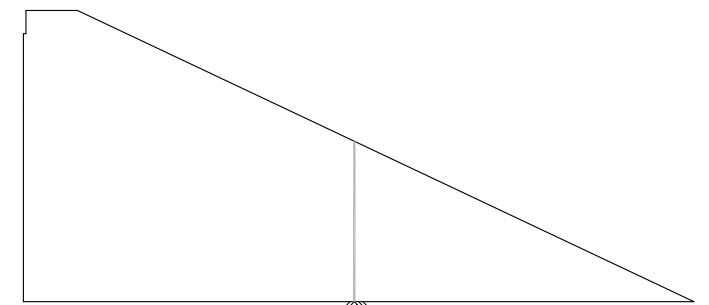
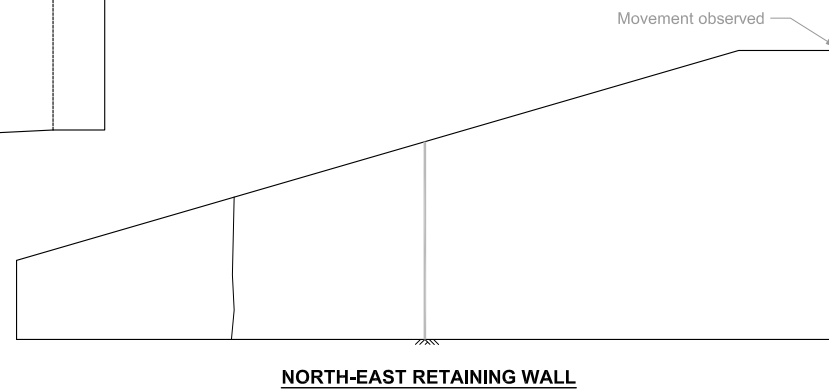
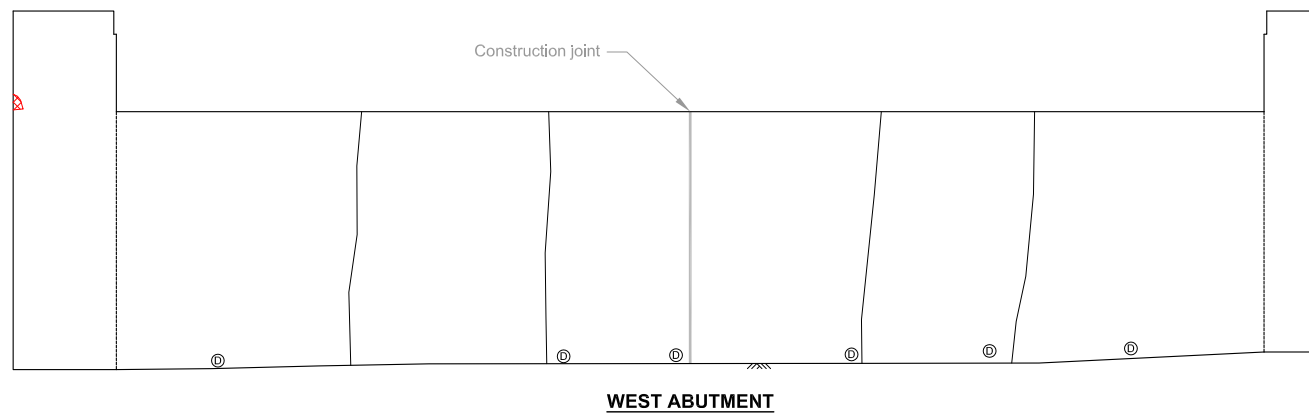


client:	IBI GROUP	
project:	MAPLE GROVE ROAD OVER ELLIS CREEK BRIDGE SITE NUMBER 3801 CAMBRIDGE, ON	
	GPS LOCATION: 43.435260, -80.332996	
title:	ASPHALT THICKNESS OF DECK AT CORE AND SAWN SAMPLE LOCATIONS AND CONCRETE COVER OF BARRIER WALLS	
project no:	OE18761AC	drawing no./figure no: 2



- | | | | | | | | |
|---|------------------------|---|------------------------|---|------------------------------------|---|---|
|  | Core Sample Location |  | Honey-combed Area |  | Concrete cover (Longitudinal) (mm) |  | Ground Location |
|  | Sawn Sample Location |  | Spall |  | Concrete cover (Transverse) (mm) |  | Ground Check Location |
|  | Drain |  | Patched Spall |  | Asphalt Thickness (mm) |  | 0.000 to -0.199 volts |
|  | Wet Area |  | Pot Hole/Asphalt Patch |  | Cover over 60mm |  | -0.200 to -0.299 volts |
|  | Delamination |  | Unsealed Asphalt Crack |  | Cover from 40mm to 60mm |  | -0.300 to -0.349 volts |
|  | Light Scaling |  | Sealed Asphalt Crack |  | Cover from 20mm to 39mm |  | -0.350 to -0.449 volts |
|  | Medium Scaling |  | Medium Stained Crack |  | Cover less than 20mm |  | more negative than -0.450 volts |
|  | Severe Scaling |  | Medium Concrete Crack | | |  | Copper-Copper Sulphate Half-Cell Potential (negative volts $\times 10^{-3}$) |
|  | Light Pattern Cracking |  | Wide Concrete Crack | | | | |

drawn	JP	 ORBITENGINEERING Consulting Engineers	client: IBI GROUP	
approved	HA		project: MAPLE GROVE ROAD OVER ELLIS CREEK BRIDGE	
date	OCT 2018		SITE NUMBER 3801 CAMBRIDGE, ON GPS LOCATION: 43.435260, -80.332996	
scale	1:150		title: SURFACE DETERIORATION OF SOFFIT	
original size	TABLOID		project no: OE18761AC	drawing no./figure no: 3



drawn	JP	 ORBITENGINEERING Consulting Engineers	client: IBI GROUP	
approved	HA		project: MAPLE GROVE ROAD OVER ELLIS CREEK BRIDGE SITE NUMBER 3801 CAMBRIDGE, ON GPS LOCATION: 43.435260, -80.332996	
date	OCT 2018		title: SURFACE DETERIORATION OF ABUTMENTS AND RETAINING WALLS	
scale	1:150		project no: OE18761AC	
original size	TABLOID		drawing no./figure no: 4	