

REPORT

DETAILED BRIDGE DECK
CONDITION SURVEY

Argyle Street South Bridge
Old Highway 6 over the Grand River
Caledonia, Haldimand County

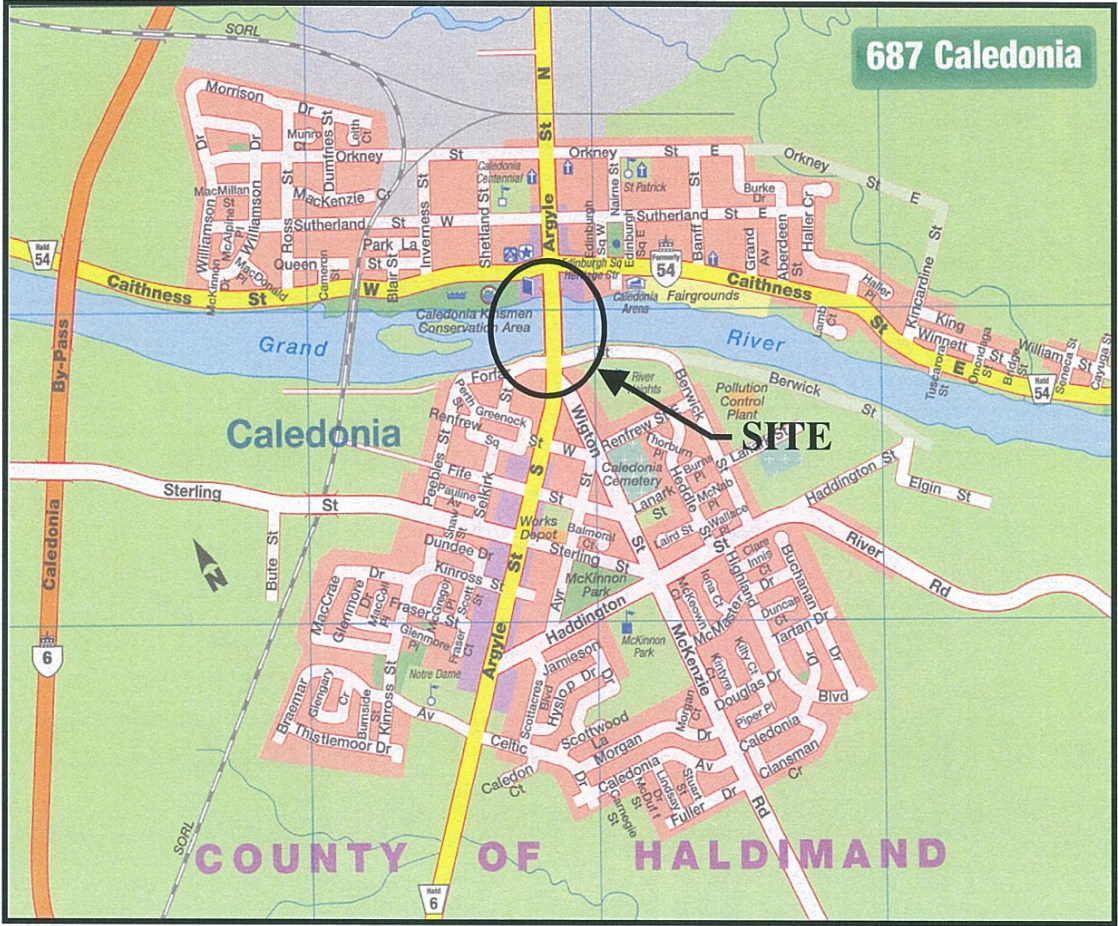
Site #9-002

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STRUCTURE IDENTIFICATION SHEET			
GENERAL INFORMATION			
STRUCTURE NAME <u>Argyle Street South Bridge over the Grand River</u>			
SITE NUMBER <u>9-002</u>		DISTRICT NUMBER <u>N/A</u>	
HIGHWAY <u>above Old Highway 6</u>		below <u>none</u>	
TYPE OF STRUCTURE <u>Reinforced concrete bowstring arches with concrete beams</u>			
NUMBER OF SPANS <u>9</u>		SPAN LENGTH (m) <u>9 @ 22.13m each</u>	
ROADWAY WIDTH <u>7.01m</u>		YEAR BUILT <u>1927</u>	
DIRECTION OF STRUCTURE <u>North to South</u>			
SEQUENCE NUMBER <u>N/A</u>		TOWNSHIP NUMBER <u>143-Seneca</u>	
LHRS NUMBER <u>N/A</u>		BRIDGE NUMBER (MUNIC.) <u>N/A</u>	
LOCATION <u>Caledonia, Haldimand County</u>		JURISDICTION <u>MTO</u>	
INSPECTORS NAME <u>Scott Quach, P. Eng.</u>			
PARTY MEMBERS <u>Kamal Shaibon, P.Eng., Paul Locham, CET, Joel Borcillo, Kyle Rainbow, Kwame Johnson</u>			
DATE OF INSPECTION <u>May 22 to 25, and August 9, 2007</u>			
TEMPERATURE <u>23 to 28 °C</u>		WEATHER <u>Periods of rain</u>	
MTO REGION <u>Southwest</u>		AADT <u>N/A</u>	
DECK RIDING SURFACE <u>Asphalt</u>			
YEAR LAST REHABILITATED <u>1983</u>			
ENGINEER'S STAMP			

2.0 KEY PLAN



3.0 SUMMARY OF SIGNIFICANT FINDINGS

3.1 Description of Structure

The existing Argyle Street South Bridge over the Grand River in Caledonia is a nine span reinforced concrete bowstring arched structure. Constructed originally in 1927 as a two lane road, the bridge was rehabilitated with new concrete overlay, waterproofing membrane, asphalt pavement, and new deck expansion joint system on the top deck, shotcrete repair on deck soffit, and patch repairs of substructures in 1983. The bridge is currently posted with a load limit of L1 = 18 tonnes, L2 = 32 tonnes, and L3 = 45 tonnes resulting from a 2001 evaluation conducted by the Ministry.

There are several utility lines on the bridge structure. All utility lines (Bell Canada in 9 PVC ducts and 2 coaxial cables, a Mountain Cablevision cable, and a Haldimand County Hydro line) are suspended along the underside of the bridge deck. There is no evidence of embedded conduits in the concrete bridge structure.

This detailed condition survey was performed as an update of the Morrison Hershfield's 2003 detailed bridge deck condition survey of the bridge structure. A close up inspection of the bridge underside using the Bridgemaster Inspection Vehicle was also completed over the same time period as the inspection work on the deck surface to minimize disruption of traffic crossing the bridge. General views of the bridge deck are shown on Photos 1 to 5 in Appendix "G".

3.2 Asphalt Surface and Waterproofing

The deck asphalt wearing surface is in good condition. Top surface of the asphalt is generally lightly ravelled at areas adjacent to the concrete curbs. There are few light longitudinal unsealed cracks on the deck asphalt surface at the centerline of the roadway. A localized light depression with narrow progressive edge cracks presents on the asphalt surface near the northwest corner of Span 8; Core C-21, taken in the area, showed no significant defects in the asphalt or the concrete bridge deck (Photo 6). No significant deterioration of the asphalt was found in any of the cores and sawn asphalt samples taken on the bridge deck.

Two lifts of asphalt were encountered in several of the cores and sawn asphalt samples that were taken near or adjacent to the concrete curbs. Thickness of the top course ranges from 30mm to 50mm, averaging 42mm. A poor bonding condition was found in Sawn Asphalt Sample SAS-7, located near the southwest corner of Span 4; all other samples showed fair to good bonding condition between the asphalt lifts.

Total asphalt thickness, measured at cores and sawn asphalt samples, varies from 50mm to 100mm with an average of 72mm. Considering those cores and sawn asphalt samples that were taken in the 2003 inspection, the asphalt thickness would vary from 50mm to 105mm with an overall average of 72mm (see Drawing 9-002-01 and 9-002-02 in Appendix "H"). The asphalt thickness was generally found to be less at the samples taken towards the centerline of the roadway. Thickness of the asphalt was not measured in drilled holes at grid points for half-cell tests since all holes were intentionally drilled deeper into the concrete ensuring proper half-cell test results.

The bridge deck waterproofing system is made up of rubberized bituminous asphalt covered with a mastic protection board. A layer of premoulded rubberized membrane embedded in the waterproofing layer is evident in all the cores and sawn asphalt samples that are located within 300mm of the concrete curbs (C-1, C-4, C-7, C-13, C-18, SAS-3, SAS-7, SAS-8, and SAS-9). The system has a total thickness ranging from 3mm to 13mm with an average of 7mm. The waterproofing is generally in fair to good condition and is generally well bonded to the concrete deck surface.

3.3 Concrete Deck Slab

The concrete deck slab is in fair condition. Total thickness of the concrete deck, 200mm shown on the original 1927 drawings plus 50mm (56mm less 6mm scarification depth) concrete overlay shown on the 1983 rehabilitation drawings, is 250mm. Cores C-11 and C-13, taken through the deck near the east side mid section of Span 1 and the southwest corner of Span 2, respectively showed a total slab thickness of 275mm and 278mm. It should be noted that two core samples taken through the deck in the 2003 inspection indicated the total slab thickness of 290mm near the southwest corner of Span 4 and 305mm near the centre southern end of the deck slab at Span 1.

A total of twenty-four cores and eleven sawn asphalt samples were taken in the asphalt covered deck area. Concrete overlay was encountered in all of the core samples. Thickness of the overlay layer ranges from 50mm to over 245mm with an average of 113mm. Bond between the overlay and the concrete deck is generally good, except for Cores C-18 and C-23 taken in Span 6 and 9 of the bridge deck that showed a poor to fair bonding condition. Longitudinal construction joint in the concrete overlay was encountered in Core C-1 near the east curb in Span 7 and in Core C-23 near the centerline of the road in Span 9; saw cut mark extending 60mm depth into the original concrete deck was also revealed in Core C-23 below the construction joint in overlay layer. It should be noted that the extra thick concrete overlay is most likely included local patches and through slab repair on the original bridge deck.

All cores and sawn asphalt samples showed no significant defects on the top concrete overlay layer, except for a narrow longitudinal crack at the top 20mm of the overlay in Core C-14 and a narrow transverse crack at the bottom 110mm in Core C-9. No significant deterioration of the original concrete deck below the overlay layer in any of the core samples.

Out of the total 24 cores taken in the deck slab, 15 cores intercepted reinforcing rebars in the concrete deck. Epoxy coated reinforcing steel bars were intercepted in the concrete overlay layer at 3 of the 15 core locations (Cores C-9, C-11, and C-13); concrete cover to the epoxy bars ranges from 75mm in Core C-11 to 240mm in Core C-9. The remaining twelve cores intercepted black smooth round bars in the original concrete bridge deck layer; concrete cover to the intercepted rebars ranges from 126mm to 270mm, with an average of 220mm. Concrete cover, measured at the sawn asphalt samples, ranges from 83mm to 179mm with an average of 135mm. It should be noted that the 1927 structural drawings indicated only a bottom reinforcing steel mat in the bridge deck, thus explaining the extra thick concrete cover encountered in the samples. Concrete cover meter readings were not identifiable at two of the sawn asphalt samples (SAS-1 and SAS-4) due to excessive cover depth as evident in the core samples.

Due to the lack and the excessive depth of reinforcing steel bars intercepted in the core samples, corrosion potential survey could only be completed on 7 of the 9 deck spans. As indicated in the MTO Rehabilitation Manual (Revision 9 dated April 2004)

and the 2003 Detailed Condition Survey Report by Morrison Hershfield (June 2003), a half-cell survey of a bridge deck with black smooth round bars is not possible or unreliable as there is no continuity between the bars. Nevertheless, it is understood that the corrosion potential surveys completed on this bridge deck are to compare the results with the previous 2003 results and for a general trend of potential over the deck area. Where surveyed, the corrosion potential readings (Drawings 9-002-03 and 04 in Appendix "H") indicate a localized area of active corrosion at the northeast corner of deck at Span 4. Uncertain corrosion activity areas were generally found in areas adjacent to the deck expansion joints and the concrete curbs. The results of this survey correlate well with the previous 2003 survey results. Judging for the readings, the concrete bridge deck has become more active in the corrosion activity since 2003.

Concrete compressive strength of the original concrete deck slab, measured in Cores C-2, C-13, and C-22 extracted from Span 6, 2, and 8 of the bridge deck, was found to be 70.0 MPa, 64.9 MPa, and 57.2 MPa, respectively. Previous test results in 2003 showed the 50.4 MPa original concrete in Span 9 and 68.0 MPa in Span 4. Specified compressive strength of the original concrete deck is unknown.

Air void analysis was not performed since it is known that the concrete bridge deck constructed in 1927 would be non air-entrained concrete.

Chloride content was measured in Cores C-6, C-21, and C-24 taken near deck expansion joints in Span 4, 8, and 9, respectively. Chloride concentration was checked only in the original concrete portion in Core C-6 (6 alternating 10mm strips from 130mm to 240mm concrete depth) and from the top of the overlay to the original concrete deck in Cores C-21 (9 strips from top to 170mm depth) and C-24 (8 strips from top to 150mm depth). When corrected to account for an assumed background chloride content of 0.049% for concrete overlay (assumed value in 2003) and 0.022% for the original concrete deck, the concrete was found to be highly chloride-contaminated at the top surface extending down to 220mm depth at the location of Core C-6 and to 130mm depth at the locations of Cores C-21 and C-24. Considering the observed concrete cover in the core samples (270mm cover in C-6, 210mm in C-21, and 246mm in C-24), chloride contamination is not a concern at the location of the tested cores. However, the test results imply that all top reinforcing steel bars, particularly those epoxy coated bars in the concrete overlay layer lie in chloride-contaminated concrete.

3.4 Deck Underside

Refer to Drawings 9-002-05 and 06 in Appendix “H” for observations on the deck underside.

The underside of the deck was surveyed with the aid of the Bridgemaster Inspection Vehicle. The underside surface of the deck is generally in poor to fair condition with numerous concrete patches, delamination, and spalls areas (Photos 22 to 24). Previous shotcrete repairs on the deck soffit are evident throughout the entire length of the bridge deck. Through slab repairs are also evident at several locations of the soffit at Spans 1 to 4. Delamination areas on the deck soffit were found primarily in the vicinity of the deck drains (Photo 25), concrete patches, underside of the sidewalks, as well as on the interior soffit areas at Span 1 and Spans 3 to 8 of the bridge deck. Localized spalled pockets, showing medium to severe rust on exposed reinforcing steel (Photo 26), occurred in places in the delamination areas on the deck soffit. Several narrow to medium cracks with light wet staining were also found in places on the deck soffit surface.

3.5 Components

The concrete curbs (located between the traffic lane and the concrete arch) and the sidewalks (between the arch and railing) are in good condition (Photos 16 and 17). The concrete curbs were completely replaced in 1983 as part of the deck rehabilitation. The sidewalks were repaired and overlaid with latex modified concrete during the rehabilitation project. There are several hairline to narrow cracks, running longitudinally, on the sidewalk surface. No delamination was detected during chain dragging of the sidewalk surfaces. Core C-26, taken in the west sidewalk near the south end of the bridge, showed a total concrete sidewalk thickness of 160mm with a 35mm thick concrete overlay layer at the top. No significant defect was encountered in the core sample. The core intercepted a longitudinal #4 smooth black bar at 127mm cover.

The east and west concrete railings, over the bridge length, are generally in fair to good condition with localized small delamination and spalled areas (Photo 18). A medium to wide horizontal crack was found running continuously over two rail panels, across the top of the ballasters and posts, presents at the south end of the east

rail at Span 5 (Photo 19). The north approach end panel of the west rail was also found cracked along the bottom of the rail panel. Refer to Drawings 9-002-05 and 06 in Appendix “H” for observations of the railings.

Surface drainage is provided through 54 drain pipes, 6 per deck span, on the bridge deck. Each deck drains is 219mm OD galvanized steel pipe. All drains are in fair to good condition with light to medium rust on the downspout end. The drains were installed as part of the deck rehabilitation in 1983.

All expansion joints at the north and south ends of the deck and at the piers are of a strip seal type. All deck joints including seals, concrete end-dams, top of ballast walls, and steel armouring angles were completely replaced during the 1983 rehabilitation of the bridge structure. All joint seals were typically filled with sand/gravel and roadway debris (Photos 7 and 8). Where inspected, the seals were found to be in good condition. All concrete dams typically exhibit small pockets of shallow spalls along the length of the joint steel angles. Isolated large shallow spalled areas present on concrete dams at the location Piers 2 to 4, and at Pier 8 (Photo 9). A 1.7m section of steel nosing angle at top corner of the concrete ballast wall at the northwest corner appeared to have been torn off by a plow (Photo 10). Damaged from plows was also noted on the joint steel angle at Pier 2 near the centerline of the road (Photo 11).

The supporting concrete arches and floor beams are generally in fair condition (Photos 4, 5, and 12). Refer to Drawings 9-002-05, 06, and 07 to 10 in Appendix “H” for observations on the concrete floor beams and arches. Above the bridge deck, severe deterioration (cracks, delamination, and spalls) was generally noted on the lower portion of the concrete arches and the concrete hangers (Photos 14 and 15). Localized delamination and shallow spalled areas were found on the top surface above the bridge deck at some of the arches (Photo 13). Below the deck, areas of shotcrete patches were found in places on the bottom arch chords and floor beams over the bridge length. Significant deterioration on the bottom chords occurred mainly in areas adjacent to the deck drainage pipes and at the end areas near the bearings where the concrete was generally found to be largely delaminated, some with severe spalled (Photos 25, 27, and 28). A diagonal crack, typically extending from the bottom surface near bearing shoe plate to deck soffit along the top arch chord profile, was generally noted on the outside face of the arch bottom chord at the piers

and the abutment ends; many of these cracks were routed and caulked (Photo 31), except for the cracks at Pier 1 (north side, east and west chords, Photo 32), Pier 4 (south side, west chord), and at Piers 6 and 7 (north side, east chords). It should be noted that the diagonal crack at the end of the bottom chord appeared to coincide with the location of an exposed bent steel plate for rebar anchorage observed at Pier 7, east side (Photos 33 and 34). A localized severe honeycombing pocket showing large cavity or hole, approximately 130mm x 300mm opening size, was found on the underside of the east bottom chord at junction with a floor beam north of Pier 2; several layers of light to medium rusted rebars were visible in the cavity (Photos 29 and 30). All concrete end floor beams between the bottom chords at the piers and the abutments were completely reconstructed during the 1983 bridge rehabilitation and are generally in good condition. The exterior end floor beams below the sidewalks, however, appeared to have been replaced in places, where not replaced, the exterior floor beams were found patched with shotcrete; cracks, delamination, and spalls were generally noted on the original patched end floor beams (Photo 34). Several of the intermediate floor beams are in poor condition with severe cracks, delamination, and spalls, particularly the beams at Span 2 (Photos 35 and 36).

Bearings at the abutments and piers are generally covered with concrete debris and shotcrete patches, where observable, the bearings are in fair to good condition. The bridge bearings typically seat on concrete pedestal bearing seats, except for the east and west bearings at Pier 3 and the west bearings at Pier 4 and 5 where the pedestals are made of steel (un-painted steel stub column, Photo 38). Expansion bearings, elastomeric bearing type, typically located on the north side of each arch, were installed as part of the 1983 bridge rehabilitation; galvanized steel shim plates were found protruding from the bearings at several locations. Fixed bearings, typically located on the south side of each arch, were generally not visible except for those atop of the steel pedestals at Pier 3 to 5 where a thin layer of neoprene material was found present.

The concrete substructure (abutments, piers, wingwalls, and retaining wall) is generally in fair to good condition (Photos 39 to 49). Refer to Drawings 9-002-11 and 12 for observations on the concrete substructures. Horizontal construction joints are presented at all piers and abutment walls. Significant deterioration of the concrete, namely delamination and light scaling, was generally found in the areas of the construction joints. Cracks on the substructures, mostly medium vertical cracks,

were also found extending between the construction joints or from the joints to the top bearing seat or the ground surface. A wide crack, extending from north to south faces, was noted on the upper portion of Pier 2 (Photo 41). Shallow spalled or severe scaling pocket was noted on the top central bearing seat of Pier 6 (Photo 42). Rocks and boulders for scour protection are presented at all the piers. Numerous graffiti presents on both abutment walls. At the south abutment end, the south embankment slope is covered with a timber boardwalk for pedestrian crossing under the bridge (Photo 50); large concrete blocks are present for the protection of the south embankment slope below the bridge deck (Photo 47). There is no slope protection on the embankment at the north abutment end.

The approach roadways are in good condition. There is no crack on the roadway asphalt surface in the vicinity of the bridge deck (Photos 20 and 21). Core C-25, taken in the south approach roadway, showed a 165mm thick asphalt pavement on granular roadbase; no concrete approach slab was encountered in the core sample. The approach curbs and sidewalks are in good condition with few narrow and medium cracks. A short section of steel pipe handrail is located on the approach sidewalk at the northeast, southeast, and at the southwest corners of the bridge structure; the original pipe handrail was removed from the sidewalk at the northwest corner of the bridge. All pipe handrails are in fair to good condition.

APPENDIX A
Detailed Condition Survey Summary Sheets

-A1-
DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE

Page 1 of 3

Site Number: 9-002

1. Dimensions and Area of Survey

Width between N abutment curbs 7.01 m. Width between W abutment curbs 7.01 m.

Length between abutment joints 199.14 m. Area of deck riding surface 1396.0 m².

2. Asphalt Surface Cracks

Orientation	Unsealed (m)	Sealed (m)
Transverse	--	--
Longitudinal	23	--
Random	--	--

3. Asphalt Condition and Depth

Condition *	Depth		
	Min (mm)	Max (mm)	Avg (mm)
F-G	50	100	72

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

4. Waterproofing

Type	Condition *	Conc. Bond *	Thickness (mm)		
			Min	Max	Avg
**	F-G	G	3	13	7

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

5. Concrete Cover – Cores and Sawn Samples

Minimum (mm)	Maximum (mm)	Average (mm)
75	270	178

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

Remarks

Dimensions of the deck were taken from the structural drawings.

The deck asphalt wearing surface is in good condition with few unsealed longitudinal cracks. Top surface of the asphalt is typically lightly ravelled at areas adjacent to the curbs. A localized light depression with narrow progressive edge cracks presents on the asphalt surface near the northwest corner of Span 8. No significant deterioration of the asphalt was found in any of the cores and sawn asphalt samples taken on the bridge deck.

Asphalt depth is measured in cores and sawn asphalt samples.

** Waterproofing is made up of rubberized asphalt covered with protection board. A layer of premoulded rubberized membrane embedded in the waterproofing layer is evident in cores and sawn asphalt samples that are taken adjacent to the curbs.

A total of 15 cores intercepted reinforcing steel in the bridge deck. Three of the cores revealed epoxy coated rebars in the concrete overlay layer at 75mm to 240mm cover. The remaining twelve cores intercepted black smooth round bars in the original concrete bridge deck layer with concrete cover ranging from 126mm to 270mm, averaging of 220mm. Cover meter readings were not identifiable at two of the sawn asphalt samples (SAS-1 and SAS-4) due to excessive cover depth as evident in the core samples.

It should be noted that 1927 structural drawings showed only a bottom reinforcing steel mat in the bridge deck, thus explaining the extra thick concrete cover encountered in the samples.

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DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE

Site Number: 9-002

6. Corrosion Activity

Minimum (V)	Maximum (V)	Average (V)
-0.14	-0.36	-0.19

0 to -0.20	-0.20 to -0.30	-0.30 to -0.35	-0.35 to -0.45	< -0.45	V
592	260	1	--	--	m ²
69.4	30.5	0.1	--	--	%

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 - 0.20	16	--	--	--	--	--	--
- 0.20 to - 0.35	7	--	--	--	--	--	--
≤ - 0.35	--	--	--	--	--	--	--

8. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (Volts)		0 to - 0.20	- 0.20 to - 0.35	≤ - 0.35
Chloride Content *	0 – 10 mm	0.181	0.177	
	20 – 30 mm	0.150	0.146	
	40 – 50 mm	0.119	0.097	
	60 – 70 mm	0.093	0.093	
	80 – 90 mm	0.071	0.062	
	100 – 110 mm	0.058	0.036	
	120 – 130 mm	0.031	0.026	
	140 – 150 mm	0.005	0.98**	
	160 – 170 mm		0.071**	
	170 – 180 mm		0.129**	
	190 – 200 mm		0.084**	
	210 – 220 mm		0.044**	
	230 – 240 mm		0.013**	

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

Accurate measurement of the half-cell readings was not possible on the bridge deck. Rebars intercepted in the cores are typically black smooth round bars which have been known to be electrically discontinuous, as such, the half-cell results should be treated as indicative only.

Due to the lack and the excessive depth of reinforcing steel bars in the concrete bridge deck, corrosion potential survey could only be completed on 7 of the 9 deck spans and only half of the deck was surveyed in 3 of the 7 spans.

All cores and sawn asphalt samples showed no significant defects on the top concrete overlay layer, except for a narrow longitudinal crack at the top 20mm of the overlay in Core C-14 and a narrow transverse crack at the bottom 110mm in Core C-9. No significant deterioration of the original concrete deck below the overlay layer in any of the core samples.

Chloride content was measured in Cores C-6, C-21, and C-24 taken near deck expansion joints. Chloride concentration was checked only in the original concrete portion in Core C-6 (130mm to 240mm depth, uncertain potential area) and from the top of the overlay to the original concrete deck in Cores C-21 (9 strips to 170mm depth, uncertain area) and C-24 (8 strips to 150mm depth, inactive area).

** Values shown include the measurements obtained for Core C-6.

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DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE

Site Number: 9-002

9. Chloride Content at Level of Rebar

Core No.	6	21	24					
Chloride content *	0	0	0					

*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					
	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

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					
G2		N/A				
G3			N/A			
G4				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 ____ No ✓ Marginal ____

13. Compressive Strength

Average Compressive Strength 64.0 MPa

Remarks

Considering the observed concrete cover in the core samples (270mm cover in C-6, 210mm in C-21, and 246mm in C-24), chloride contamination is not a concern at the location of the tested cores.

AC Resistance, IR Drop and Half-Cell Potential measurements are not included in the scope for this assignment.

The bridge deck was constructed prior to 1958, the concrete is not expected to be air entrained.

Concrete compressive strength of the original concrete deck slab, measured in Cores C-2, C-13, and C-22 extracted from Span 6, 2, and 8 of the bridge deck, was found to be 70.0 MPa, 64.9 MPa, and 57.2 MPa, respectively

- A4 -
DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

Component Type Deck Soffit
& Location

OSIM Identifier

1. Dimensions and Area

Width 12.80m Length 199.14m Height m
Diameter m Total Area Surveyed 1,851.70m² (Area excluding girders)

2. Cracks (medium and wide)

Type		Trans.	Long'inal	Other	Total (m)
Medium Width	Clean	--	--	--	--
	Stained	--	--	--	
Wide Width	Clean	--	--	--	--
	Stained	--	--	--	

Remarks

There are several narrow cracks with light wet staining on the deck soffit surface.

3. Alkali aggregate reaction

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

Items 3 to 5 are not required for this assignment.

4. Concrete Cover

Minimum	Maximum	Average	
			mm
0 – 20 mm		40 – 60 mm	m ²
			%
20 – 40 mm		Over 60 mm	m ²
			%

5. Corrosion Activity

Minimum		Maximum		Average	
V					

0 to - 0.20	-0.20 to - 0.30	- 0.30 to - 0.35 (V)	- 0.35 to - 0.45	< - 0.45

	m ²
	%

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DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

Remarks

Previous shotcrete repairs on the deck soffit are evident throughout the entire length of the bridge deck. Through slab repairs are also evident at several locations of the soffit at Spans 1 to 4. Delamination areas on the deck soffit were found primarily in the vicinity of the deck drains, concrete patches, underside of the sidewalks, as well as on the interior soffit areas at Span 1 and Spans 3 to 8 of the bridge deck. Localized spalled pockets, showing medium to severe rust on exposed reinforcing steel, occurred in places in the delamination areas on the deck soffit.

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m2)	154.00	7.00	430.00
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ - 0.35	
161.00m ²	8.69%	N/A	N/A

7. Scaling

Light	Medium	Severe to Very severe	
--	--	--	m ²
--	--	--	%

8. Honeycombing

Total Area -- m².

9. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (Volts)		0 to - 0.20	- 0.20 to - 0.35	≤ - 0.35
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.

Items 9 and 10 are not required for this assignment.

10. Chloride Content at Level of Rebar

Core No.								
Chloride content *								

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

DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

11. AC Resistance Test Data of Epoxy Coated Rebar

Remarks

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

Items 11 to 14 are not required for this assignment.

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? Yes ____ No ____ Marginal ____

14. Compressive Strength

Average Compressive Strength _____ MPa

DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

Component Type East & West Arches, Spans 1 to 9
& Location

OSIM Identifier _____

1. Dimensions and Area

Width ____ Length: ____ Height ____
Diameter _____m Total Area Surveyed 2286.0m²

2. Cracks (medium and wide)

Type		Horizontal	Vertical	Other	Total
Medium Width	Clean	9.2m	10.5m	-	19.7m
	Stained	-	-	-	
Wide Width	Clean	8.9m	7.7m	**47.0m	39.4m
	Stained	-	-	-	

3. Alkali aggregate reaction
4. Concrete Cover
5. Corrosion Activity

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m2)	89.5	10.6	66.5
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ - 0.35	
100.1 m ²	4.4%	N/A	N/A

7. Sealing

Light	Medium	Severe to Very severe
1.5 m ²	--	--
0.1%	--	--

8. Honeycombing
9. Adjusted Chloride Content Profile
10. Chloride Content at Level of Rebar
11. AC Resistance Test Data of Epoxy Coated Rebar
12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar
13. Concrete Air Entrainment
14. Compressive Strength

Remarks

* Dimension of each arch:
Width:- 0.61m Top Chord
0.41m Bottom Chord
0.36m Hanger
Length: 23.90m Top Chord
22.13m Bottom Chord
0.36m Hanger
Height: 0.71m Top Chord
0.63m (ext), 0.45m (int), bottom chord
0.4m to 3.32m Hanger Columns
Total area of each arch = 127.0 m2.

** Repaired cracks (routed and caulked) on bottom chords.

Above the bridge deck, severe deterioration (cracks, delamination, and spalls) was generally noted on the lower portion of the concrete arches and the concrete hangers. Localized delamination and shallow spalled areas were found on the top surface above the bridge deck at some of the arches. Below the deck, areas of shotcrete patches were found in places on the bottom arch chords and floor beams over the bridge length. Significant deterioration on the bottom chords occurred mainly in areas adjacent to the deck drainage pipes and at the end areas near the bearings where the concrete was generally found to be largely delaminated, some with severe spalled. A diagonal crack, typically extending from the bottom surface near bearing shoe plate to deck soffit along the top arch chord profile, was generally noted on the outside face of the arch bottom chord at the piers and the abutment ends; many of these cracks were routed and caulked, except for the cracks at Pier 1, Pier 4 (south side, west chord), and at Piers 6 and 7 (north side, east chords).

- A8 -
DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

Component Type Interior Floor Beams, Spans 1 to 9
& Location

OSIM Identifier

1. Dimensions and Area

Width: 0.41m Length: 7.61m Height 0.45 m
Diameter _____m Total Area Surveyed : 1076.7m²

2. Cracks (medium and wide)

Type		Trans.	Long'inal	Other	Total
Medium Width	Clean	2.0m	--	--	2.0m
	Stained	--	--	--	
Wide Width	Clean	--	--	--	--
	Stained	--	--	--	

Remarks

12 interior floor beams, between the east and west bottom chords, at each deck span, totaling 108 beams over the entire length of the bridge deck.

Several of the intermediate floor beams are in poor condition with severe cracks, delamination, and spalls, particularly the beams at Span 2

3. Alkali aggregate reaction
4. Concrete Cover
5. Corrosion Activity
6. Delaminations and Spalls

Item 3 to5 and 8 to14 are not in scope.

Defect Type	Delaminations	Spalls	Patches
Area (m2)	8.0	0.70	15.0
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ - 0.35	
8.70 m ²	0.81%	N/A	N/A

7. Scaling

Light	Medium	Severe to Very severe
--	--	--
--	--	--

8. Honeycombing
9. Adjusted Chloride Content Profile
10. Chloride Content at Level of Rebar
11. AC Resistance Test Data of Epoxy Coated Rebar
12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar
13. Concrete Air Entrainment
14. Compressive Strength

- A9 -
DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

Component Type Exterior Floor Beams, Spans 1 to 9
& Location

OSIM Identifier

1. Dimensions and Area

Width: 0.25m Length: 2.18m Height 0.47m (avg)
Diameter _____m Total Area Surveyed : 560.4m²

2. Cracks (medium and wide)

Type		Trans.	Long'inal	Other	Total
Medium Width	Clean	-	-	-	--
	Stained	-	-	-	
Wide Width	Clean	-	-	-	--
	Stained	-	-	-	

Remarks

12 exterior floor beams (cantilever brackets), below each sidewalk, at each deck span, totaling 216 beams for the 9 span bridge deck.

The exterior floor beams below the sidewalks appeared to have been repair with shotcrete in places over the bridge length. Cracks, delamination, and spalls were generally noted on the original patched end floor beams.

3. Alkali aggregate reaction
4. Concrete Cover
5. Corrosion Activity
6. Delaminations and Spalls

Item 3 to5 and 8 to14 are not in scope.

Defect Type	Delaminations	Spalls	Patches
Area (m2)	1.70	0.90	0.50
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ - 0.35	
2.60 m ²	0.46%	N/A	N/A

7. Scaling

Light	Medium	Severe to Very severe
--	--	--
--	--	--

8. Honeycombing
9. Adjusted Chloride Content Profile
10. Chloride Content at Level of Rebar
11. AC Resistance Test Data of Epoxy Coated Rebar
12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar
13. Concrete Air Entrainment
14. Compressive Strength

- A10 -
DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

Component Type & Location Pier 1 to Pier 8

OSIM Identifier

1. Dimensions and Area

Width 1.78 m (avg) Length: 11.23m Height 4.58 m (avg.)
Diameter m Total Area Surveyed 834.0m²

2. Cracks (medium and wide)

Type		Horizontal	Vertical	Other	Total
Medium Width	Clean	24.0	131.0m	--	155.0m
	Stained	--	--	--	
Wide Width	Clean	11.0	5.0	-	18.0m
	Stained	2.0	-	-	

3. Alkali aggregate reaction
4. Concrete Cover
5. Corrosion Activity
6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m2)	8.5	1.0	5.0
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ - 0.35	
9.5 m ²	1.1 %	N/A	N/A

7. Scaling

Light	Medium	Severe to Very severe
11.0m ²	--	--
1.3%	--	--

8. Honeycombing
9. Adjusted Chloride Content Profile
10. Chloride Content at Level of Rebar
11. AC Resistance Test Data of Epoxy Coated Rebar
12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar
13. Concrete Air Entrainment
14. Compressive Strength

Remarks

Horizontal construction joints are presented at all piers. Significant deterioration of the concrete, namely delamination and light scaling, was generally found in the areas of the construction joints. Cracks on the piers, mostly medium vertical cracks, were also found extending between the construction joints or from the joints to the top bearing seat or the ground surface. A wide crack, extending from north to south faces, was noted on the upper portion of Pier 2. Shallow spalled or severe scaling pocket was noted on the top central bearing seat of Pier 6. Rocks and boulders for scour protection are presented at all the piers.

Item 3 to5 and 8 to14 are not in scope.

- A11 -
DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

Component Type & Location North & South Abutments

OSIM Identifier

1. Dimensions and Areas

Width : 11.65 m (avg) Length: Height: 3.35m (avg)
Diameter m Total Area Surveyed: 77.8 m²

2. Cracks (medium and wide)

Type		Horizontal	Vertical	Other	Total
Medium Width	Clean	1.0m	6.5m	--	13.5m
	Stained	6.0m	--	--	
Wide Width	Clean	--	4.5m	--	4.5m
	Stained	--	--	--	

3. Alkali aggregate reaction
4. Concrete Cover
5. Corrosion Activity
6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m2)	1.30m	0.20	1.60
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ - 0.35	
1.50m ²	1.93 %	N/A	N/A

7. Scaling

Light	Medium	Severe to Very severe
4.50m ²	--	--
5.78 %	--	--

8. Honeycombing
9. Adjusted Chloride Content Profile
10. Chloride Content at Level of Rebar
11. AC Resistance Test Data of Epoxy Coated Rebar
12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar
13. Concrete Air Entrainment
14. Compressive Strength

Remarks

Horizontal construction joints are presented on both abutment walls. Significant deterioration of the concrete, namely delamination and light scaling, was generally found in the areas of the construction joints. Cracks on the substructures, mostly medium vertical cracks, were also found extending between the construction joints or from the joints to the top bearing seat or the ground surface. Numerous graffiti presents on both abutment walls. At the south abutment end, the south embankment slope is covered with a timber boardwalk for pedestrian crossing under the bridge; large concrete blocks are present for the protection of the south embankment slope below the bridge deck

Item 3 to5 and 8 to14 are not in scope.

- A12 -
DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

Component Type: Wingwalls OSIM Identifier _____
& Location

1. Dimensions and Areas

Width : _____ m Length: 5.50m (avg) Height: 2.90m (avg)
Diameter _____ m Total Area Surveyed: 31.90 m²

2. Cracks (medium and wide)

Type		Horizontal	Vertical	Other	Total
Medium Width	Clean	8.3m	6.8m	-	19.6m
	Stained	-	4.50m	-	
Wide Width	Clean	-	0.6	-	0.6m
	Stained	-	-	-	

3. Alkali aggregate reaction
4. Concrete Cover
5. Corrosion Activity

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m2)	2.20	0.10	19.5
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ - 0.35	
2.30 m ²	7.21 %	N/A	N/A

7. Scaling

Light	Medium	Severe to Very severe
--	--	--
--	--	--

8. Honeycombing
9. Adjusted Chloride Content Profile
10. Chloride Content at Level of Rebar
11. AC Resistance Test Data of Epoxy Coated Rebar
12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar
13. Concrete Air Entrainment
14. Compressive Strength

Remarks

Numerous hairline to narrow cracks, some with efflorescent stained, on all wingwalls. Localized delamination and spalled areas present on the northwest wingwall. Large shotcrete patches with numerous narrow cracks and delamination areas on the south wingwalls.

Item 3 to5 and 8 to14 are not in scope.

- A13 -
DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Site Number: 9-002

Component Type East & West Railings
& Location

1. Dimensions and Area

Width: 0.30m Length: 214.30m Height 1.22 m
Diameter _____ m Total Area Surveyed 1174.00 m²

2. Cracks (medium and wide)

Type		Horizontal	Vertical	Other	Total
Medium Width	Clean	4.0	-	-	4.0 m
	Stained	-	-	-	
Wide Width	Clean	5.0m	-	-	5.0 m
	Stained	-	-	-	

3. Alkali aggregate reaction
4. Concrete Cover
5. Corrosion Activity

6. Delaminations and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m2)	6.5	12.5	--
Total Delaminations and Spalls		Total Delaminations and Spalls in Areas ≤ - 0.35	
19.0 m ²	1.6 %	N/A	N/A

7. Scaling

Light	Medium	Severe to Very severe
--	--	--
--	--	--

8. Honeycombing
9. Adjusted Chloride Content Profile
10. Chloride Content at Level of Rebar
11. AC Resistance Test Data of Epoxy Coated Rebar
12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar
13. Concrete Air Entrainment
14. Compressive Strength

Remarks

The east and west concrete railings, over the bridge length, are generally in fair to good condition with localized small delamination and spalled areas. A medium to wide horizontal crack was found running continuously over two rail panels, across the top of the ballasters and posts, presents at the south end of the east rail at Span 5. The north approach end panel of the west rail was also found cracked along the bottom of the rail panel.

Item 3 to5 and 8 to14 are not in scope.

- A14 -
DETAILED CONDITION SURVEY SUMMARY SHEET

EXPANSION JOINTS

		Abutment		Intermediate	
		Joint 1	Joint 2	Joint 3	Joint 4
Dimensions		N	S	Pier 1	Pier 2
a	mm	2.58	2.60	2.59	2.58
b	mm	140	155	130	155
b'	mm	150	170	155	170
c	m	7.01*	7.01*	7.01*	7.01*
d	mm	150	140	128	150
d'	mm	165	150	140	170
e	mm	2.61	2.61	2.61	2.61

DEPTH OF ASPHALT @ DECK SIDE							
1	mm	--	--	--	--	--	--
2	mm	--	--	--	--	--	--
3	mm	--	--	--	--	--	--

WIDTH : TOP BALLAST WALL AND END DAMS								
	N	S	N	S	N	S	N	S
1	mm	705	470	460	590	465	465	470
2	mm	700	470	460	590	462	465	465
3	mm	690	465	465	575	462	465	465

GAP DIMENSION				
1	mm	45	50	55
2	mm	45	50	55
3	mm	48	55	52

MISC. JOINT DETAILS	SKEW ANGLE			0
EXP.	√	√	√	√
FIXED				
TYPE	Strip seal	Strip seal	Strip seal	Strip seal
LEAKING	No	No	No	No
ANGLE SIZE @ GAP (mm)	120	120	120	120

	E	JOINT DIMENSIONS			W
TEMPERATURE °C		DECK	26	AMBIENT	26

TYPICAL SECTIONS AT JOINTS				
X - X				

SITE NO 9-002

REMARKS

* Roadway width taken from the 1983 rehabilitation drawings.

All expansion joints at the north and south ends of the deck and at thepiers are of a strip seal type. All deck joints including seals, concrete end-dams, top of ballast walls, and steel armouring angles were completely replaced during the 1983 rehabilitation of the bridge structure.

All joint seals were typically filled with sand/gravel and roadway debris. Where inspected, the seals were found to be in good condition. All concrete dams typically exhibit small pockets of shallow spalls along the length of the joint steel angles. Isolated large shallow spalled areas present on concrete dams at the location Piers 2 to 4, and at Pier 8.

A 1.7m section of steel nosing angle at top corner of the concrete ballast wall at the northwest corner appeared to have been torn off by plow. Plow blade marks also present on the joint steel angle at Pier 2 near the centerline of the road.

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DETAILED CONDITION SURVEY SUMMARY SHEET

EXPANSION JOINTS

SITE NO 9-002

		Intermediate		Intermediate	
		Joint 5	Joint 6	Joint 7	Joint 8
Dimensions		Pier 3	Pier 4	Pier 5	Pier 6
a	mm	2.58	2.57	2.59	2.58
b	mm	130	140	140	140
b'	mm	140	155	155	160
c	m	7.01*	7.01*	7.01*	7.01*
d	mm	140	125	125	140
d'	mm	150	150	140	155
e	mm	2.61	2.61	2.60	2.63

DEPTH OF ASPHALT @ DECK SIDE							
1	mm	--	--	--	--	--	--
2	mm	--	--	--	--	--	--
3	mm	--	--	--	--	--	--

WIDTH : TOP BALLAST WALL AND END DAMS								
	N	S	N	S	N	S	N	S
1	mm	460	460	455	455	465	465	460
2	mm	460	460	455	460	465	460	465
3	mm	465	465	465	465	465	460	465

GAP DIMENSION				
1	mm	45	45	52
2	mm	45	45	55
3	mm	47	45	60

MISC. JOINT DETAILS	SKEW ANGLE			0
EXP.	√	√	√	√
FIXED				
TYPE	Strip seal	Strip seal	Strip seal	Strip seal
LEAKING	No	No	No	No
ANGLE SIZE @ GAP (mm)	120	120	120	120

	E	JOINT DIMENSIONS			W
TEMPERATURE °C		DECK	26	AMBIENT	26

TYPICAL SECTIONS AT JOINTS				
X - X				

REMARKS

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Deck

Site No: 9-002

1. Delaminations:

Weight of Chain: 1.68 kg/m; with 50 mm links

Other Equipment: 16 oz Hammer

2. Concrete Cover:

Covermeter Make & Model: Proba 3D Micro Covermeter

Battery Check:

Reading at Start of Test: OK

Reading at End of Test: OK

Concrete Cover Check:

Location of Check: _____

Actual Depth & Rebar Dia: _____

Reading Before Test: _____

Reading Each 30 min During Test: _____

Reading End of Test: _____

3. Corrosion Activity: Sta.88.50 to 109.50; G/L 0.00 to 3.51 (Span #5)

Half Cell Make & Model: M.C. Miller Model RE-3

Multimeter Make & Model: FLUKE 23 III Multimeter

Length and Gauge of Lead Wires: 100 m, 16 ga.

Deck Temp:

Start of Test: 31 °C

End of Test: 31 °C

Ambient Temp:

Start of Test: 32 °C

End of Test: 32 °C

Battery Check: O.K.

Ground Check:

Method of Connection: Self Tapping Screw

Ground Location: Long. #5 in C-4

Check Location: Transv. #4 in C-3

Lead Resistance: 0.9 Ω

Voltage Drop (mV's): 0.6

Resistance: 13.0 Ω

Resistance Reversed: 17 Ω

Grid Point Potential Readings Check - See Table Below

Location	Initial Reading	Check Reading*	Check Reading-Latex Concrete Overlay **
Sta. 90.00; G/L 0.51	-0.23	-0.25	N/A
Sta. 94.50, G/L 3.51	-0.17	-0.18	N/A
Sta. 99.00, G/L 0.51	-0.18	-0.16	N/A
Sta. 102.00, G/L 2.01	-0.16	-0.18	N/A
Sta. 10800, G/L 0.51	-0.20	-0.22	N/A

* Check at least 5 readings at beginning of test and each change in ground.

** On decks with latex modified concrete overlay, check at least 5 locations by drilling holes through the latex concrete overlay into the original concrete substrate.

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Deck

Bridge No: 9-002

1. Delaminations:

Weight of Chain: 1.68 kg/m; with 50 mm links

Other Equipment: 16 oz Hammer

2. Concrete Cover:

Covermeter Make & Model: Proba 3D Micro Covermeter

Battery Check:

Reading at Start of Test: OK

Reading at End of Test: OK

Concrete Cover Check:

Location of Check: _____

Actual Depth & Rebar Dia: _____

Reading Before Test: _____

Reading Each 30 min During Test: _____

Reading End of Test: _____

3. Corrosion Activity: Sta. 67.50 to 88.0; G/L 3.51 to 7.01 (Span #6)

Half Cell Make & Model: M.C. Miller Model RE-3

Multimeter Make & Model: FLUKE 23 III Multimeter

Length and Gauge of Lead Wires: 100 m, 16 ga.

Deck Temp:

Start of Test: 27 °C

End of Test: 27 °C

Ambient Temp:

Start of Test: 28 °C

End of Test: 28 °C

Battery Check: O.K.

Ground Check:

Method of Connection: Self Tapping Screw

Ground Location: Long. #5 in C-18

Check Location: Transv. #4 in C-17

Lead Resistance: 0.9 Ω

Voltage Drop (mV's): 0.5

Resistance: 18 Ω

Resistance Reversed: 20 Ω

Grid Point Potential Readings Check - See Table Below

Location	Initial Reading	Check Reading*	Check Reading-Latex Concrete Overlay **
Sta. 67.50, G/L 6.51	-0.26	-0.28	N/A
Sta. 70.50, G/L 5.01	-0.19	-0.17	N/A
Sta. 73.50, G/L 3.51	-0.20	-0.20	N/A
Sta. 78.00, G/L 6.51	-0.17	-0.16	N/A
Sta. 81.00, G/L 5.01	-0.16	-0.18	N/A

* Check at least 5 readings at beginning of test and each change in ground.

** On decks with latex modified concrete overlay, check at least 5 locations by drilling holes through the latex concrete overlay into the original concrete substrate.

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Deck

Bridge No: 9-002

1. Delaminations:

Weight of Chain: 1.68 kg/m; with 50 mm links

Other Equipment: 16 oz Hammer

2. Concrete Cover:

Covermeter Make & Model: Proba 3D Micro Covermeter

Battery Check:

Reading at Start of Test: OK

Reading at End of Test: OK

Concrete Cover Check:

Location of Check: _____

Actual Depth & Rebar Dia: _____

Reading Before Test: _____

Reading Each 30 min During Test: _____

Reading End of Test: _____

3. Corrosion Activity: Sta. 0.00 to 21.0; G/L 3.51 to 7.01 (Span #9)

Half Cell Make & Model: M.C. Miller Model RE-3

Multimeter Make & Model: FLUKE 23 III Multimeter

Length and Gauge of Lead Wires: 100 m, 16 ga.

Deck Temp:

Start of Test: 28 °C

End of Test: 28 °C

Ambient Temp:

Start of Test: 28 °C

End of Test: 28 °C

Battery Check: O.K.

Ground Check:

Method of Connection: Self Tapping Screw

Ground Location: Long. #5 in C-23

Check Location: Long. #5 in C-24

Lead Resistance: 0.9 Ω

Voltage Drop (mV's): 0.5

Resistance: 20 Ω

Resistance Reversed: 21 Ω

Grid Point Potential Readings Check - See Table Below

Location	Initial Reading	Check Reading*	Check Reading-Latex Concrete Overlay **
Sta. 0.30, G/L 6.51	-0.23	-0.24	N/A
Sta. 3.00, G/L 3.51	-0.25	-0.25	N/A
Sta. 6.00, G/L 5.01	-0.15	-0.14	N/A
Sta. 9.00, G/L 6.51	-0.14	-0.16	N/A
Sta. 12.00, G/L 3.51	-0.24	-0.23	N/A

* Check at least 5 readings at beginning of test and each change in ground.

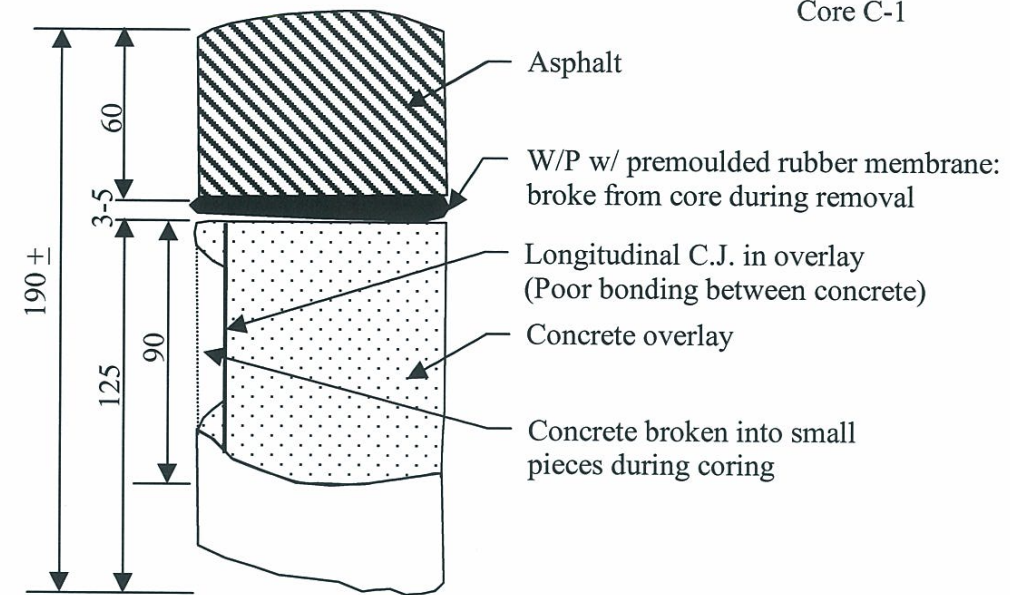
** On decks with latex modified concrete overlay, check at least 5 locations by drilling holes through the latex concrete overlay into the original concrete substrate.

APPENDIX C
Core Photographs and Sketches

- C1 -

Site No. 9-002

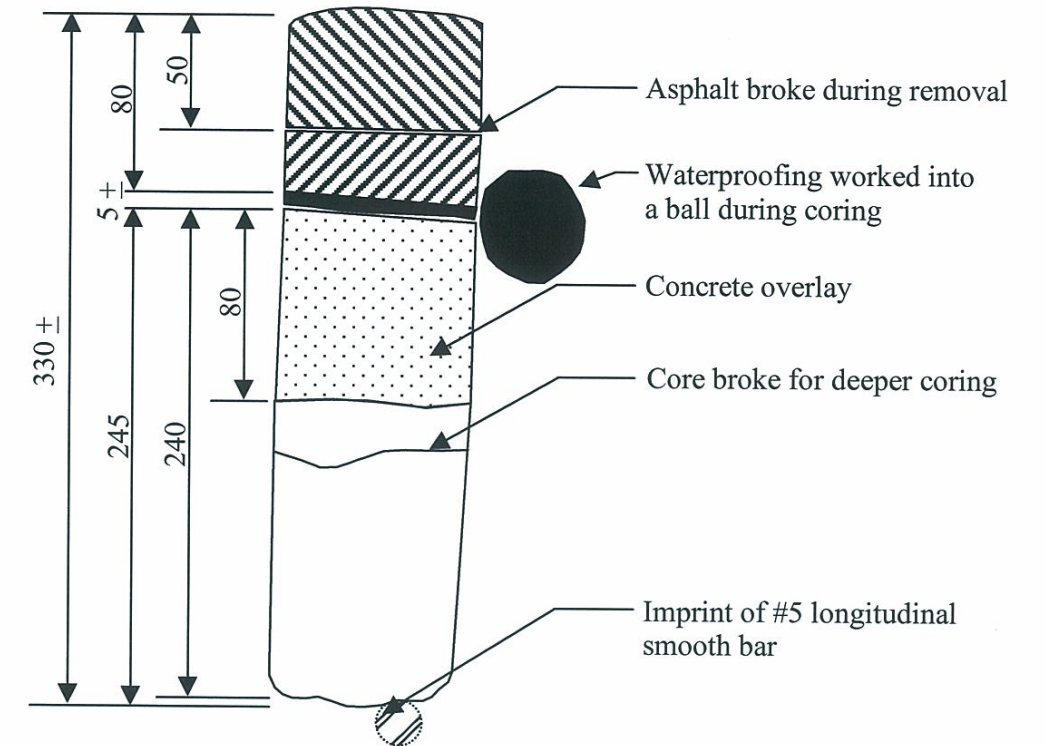
Core C-1



- C2 -

Site No. 9-002

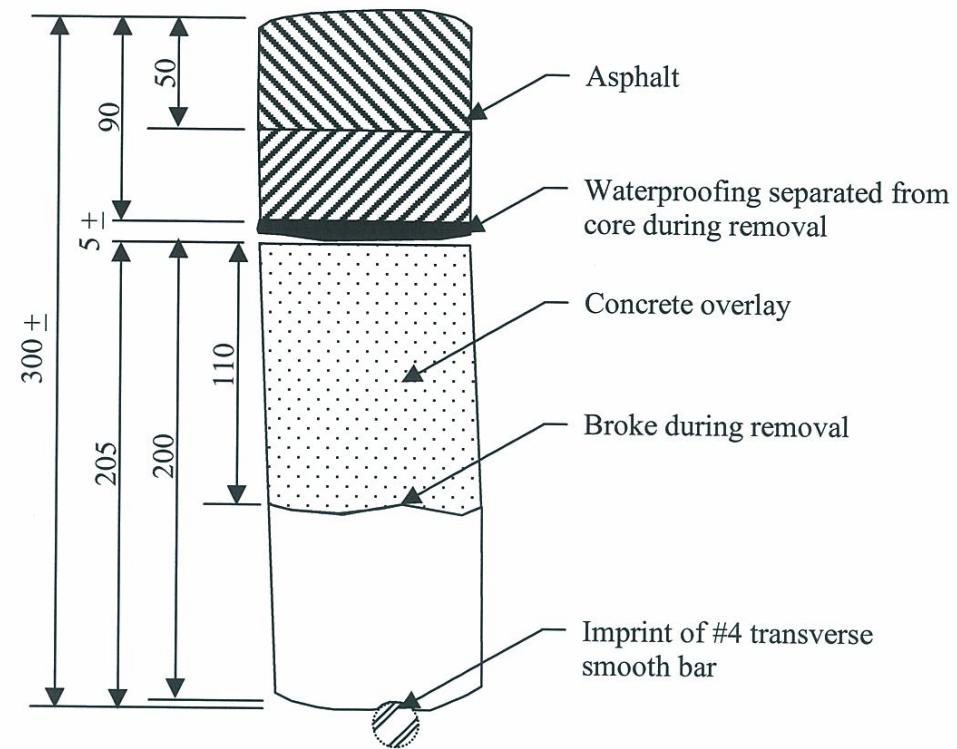
Core C-2



- C3 -

Site No. 9-002

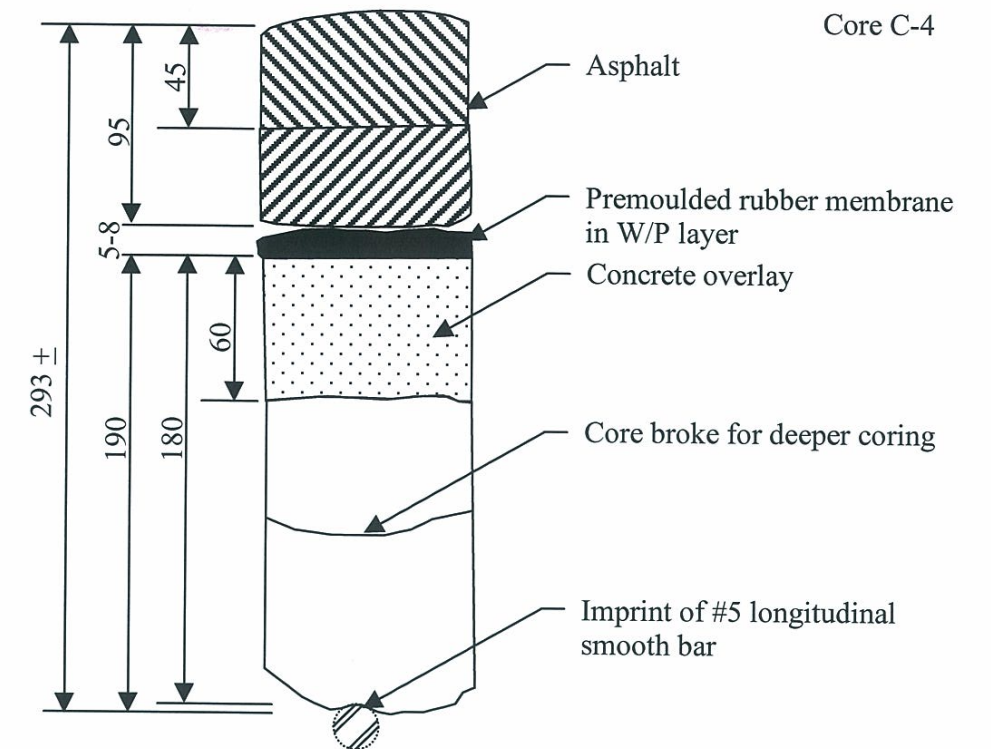
Core C-3

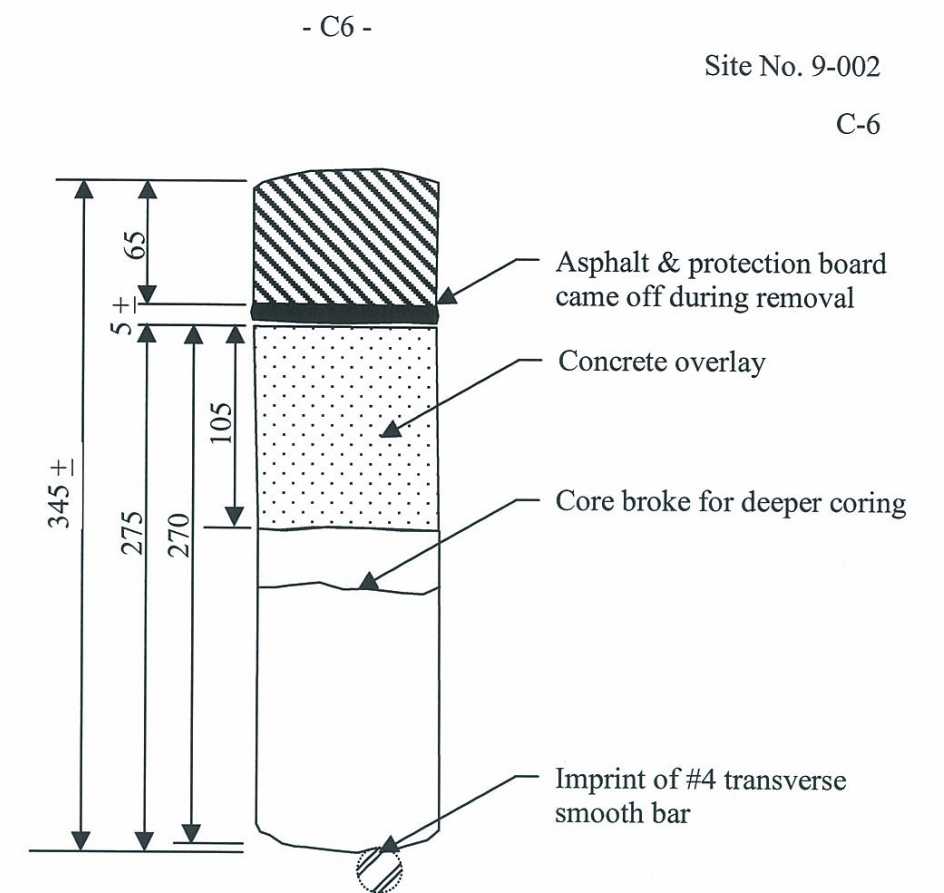
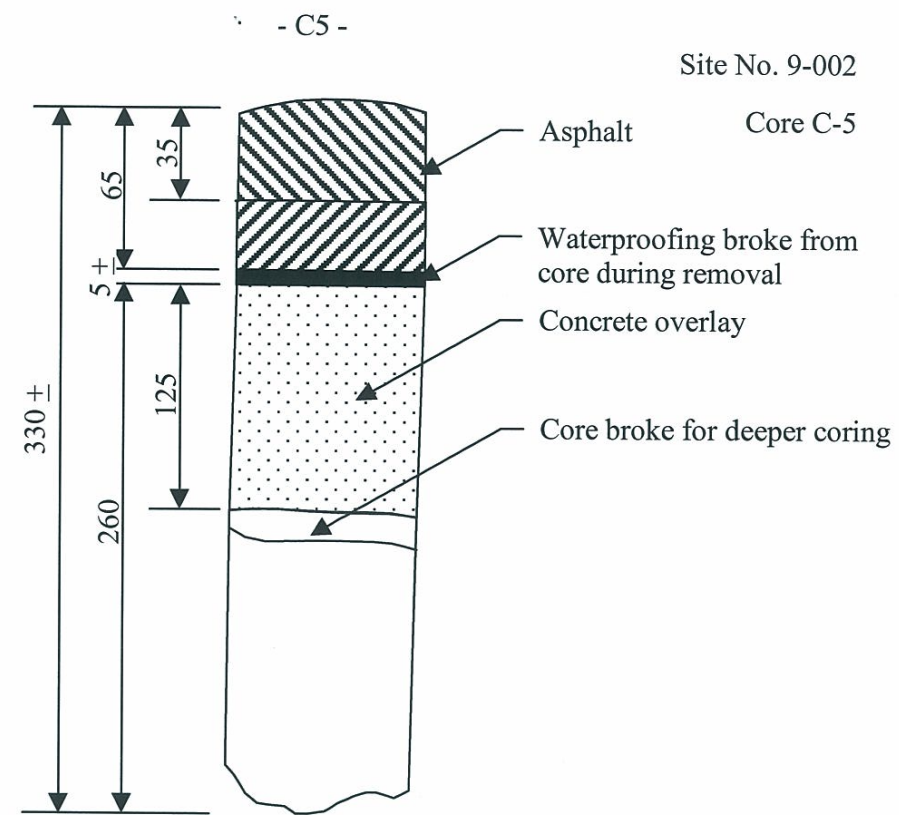


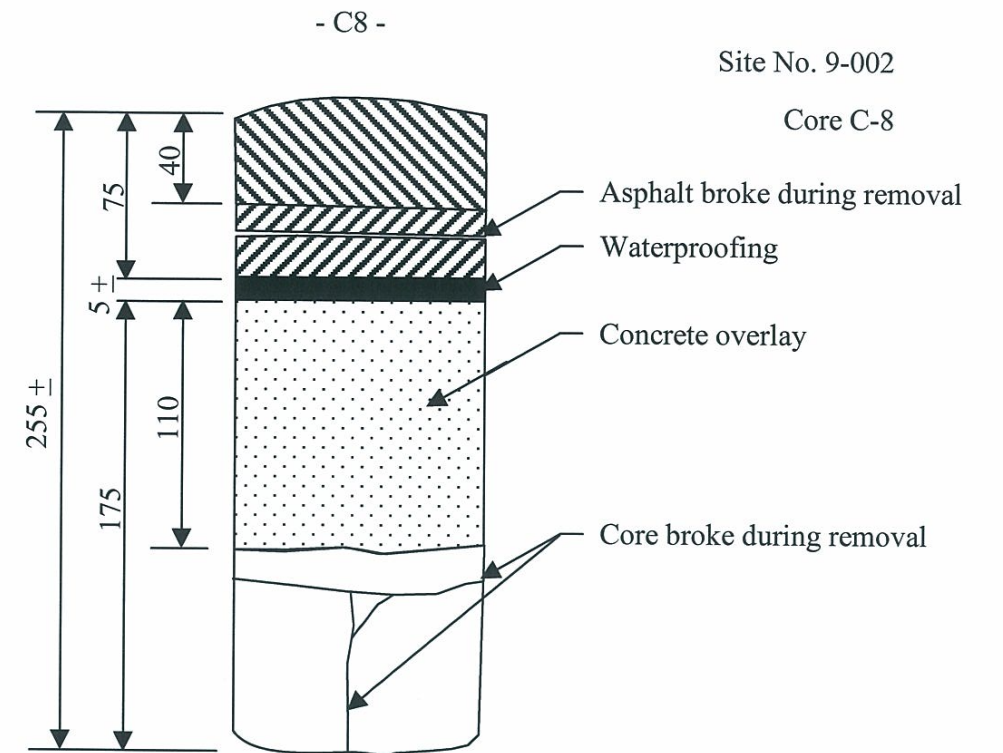
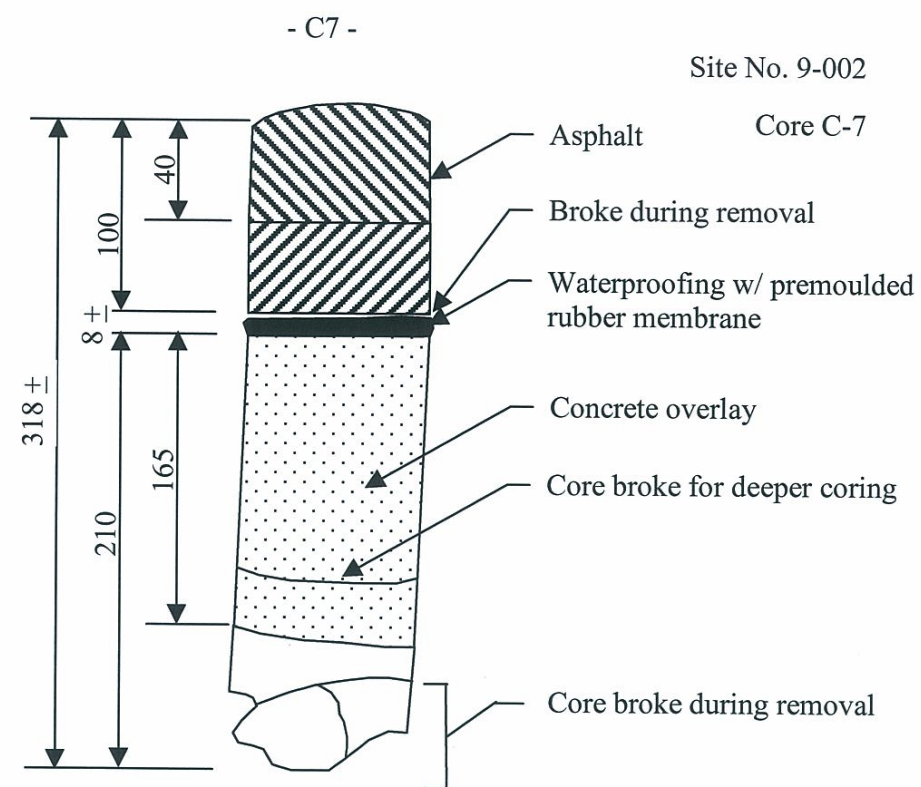
- C4 -

Site No. 9-002

Core C-4



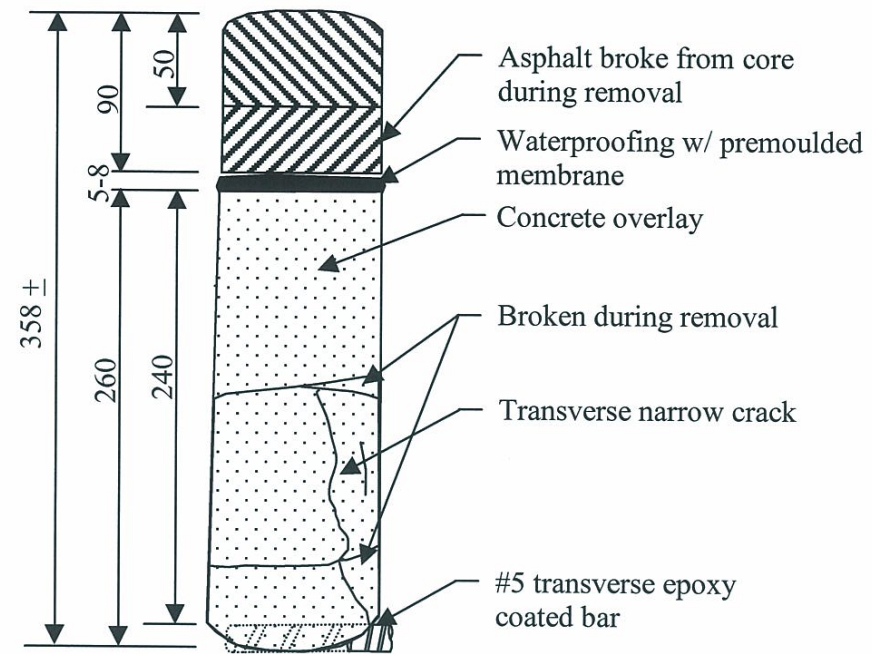




- C9 -

Site No. 9-002

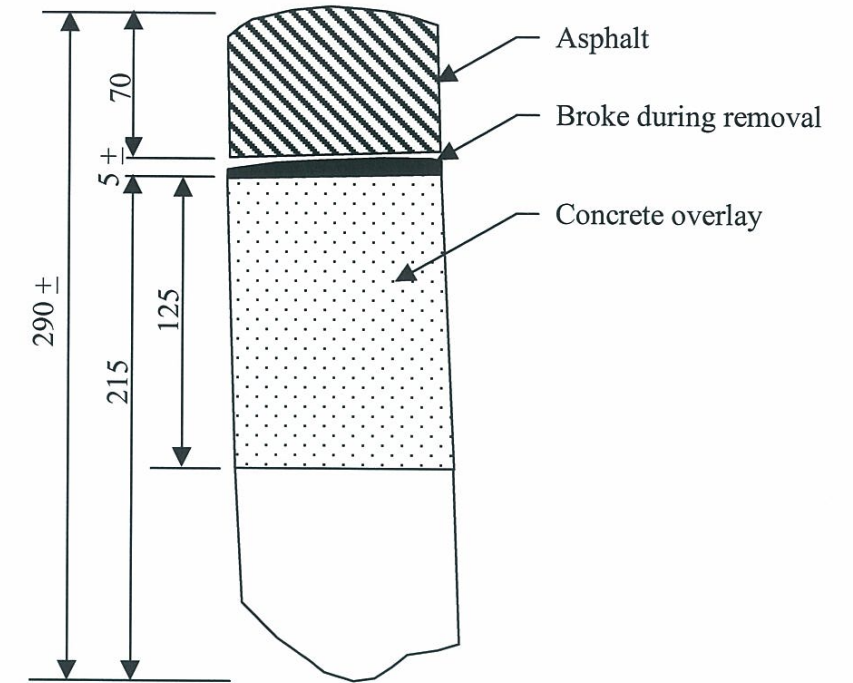
Core C-9



- C10 -

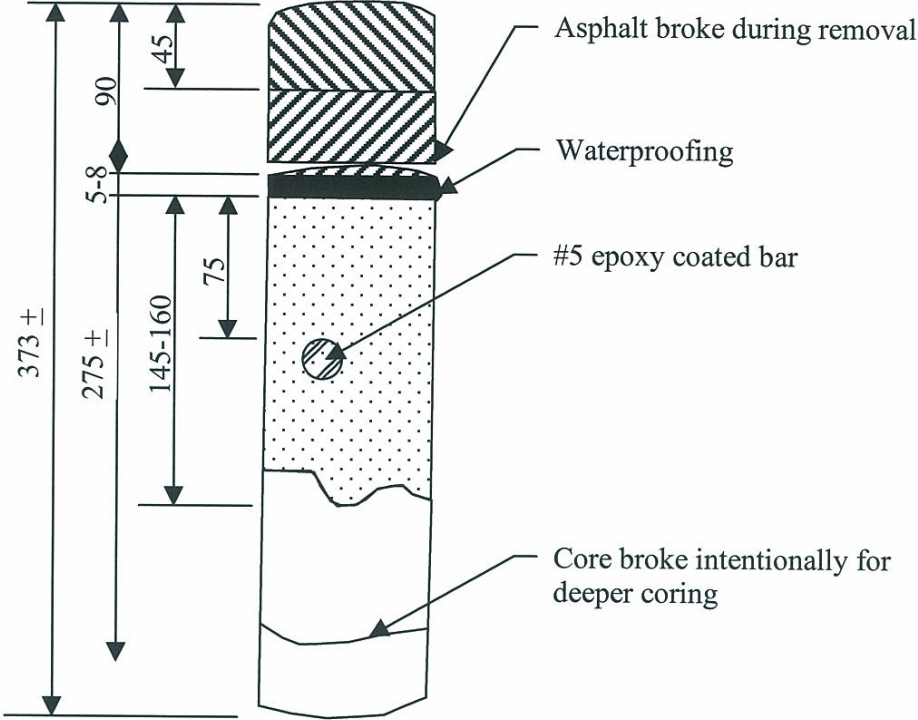
Site No. 9-002

Core C-10



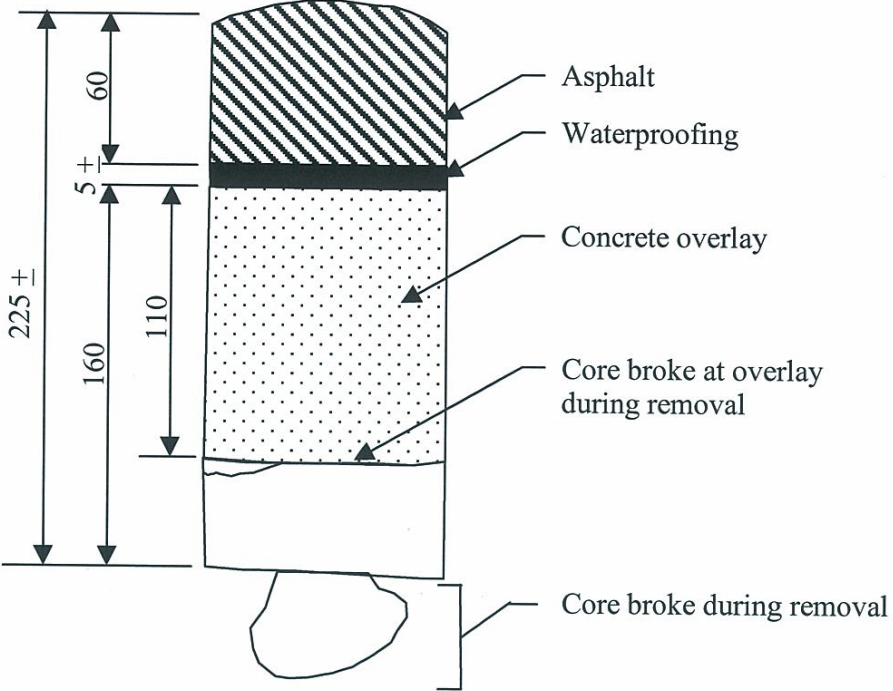
- C11 -

Site No. 9-002
Core C-11



- C12 -

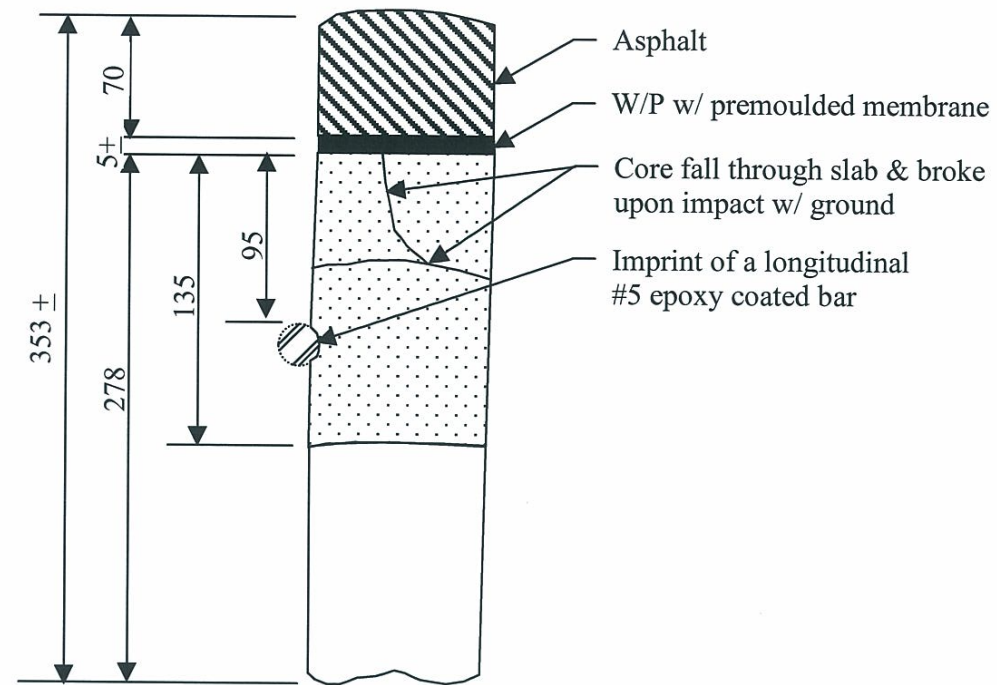
Site No. 9-002
Core C-12



- C13 -

Site No. 9-002

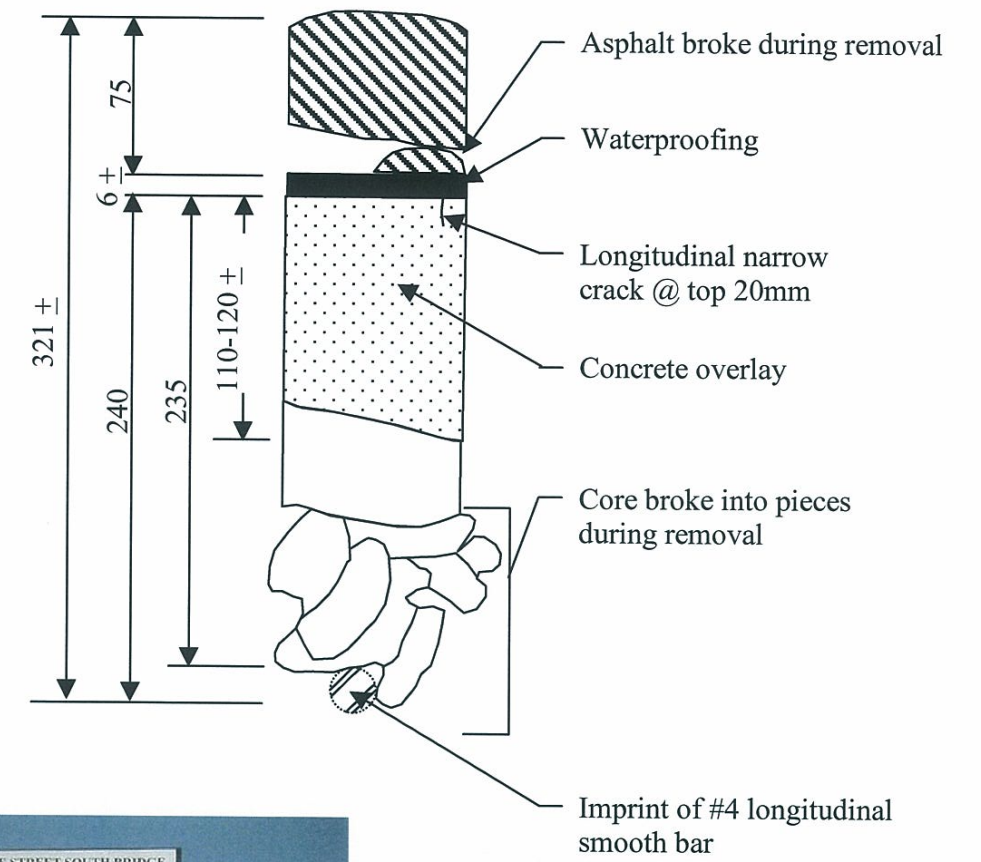
Core C-13

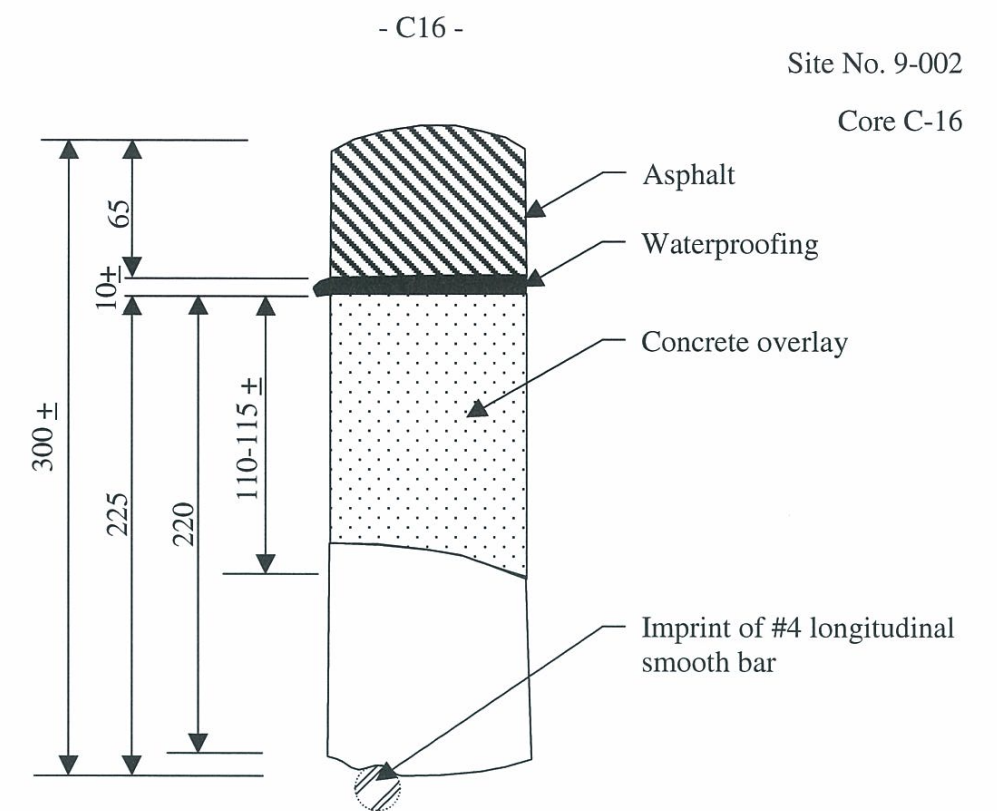
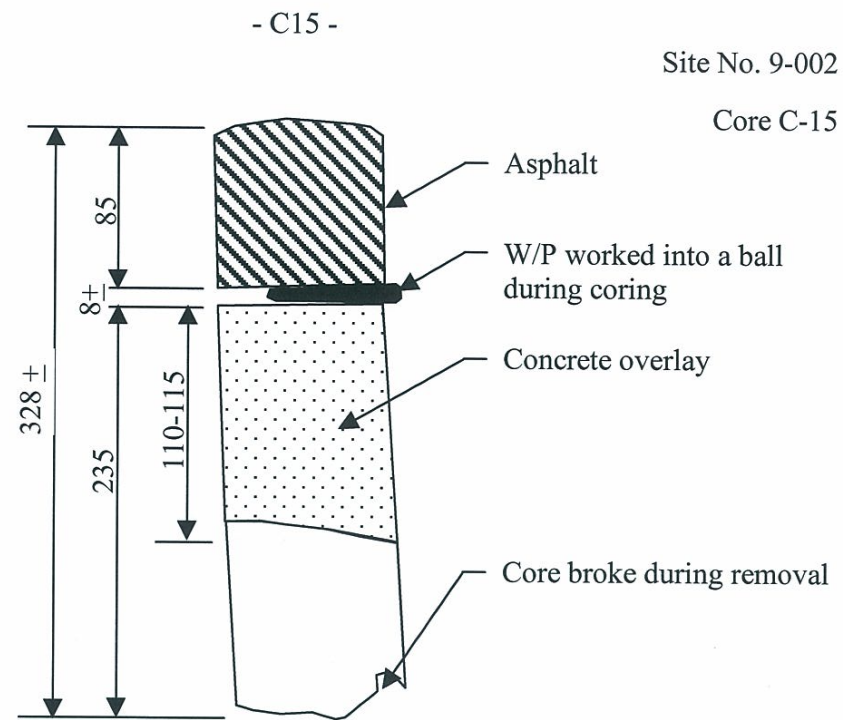


- C14 -

Site No. 9-002

Core C-14

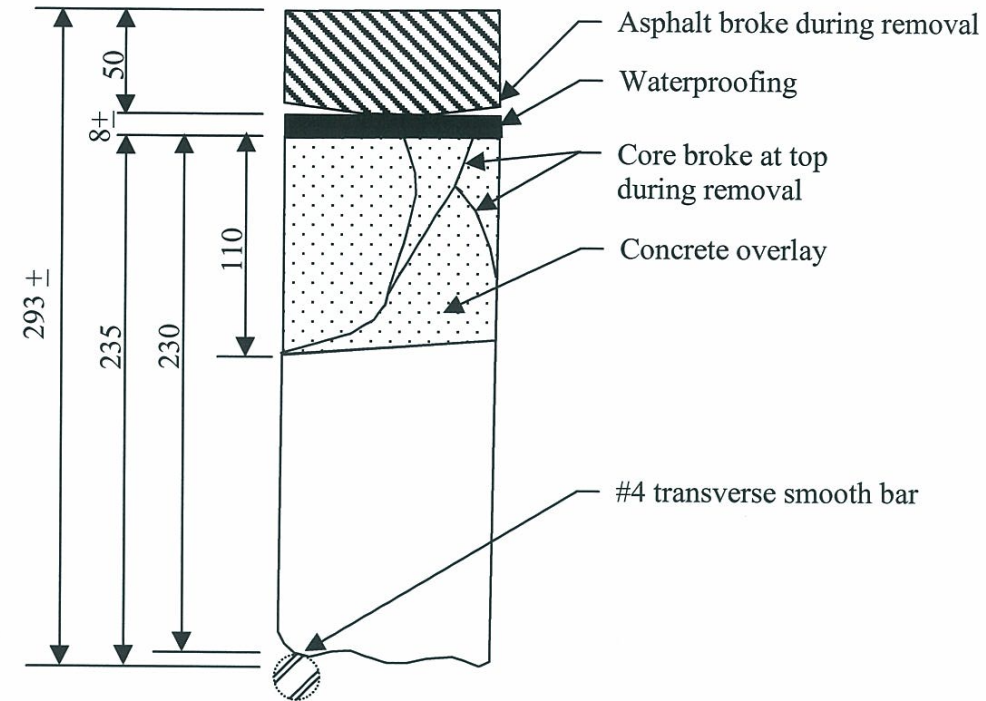




- C17 -

Site No. 9-002

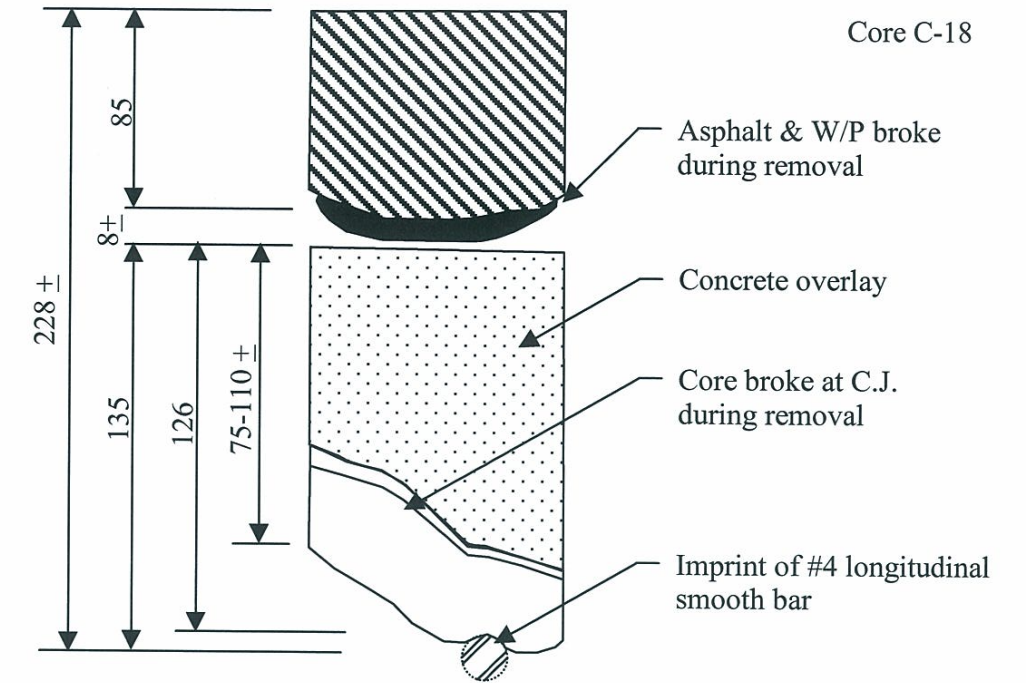
Core C-17



- C18 -

Site No. 9-002

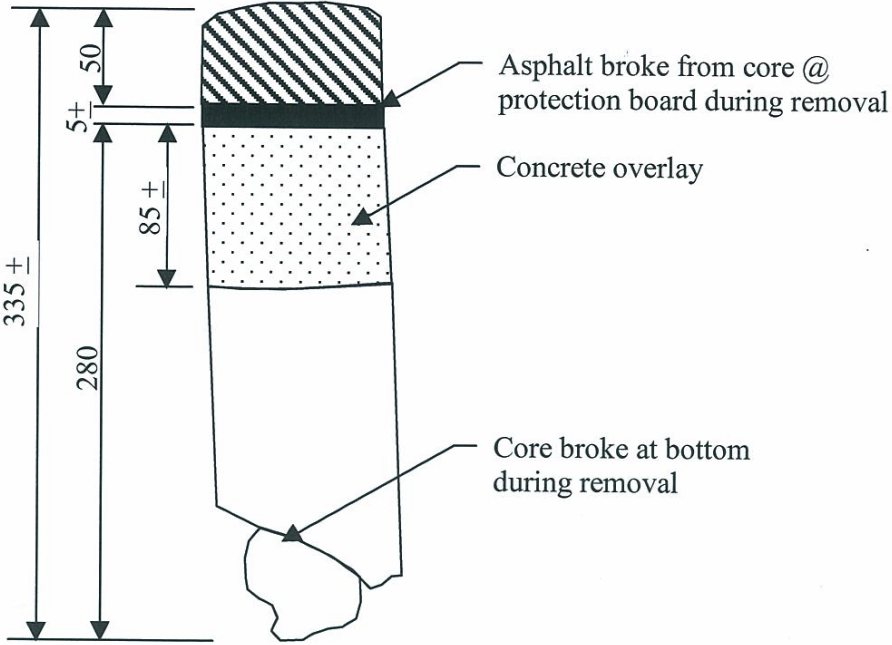
Core C-18



- C19 -

Site No. 9-002

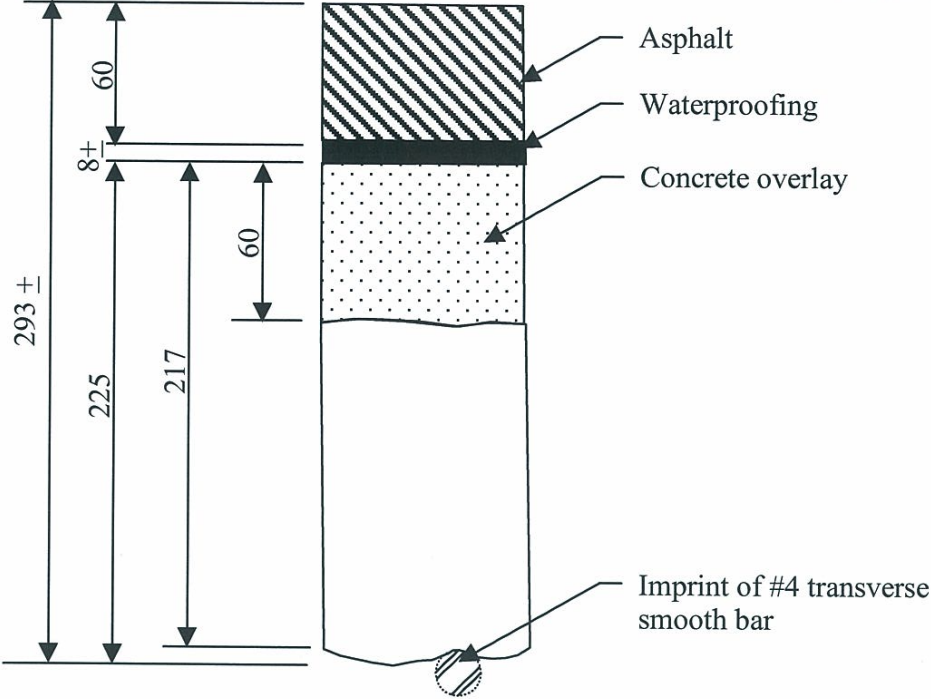
Core C-19



- C20 -

Site No. 9-002

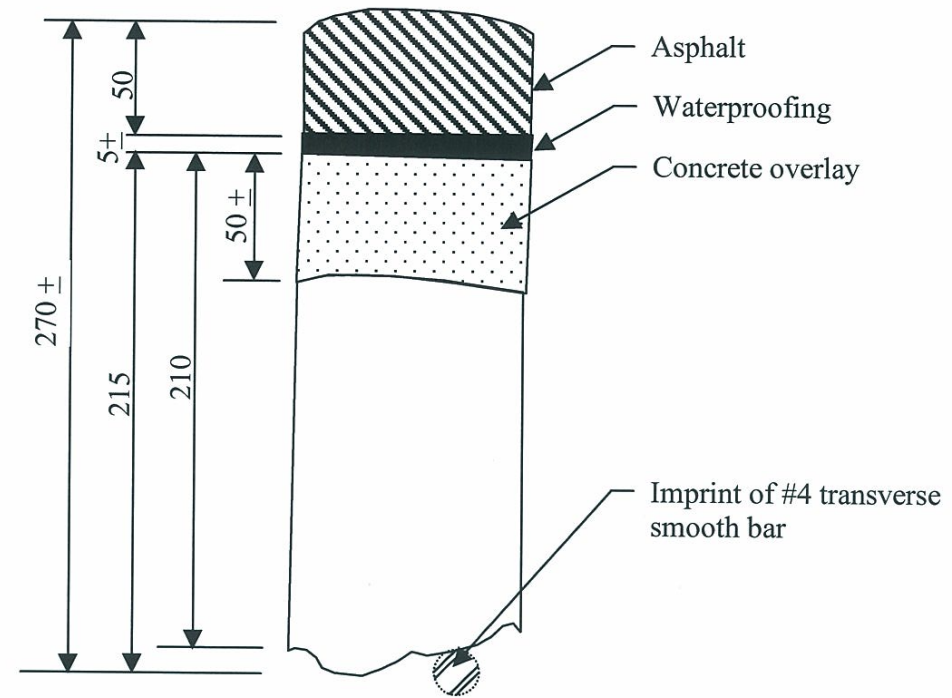
Core C-20



- C21 -

Site No. 9-002

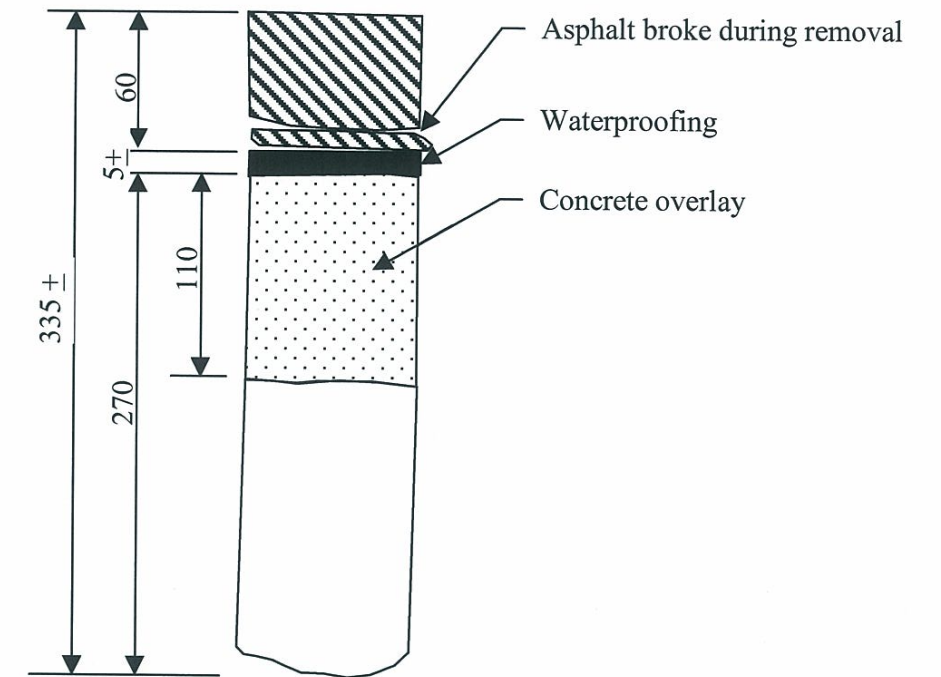
Core C-21

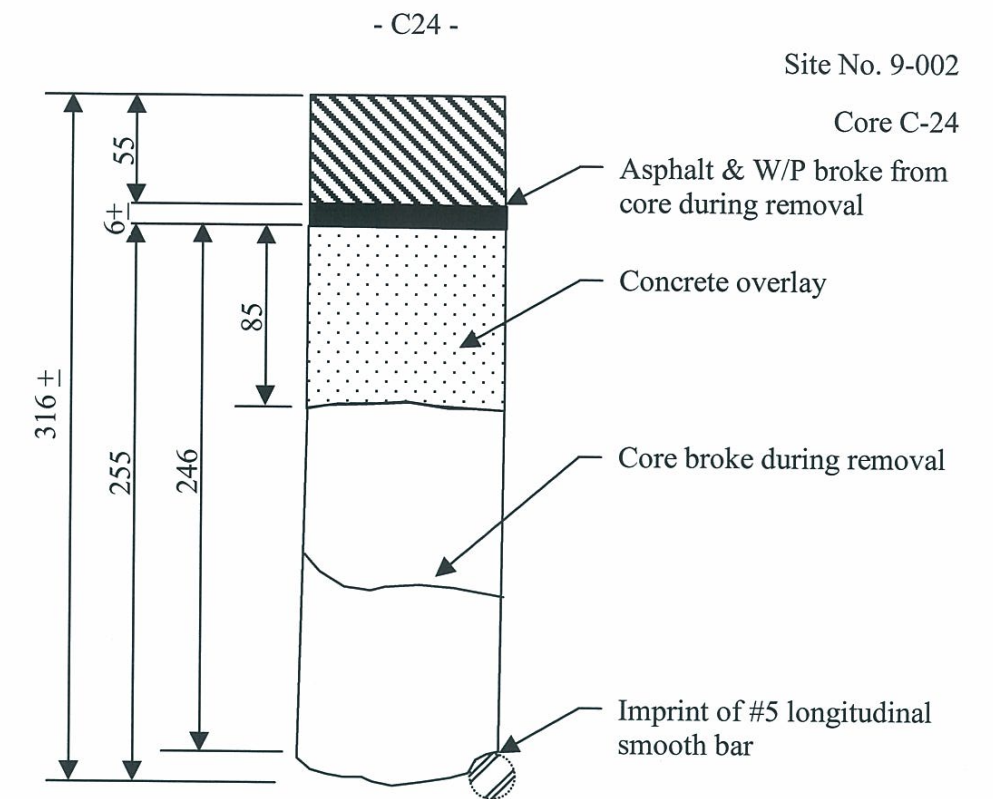
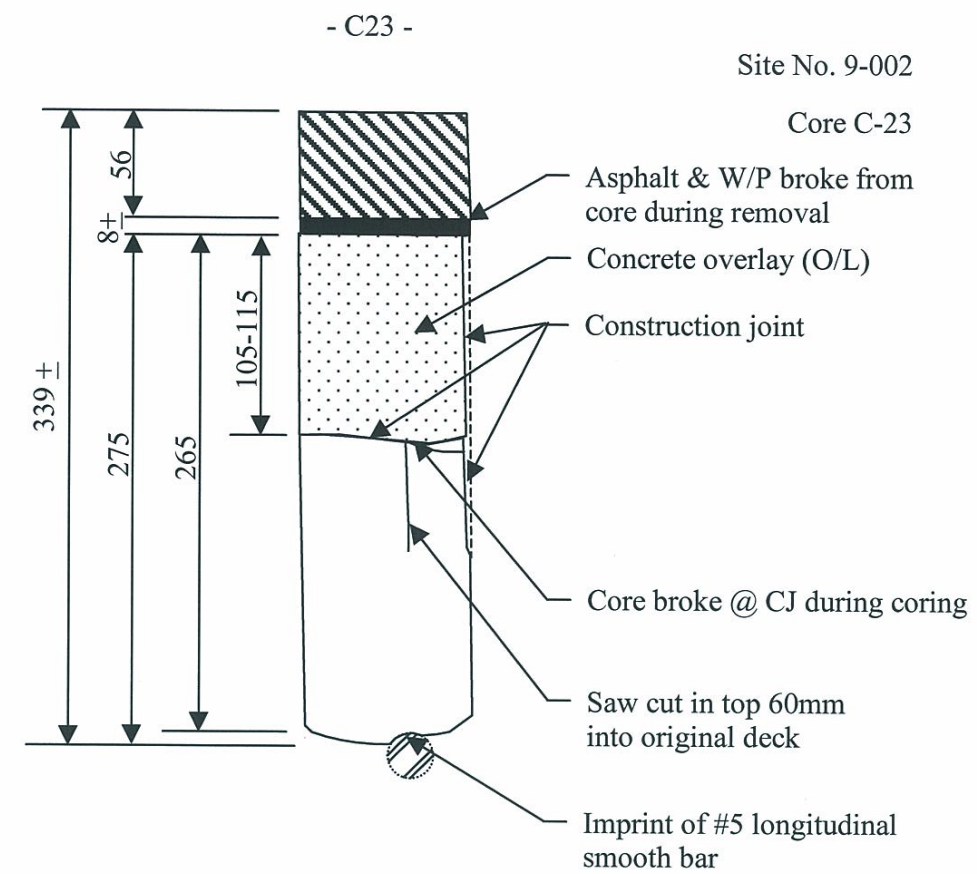


- C22 -

Site No. 9-002

Core C-22

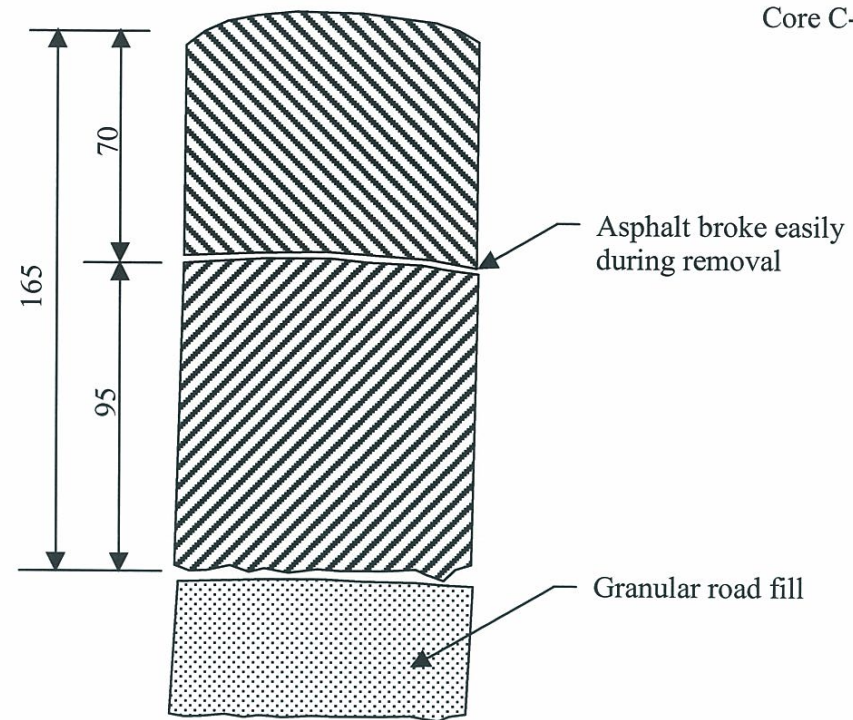




- C25 -

Site No. 9-002

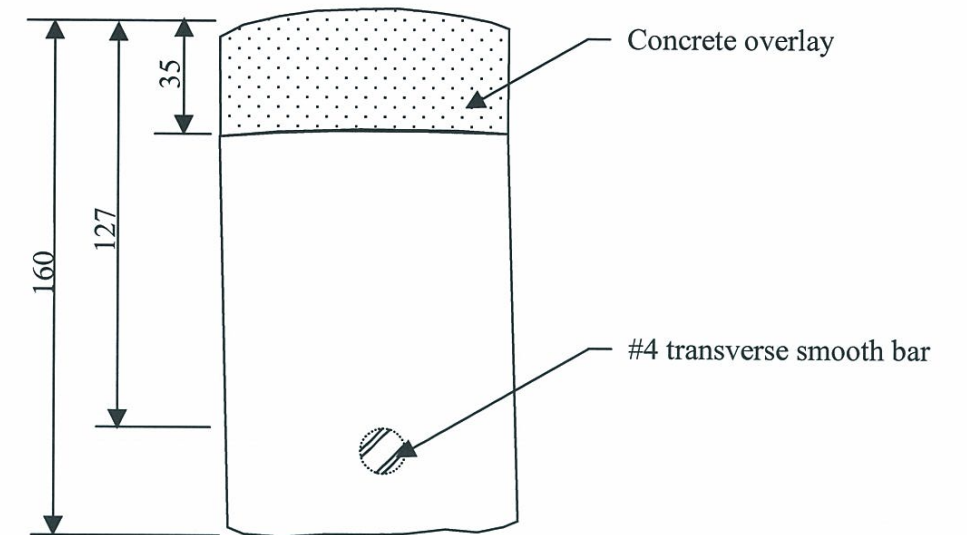
Core C-25



- C26 -

Site No. 9-002

Core C-26



APPENDIX D
Core Logs

CORE LOG ASPHALT COVERED BRIDGE DECKS

Core No.		C - 1	C - 2
Location		Sta. 49.37; G/L 0.15	Sta. 81.00; G/L 0.34
Diameter, mm		100	100
Thickness of Asphalt, mm		60	80
Thickness of Asphalt @ nearest grid point		--	--
Thickness of Concrete, mm		125	245
Full Depth, (yes/no)		No	No
Condition of Asphalt (1)		G	G
Waterproofing (W/P) type		Rubberized Asphalt with premoulded membrane & Protection Board	Rubberized Asphalt with Protection Board
Condition of W/P (1)		G	G
W/P Thickness, mm		3–5±	5 ±
Bond of Asphalt or W/P to Concrete		G	F
Defects in Concrete (2)		None	None
Condition of Rebar (3)		N/A	No Rust
Corrosion Potential			-0.19 V
Compressive Strength, MPa			70.0
Chloride Content	0-10 mm 20-30 mm % Chloride by Weight of Concrete 40-50 mm 60-70 mm 80-90 mm		
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm		
Testing Laboratory			J.T. Donald Consultants Limited
Remarks		<div><div>– Cored adjacent to east curb in Span 7.</div><div>– Asphalt & W/P separated from core during removal.</div><div>– Concrete overlay at top 90mm of deck; good bonding.</div><div>– Longitudinal Construction Joint (CJ) in the overlay concrete on west side of core; poor bonding at CJ.</div><div>– No rebar encountered in core.</div></div>	<div><div>– Top asphalt lift, 50mm thick, broke from lower lift during removal (Fair bonding).</div><div>– Concrete overlay at top 80mm of deck; good bonding.</div><div>– W/P rubble during coring.</div><div>– Core broke intentionally at 125mm depth for deeper coring.</div><div>– Cut top of a longitudinal #5 black smooth round bar at 240mm cover; imprint at bottom of core.</div><div>– Laboratory test performed on original concrete below the overlay.</div></div>

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

Core No.		C – 3	C – 4
Location		Sta. 90.93; G/L 1.80	Sta. 109.77; G/L 0.22
Diameter, mm		100	100
Thickness of Asphalt, mm		90	95
Thickness of Asphalt @ nearest grid point		--	--
Thickness of Concrete, mm		205	190
Full Depth, (yes/no)		No	No
Condition of Asphalt (1)		G	G
Waterproofing (W/P) type		Rubberized Asphalt with Protection Board	Rubberized Asphalt with premoulded membrane & Protection Board
Condition of W/P (1)		G	G-F
W/P Thickness, mm		5 ±	5–8
Bond of Asphalt or W/P to Concrete		G	G-F
Defects in Concrete (2)		None	None
Condition of Rebar (3)		No Rust	No Rust
Corrosion Potential		-0.20 V	-0.19 V
Compressive Strength, MPa			
Chloride Content % Chloride by Weight of Concrete	0-10 mm		
	20-30 mm		
	40-50 mm		
	60-70 mm		
	80-90 mm		
Air Voids	Air content, %		
	Spec. surf. , mm² / mm³		
	Spacing factor, mm		
Testing Laboratory			
Remarks		<ul style="list-style-type: none">– Top asphalt lift, 50mm thick, well bonded to lower lift.– 110mm overlay and fair to good bonding between overlay and concrete.– Cut top of a transverse #4 black smooth bar at 200mm cover; imprint at bottom of core.	<ul style="list-style-type: none">– Cored NE corner of deck in Span 5.– Top asphalt lift, 45mm thick, well bonded to lower lift.– Asphalt & W/P broke from core during removal.– 60mm overlay and good bonding between overlay and concrete.– Cut top of a longitudinal #5 black smooth bar at 180mm cover; imprint at bottom of core.– Core broke intentionally at 120mm depth for deeper coring.

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

Core No.		C - 5	C – 6	
Location		Sta. 116.65; G/L 1.78	Sta. 131.74; G/L 3.28	
Diameter, mm		100	100	
Thickness of Asphalt, mm		65	65	
Thickness of Asphalt @ nearest grid point		--	--	
Thickness of Concrete, mm		260	275	
Full Depth, (yes/no)		No	No	
Condition of Asphalt (1)		G	G	
Waterproofing (W/P) type		Rubberized Asphalt with Protection Board	Rubberized Asphalt with Protection Board	
Condition of W/P (1)		G	G	
W/P Thickness, mm		5±	5±	
Bond of Asphalt or W/P to Concrete		G	G	
Defects in Concrete (2)		None	None	
Condition of Rebar (3)		N/A	No Rust	
Corrosion Potential		-0.18 V	-0.35 V	
Compressive Strength, MPa				
Chloride Content			Total	Corrected
% Chloride by Weight of Concrete	130-140 mm		0.204	0.182
	150-160 mm		0.164	0.142
	170-180 mm		0.151	0.129
	190-200 mm		0.106	0.084
	210-220 mm		0.066	0.0044
	230-240 mm		0.035	0.013
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm			
Testing Laboratory			J.T. Donald Consultants Limited	
Remarks		<ul style="list-style-type: none">– Top asphalt lift, 35mm thick, well bonded to lower lift.– Asphalt & W/P separated from core during removal.– 125mm overlay and good bonding between overlay and concrete.– Core broke intentionally at 135mm depth for deeper coring.– No rebar encountered in core.	<ul style="list-style-type: none">– Asphalt broke from core during removal.– 105mm overlay; good bonding between overlay and original concrete deck.– Core broke intentionally at 130mm depth for deeper coring.– Cut top of a transverse #4 black smooth bar at 270mm cover; imprint at bottom of core.– Laboratory test performed on original concrete below the overlay.	

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

Core No.	C – 7		C – 8	
Location	Sta. 141.61; G/L 0.21		Sta. 153.10; G/L 2.59	
Diameter, mm	100		100	
Thickness of Asphalt, mm	100		75	
Thickness of Asphalt @ nearest grid point	--		--	
Thickness of Concrete, mm	210		175	
Full Depth, (yes/no)	No		No	
Condition of Asphalt (1)	G-F		F	
Waterproofing (W/P) type	Rubberized Asphalt with premoulded membrane & Protection Board		Rubberized Asphalt with Protection Board	
Condition of W/P (1)	G		G	
W/P Thickness, mm	8±		5±	
Bond of Asphalt or W/P to Concrete	G		G	
Defects in Concrete (2)	None		None	
Condition of Rebar (3)	N/A		N/A	
Corrosion Potential				
Compressive Strength, MPa				
Chloride Content	0-10 mm			
% Chloride by Weight of Concrete	20-30 mm			
	40-50 mm			
	60-70 mm			
	80-90 mm			
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm			
Testing Laboratory				
Remarks	<ul style="list-style-type: none">– Cored adjacent to east curb in Span 3.– Top asphalt lift, 40mm thick, well bonded to lower lift.– Concrete core broke intentionally at 130± mm depth for deeper coring.– Concrete overlay at top 165mm; good bonding.– No rebar encountered in core.		<ul style="list-style-type: none">– Top asphalt lift, 40mm well bond to lower lift.– Asphalt broke at lower lift during removal.– 110mm overlay and good bonding between overlay and concrete.– Bottom of core broken into pieces during removal.– No rebar encountered in core.	

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

Core No.	C - 9		C – 10	
Location	Sta. 162.25; G/L 0.45		Sta. 175.70; G/L 2.77	
Diameter, mm	100		100	
Thickness of Asphalt, mm	90		70	
Thickness of Asphalt @ nearest grid point	--		--	
Thickness of Concrete, mm	260		215	
Full Depth, (yes/no)	No		No	
Condition of Asphalt (1)	G		G	
Waterproofing (W/P) type	Rubberized Asphalt with premoulded membrane & Protection Board		Rubberized Asphalt with Protection Board	
Condition of W/P (1)	G		G	
W/P Thickness, mm	5-8		5±	
Bond of Asphalt or W/P to Concrete	G-F		G	
Defects in Concrete (2)	C		None	
Condition of Rebar (3)	No Rust		N/A	
Corrosion Potential				
Compressive Strength, MPa				
Chloride Content	0-10 mm			
% Chloride by Weight of Concrete	20-30 mm			
	40-50 mm			
	60-70 mm			
	80-90 mm			
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm			
Testing Laboratory				
Remarks	<ul style="list-style-type: none">– Cored adjacent to east curb in Span 2.– Top asphalt lift, 50mm thick, well bonded to lower lift; asphalt came off during removal.– Cut through a transverse #5 epoxy bar at 240mm cover (no rust).– Transverse narrow crack at bottom of core extending from 130mm depth to bottom of core.– Core broke at 130mm depth and at bottom during removal.		<ul style="list-style-type: none">– Asphalt broke from core during removal.– 125mm overlay and good bonding between overlay and concrete deck.– No rebar encountered in core.	

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

Core No.		C – 11	C -12
Location		Sta. 190.00; G/L 0.60	Sta. 41.80; G/L 1.83
Diameter, mm		100	100
Thickness of Asphalt, mm		90	60
Thickness of Asphalt @ nearest grid point		--	--
Thickness of Concrete, mm		275	160
Full Depth, (yes/no)		Yes	No
Condition of Asphalt (1)		F–G	G
Waterproofing (W/P) type		Rubberized Asphalt with Protection Board	Rubberized Asphalt with Protection Board
Condition of W/P (1)		G	G
W/P Thickness, mm		5-8	5±
Bond of Asphalt or W/P to Concrete		G	F–G
Defects in Concrete (2)		None	None
Condition of Rebar (3)		No Rust	N/A
Corrosion Potential			
Compressive Strength, MPa			
Chloride Content	0-10 mm 20-30 mm 40-50 mm 60-70 mm 80-90 mm		
% Chloride by Weight of Concrete			
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm		
Testing Laboratory			
Remarks		<ul style="list-style-type: none">– Top asphalt lift, 45mm thick, well bonded to lower lift.– Asphalt broke at bottom during removal.– Cut through a longitudinal #5 epoxy bar at 75mm cover.– 145mm overlay and good bonding between overlay and concrete.– Core broke intentionally at 240mm depth for deeper coring.	<ul style="list-style-type: none">– Asphalt & W/P separated from core during removal.– 110mm overlay and fair bonding between overlay and concrete.– Core broke at overlay and at bottom during removal.– No rebar encountered in core.

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

Core No.		C – 13	C –14
Location		Sta. 156.22; G/L 6.83	Sta. 137.05; G/L 5.89
Diameter, mm		100	100
Thickness of Asphalt, mm		70	75
Thickness of Asphalt @ nearest grid point		--	--
Thickness of Concrete, mm		278	240
Full Depth, (yes/no)		Yes	No
Condition of Asphalt (1)		F–G	G
Waterproofing (W/P) type		Rubberized Asphalt with Protection Board	Rubberized Asphalt with Protection Board
Condition of W/P (1)		G	G
W/P Thickness, mm		5±	6±
Bond of Asphalt or W/P to Concrete		G	G
Defects in Concrete (2)		None	C
Condition of Rebar (3)		No Rust	No Rust
Corrosion Potential			-0.20 V
Compressive Strength, MPa		64.9	
Chloride Content	0-10 mm 20-30 mm 40-50 mm 60-70 mm 80-90 mm		
% Chloride by Weight of Concrete			
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm		
Testing Laboratory		J.T. Donald Consultants Limited	
Remarks		<ul style="list-style-type: none">– Cut side of a longitudinal #5 epoxy bar at 95mm cover.– 135mm overlay and good bonding between overlay and concrete.– Core broke at top upon falling onto ground below deck.– Laboratory test performed on original concrete below the overlay.	<ul style="list-style-type: none">– Asphalt broke during removal.– 110-120mm overlay and good bonding between overlay and concrete.– Longitudinal narrow crack at top 20mm of overlay.– Cut top of a longitudinal #4 black smooth bar at 235mm cover; imprint at bottom of core.– Bottom of core broke during removal.

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

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CORE LOG ASPHALT COVERED BRIDGE DECKS

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SITE NO. 9-002

Core No.		C - 15	C -16
Location		Sta. 123.76; G/L 6.31	Sta. 95.32; G/L 4.97
Diameter, mm		100	100
Thickness of Asphalt, mm		85	65
Thickness of Asphalt @ nearest grid point		--	--
Thickness of Concrete, mm		235	225
Full Depth, (yes/no)		No	No
Condition of Asphalt (1)		G	G
Waterproofing (W/P) type		Rubberized Asphalt with Protection Board	Rubberized Asphalt with Protection Board
Condition of W/P (1)		G	G
W/P Thickness, mm		8±	10±
Bond of Asphalt or W/P to Concrete		F	G
Defects in Concrete (2)		None	None
Condition of Rebar (3)		N/A	No Rust
Corrosion Potential		-0.17 V	-0.16 V
Compressive Strength, MPa			
Chloride Content	0-10 mm		
% Chloride by Weight of Concrete	20-30 mm		
	40-50 mm		
	60-70 mm		
	80-90 mm		
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm		
Testing Laboratory			
Remarks		<ul style="list-style-type: none">W/P worked into a ball during coring.110-115mm overlay and good bonding between overlay and concrete.No rebar encountered in core.	<ul style="list-style-type: none">Concrete overlay at top 110-115mm of core; good bonding.Cut top of a longitudinal #4 black smooth bar at 220mm cover; imprint at bottom of core.

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

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CORE LOG ASPHALT COVERED BRIDGE DECKS

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SITE NO. 9-002

Core No.		C – 17	C –18
Location		Sta. 83.56; G/L 4.20	Sta. 72.58; G/L 6.85
Diameter, mm		100	100
Thickness of Asphalt, mm		50	85
Thickness of Asphalt @ nearest grid point		--	--
Thickness of Concrete, mm		235	135
Full Depth, (yes/no)		No	No
Condition of Asphalt (1)		G	F–G
Waterproofing (W/P) type		Rubberized Asphalt with Protection Board	Rubberized Asphalt with premoulded membrane & Protection Board
Condition of W/P (1)		G	G
W/P Thickness, mm		8±	8±
Bond of Asphalt or W/P to Concrete		F	G
Defects in Concrete (2)		None	None
Condition of Rebar (3)		No Rust	No Rust
Corrosion Potential		-0.16 V	-0.20 V
Compressive Strength, MPa			
Chloride Content	0-10 mm		
% Chloride by Weight of Concrete	20-30 mm		
	40-50 mm		
	60-70 mm		
	80-90 mm		
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm		
Testing Laboratory			
Remarks		<ul style="list-style-type: none">Asphalt & W/P broke from core during removal.Concrete overlay at top 110mm of core; broken during removal.Cut top of a transverse #4 black smooth bar at 230mm cover; no imprint at bottom of core.	<ul style="list-style-type: none">Cored adjacent to west curb in Span 6.Concrete overlay at top 75-110mm of core; broke at C.J. easily during removal, indicating poor to fair bonding.Cut top of a longitudinal #4 black smooth bar at 126mm cover; imprint at bottom of core.

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

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SITE NO. 9-002

Core No.		C - 19	C -20
Location		Sta. 62.06; G/L 4.16	Sta. 52.98; G/L 5.85
Diameter, mm		100	100
Thickness of Asphalt, mm		50	60
Thickness of Asphalt @ nearest grid point		--	--
Thickness of Concrete, mm		280	225
Full Depth, (yes/no)		No	No
Condition of Asphalt (1)		G	G
Waterproofing (W/P) type		Rubberized Asphalt with Protection Board	Rubberized Asphalt with Protection Board
Condition of W/P (1)		G	G
W/P Thickness, mm		5±	8±
Bond of Asphalt or W/P to Concrete		G	G
Defects in Concrete (2)		None	None
Condition of Rebar (3)		N/A	No Rust
Corrosion Potential		-0.27 V	-0.19 V
Compressive Strength, MPa			
Chloride Content	0-10 mm		
% Chloride by Weight of Concrete	20-30 mm		
	40-50 mm		
	60-70 mm		
	80-90 mm		
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm		
Testing Laboratory			
Remarks		<div>– Asphalt broke from core at protection board during removal.</div> <div>– 85mm overlay and good bonding between overlay and concrete.</div> <div>– Bottom of core broke during removal.</div> <div>– No rebar encountered in core.</div>	<div>– 60mm overlay and good bonding between overlay and concrete.</div> <div>– Cut top of a transverse #4 black smooth bar at 217mm cover; imprint at bottom of core.</div>

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

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SITE NO. 9-002

Core No.		C - 21	C -22
Location		Sta. 43.25; G/L 5.89	Sta. 24.63; G/L 4.16
Diameter, mm		100	100
Thickness of Asphalt, mm		50	60
Thickness of Asphalt @ nearest grid point		--	--
Thickness of Concrete, mm		215	270
Full Depth, (yes/no)		No	No
Condition of Asphalt (1)		G	G
Waterproofing (W/P) type		Rubberized Asphalt with Protection Board	Rubberized Asphalt with Protection Board
Condition of W/P (1)		G	G
W/P Thickness, mm		5±	5±
Bond of Asphalt or W/P to Concrete		G	G
Defects in Concrete (2)		None	None
Condition of Rebar (3)		No Rust	N/A
Corrosion Potential		-0.23 V	
Compressive Strength, MPa			57.2
Chloride Content	0-10 mm	Total	Corrected
% Chloride by Weight of Concrete	20-30 mm	0.226	0.177
	40-50 mm	0.195	0.146
	60-70 mm	0.146	0.097
	80-90 mm	0.115	0.093
	100-110 mm	0.084	0.062
	120-130 mm	0.058	0.036
	140-150 mm	0.048	0.026
	160-170 mm	0.036	0.014
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm	0.022	0.000
Testing Laboratory		J.T. Donald Consultants Limited	J.T. Donald Consultants Limited
Remarks		<div>– Cored in asphalt depression area at NW corner of Span 8.</div> <div>– 50mm overlay and good bonding between overlay and concrete.</div> <div>– Cut top of a transverse #4 black smooth bar at 210mm cover on south half; imprint at bottom of core.</div> <div>– Assumed background chloride values: 0.049% for overlay per 2003 report; 0.022% for original concrete.</div>	<div>– Asphalt broke at bottom during removal.</div> <div>– 110mm overlay and good bonding between overlay and concrete.</div> <div>– No rebar encountered in core.</div> <div>– Laboratory test performed on original concrete below the overlay.</div>

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

Core No.		C - 23	C -24	
Location		Sta. 18.76; G/L 3.50	Sta. 2.15; G/L 6.19	
Diameter, mm		100	100	
Thickness of Asphalt, mm		56	55	
Thickness of Asphalt @ nearest grid point		--	--	
Thickness of Concrete, mm		275	255	
Full Depth, (yes/no)		No	No	
Condition of Asphalt (1)		G	G	
Waterproofing (W/P) type		Rubberized Asphalt with Protection Board	Rubberized Asphalt with Protection Board	
Condition of W/P (1)		G	G	
W/P Thickness, mm		8±	6±	
Bond of Asphalt or W/P to Concrete		F	G	
Defects in Concrete (2)		None	None	
Condition of Rebar (3)		No Rust	No Rust	
Corrosion Potential		-0.29 V	-0.19 V	
Compressive Strength, MPa				
Chloride Content			Total	Corrected
% Chloride by Weight of Concrete	0-10 mm		0.230	0.181
	20-30 mm		0.199	0.150
	40-50 mm		0.168	0.119
	60-70 mm		0.142	0.093
	80-90 mm		0.120	0.071
	100-110 mm		0.080	0.058
	120-130 mm		0.053	0.031
140-150 mm		0.027	0.005	
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm			
Testing Laboratory			J.T. Donald Consultants Limited	
Remarks		<ul style="list-style-type: none">– Cored near centerline of road in Span 9.– Asphalt broke during removal.– Concrete overlay at top 105-115mm depth; poor bonding w/ gap evident at bottom of O/L.– Longitudinal C.J. in O/L along east side of core; saw cut mark in top 60mm of original deck below the longitudinal C.J. in O/L.– Cut top of a longitudinal #5 black smooth bar at 265mm cover; imprint at bottom of core.	<ul style="list-style-type: none">– Asphalt & W/P broke from core during removal.– 85mm overlay and good bonding between overlay and concrete.– Core broke at 170mm depth during removal.– Cut top of a longitudinal #5 black smooth bar at 246mm cover; imprint at bottom of core.	

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG ASPHALT COVERED BRIDGE DECKS

Core No.		C – 25 (South Approach)	C –26 (West Sidewalk)
Location		Sta. -1.56; G/L 5.87	Sta. 5.48; G/L 2.10 North of 7.00
Diameter, mm		100	100
Thickness of Asphalt, mm		165	--
Thickness of Asphalt @ nearest grid point		--	--
Thickness of Concrete, mm		--	160
Full Depth, (yes/no)		Yes	Yes
Condition of Asphalt (1)		F-G	N/A
Waterproofing (W/P) type		N/A	N/A
Condition of W/P (1)		N/A	N/A
W/P Thickness, mm		N/A	N/A
Bond of Asphalt or W/P to Concrete		N/A	N/A
Defects in Concrete (2)		N/A	None
Condition of Rebar (3)		N/A	No Rust
Corrosion Potential			
Compressive Strength, MPa			
Chloride Content	0-10 mm		
% Chloride by Weight of Concrete	20-30 mm		
	40-50 mm		
	60-70 mm		
	80-90 mm		
Air Voids	Air content, % Spec. surf. , mm² / mm³ Spacing factor, mm		
Testing Laboratory			
Remarks		<ul style="list-style-type: none">– Cored in south approach roadway.– Top 70mm asphalt came off easily during removal.– Granular road fill below core.– No concrete approach slab.	<ul style="list-style-type: none">– Cored in west sidewalk in Span 9.– 35mm overlay and good bonding to original concrete.– Cut through a transverse #4 black smooth bar at 127mm cover.

1. Condition - G= Good, F = Fair, P = Poor
2. Defects - C = Cracked, D = Delaminated, R = Rough, Sc = Scaling, S = Spalling
3. Condition of Rebar - LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

APPENDIX E
Sawn Asphalt Sample Logs

SAWN ASPHALT SAMPLE LOG

Sample No.	SAS - 1	SAS - 2
Location	Sta. 182.30; G/L 3.05	Sta. 158.70; G/L 1.96
Size, mm X mm	270 X 400	280 X 420
Thickness of Asphalt, mm	50	65
Thickness of Asphalt @ Nearest Grid Point	--	--
Condition of Asphalt (1)	G	G
Waterproofing (W/P) Type	Rubberized Asphalt with protection board	Rubberized Asphalt with protection board
W/P Thickness, mm	6 ±	7±
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 Reinforcement, mm	See remarks	87mm to longitudinal M16 bar
Defects in Concrete Surface (2)	None	None
Corrosion Potential @ Nearest Grid Point	--	--
Remarks	<div><div></div><div><div>–</div>No delamination detected in sample.<div>–</div>Cover meter reading fluctuated from 210mm to over 300mm.</div></div>	<div><div></div><div><div>–</div>No delamination detected in sample.</div></div>

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

SAWN ASPHALT SAMPLE LOG

Sample No.	SAS – 3	SAS - 4
Location	Sta.123.75; G/L 0.18	Sta. 103.32; G/L 2.29
Size, mm X mm	400 X 290	280 X 425
Thickness of Asphalt, mm	95	70
Thickness of Asphalt @ Nearest Grid Point	--	--
Condition of Asphalt (1)	G	G
Waterproofing (W/P) Type	Rubberized Asphalt with premoulded membrane & protection board	Rubberized Asphalt with protection board
W/P Thickness, mm	8±	6±
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 Reinforcement, mm	162mm to longitudinal M16 bar	See remarks
Defects in Concrete Surface (2)	None	None
Corrosion Potential @ Nearest Grid Point	-0.18	-0.16
Remarks	<div>- Sample taken adjacent to east curb. - Top asphalt lift of 42mm is well bonded to bottom asphalt lift. - No delamination detected in sample.</div>	<div>- No delamination detected in sample. - Cover meter reading fluctuated from 198mm to over 320mm.</div>

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

SAWN ASPHALT SAMPLE LOG

Sample No.	SAS – 7	SAS – 8
Location	Sta. 111.70; G/L 6.24	Sta. 87.75; G/L 6.83
Size, mm X mm	280 X 375	415 X 290
Thickness of Asphalt, mm	75	75
Thickness of Asphalt @ Nearest Grid Point	--	--
Condition of Asphalt (1)	G	F
Waterproofing (W/P) Type	Rubberized Asphalt with premoulded membrane & protection board	Rubberized Asphalt with premoulded membrane & protection board
W/P Thickness, mm	8±	12±
Condition of W/P (1)	G	G
Bond of W/P to Asphalt	G	G
Bond of Asphalt or W/P to Concrete	G	F-G
Concrete Cover to Reinforcement, mm	140mm to longitudinal M16 bar	88mm to longitudinal M16 bar
Defects in Concrete Surface (2)	None	None
Corrosion Potential @ Nearest Grid Point	-0.23	-0.21
Remarks	<div>- Sample taken adjacent to west curb. - Top asphalt lift of 35mm is well bonded to bottom asphalt lift. - No delamination detected in sample. - Light raveling on top asphalt surface.</div>	<div>- Sample taken at NW corner of span 4 adjacent to concrete end dam at west curb. - No delamination detected in sample. - Light rust on joint steel. - Light raveling on top asphalt surface.</div>

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

SAWN ASPHALT SAMPLE LOG

Sample No.	SAS – 9	SAS – 10
Location	Sta. 65.00; G/L 6.83	Sta. 32.00; G/L 5.23
Size, mm X mm	375 X 290	280 X 410
Thickness of Asphalt, mm	85	65
Thickness of Asphalt @ Nearest Grid Point	--	--
Condition of Asphalt (1)	F	G
Waterproofing (W/P) Type	Rubberized Asphalt with premoulded membrane & protection board	Rubberized Asphalt with protection board
W/P Thickness, mm	13±	6±
Condition of W/P (1)	G	G
Bond of W/P to Asphalt	G	G
Bond of Asphalt or W/P to Concrete	F	G
Concrete Cover to Reinforcement, mm	99mm to longitudinal M16 bar	127mm to longitudinal M16 bar
Defects in Concrete Surface (2)	None	None
Corrosion Potential @ Nearest Grid Point	-0.29	-0.16
Remarks	<div>- Sample taken adjacent to west curb near north concrete end dam at span 7.</div> <div>- No delamination detected in sample.</div> <div>- Light raveling on top asphalt surface.</div>	<div>- No delamination detected in sample.</div>

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

SAWN ASPHALT SAMPLE LOG

Sample No.	SAS – 5	SAS - 6
Location	Sta.197.15; G/L 4.51	Sta. 143.17; G/L 4.67
Size, mm X mm	280 X 395	260 X 420
Thickness of Asphalt, mm	75	70
Thickness of Asphalt @ Nearest Grid Point	--	--
Condition of Asphalt (1)	G	G
Waterproofing (W/P) Type	Rubberized Asphalt with protection board	Rubberized Asphalt with protection board
W/P Thickness, mm	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 Reinforcement, mm	164mm to longitudinal M16 bar	178mm to longitudinal 16M bar
Defects in Concrete Surface (2)	None	None
Corrosion Potential @ Nearest Grid Point	--	-0.17
Remarks	<div>- No delamination detected in sample.</div>	<div>- No delamination detected in sample.</div>

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

SAWN ASPHALT SAMPLE LOG

Sample No.	SAS – 11	
Location	Sta. 9.35; G/L 5.23	
Size, mm X mm	280 X 385	
Thickness of Asphalt, mm	65	
Thickness of Asphalt @ Nearest Grid Point	--	
Condition of Asphalt (1)	G	
Waterproofing (W/P) Type	Rubberized Asphalt with protection board	
W/P Thickness, mm	6±	
Condition of W/P (1)	G	
Bond of W/P to Asphalt	G	
Bond of Asphalt or W/P to Concrete	G	
Concrete Cover to Reinforcement, mm	179mm to longitudinal M16 bar	
Defects in Concrete Surface (2)	None	
Corrosion Potential @ Nearest Grid Point	-0.15	
Remarks	– No delamination detected in sample.	

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

APPENDIX F
Sawn Asphalt Sample Photographs

- F1 -



SAS-1

- F2 -



SAS-3

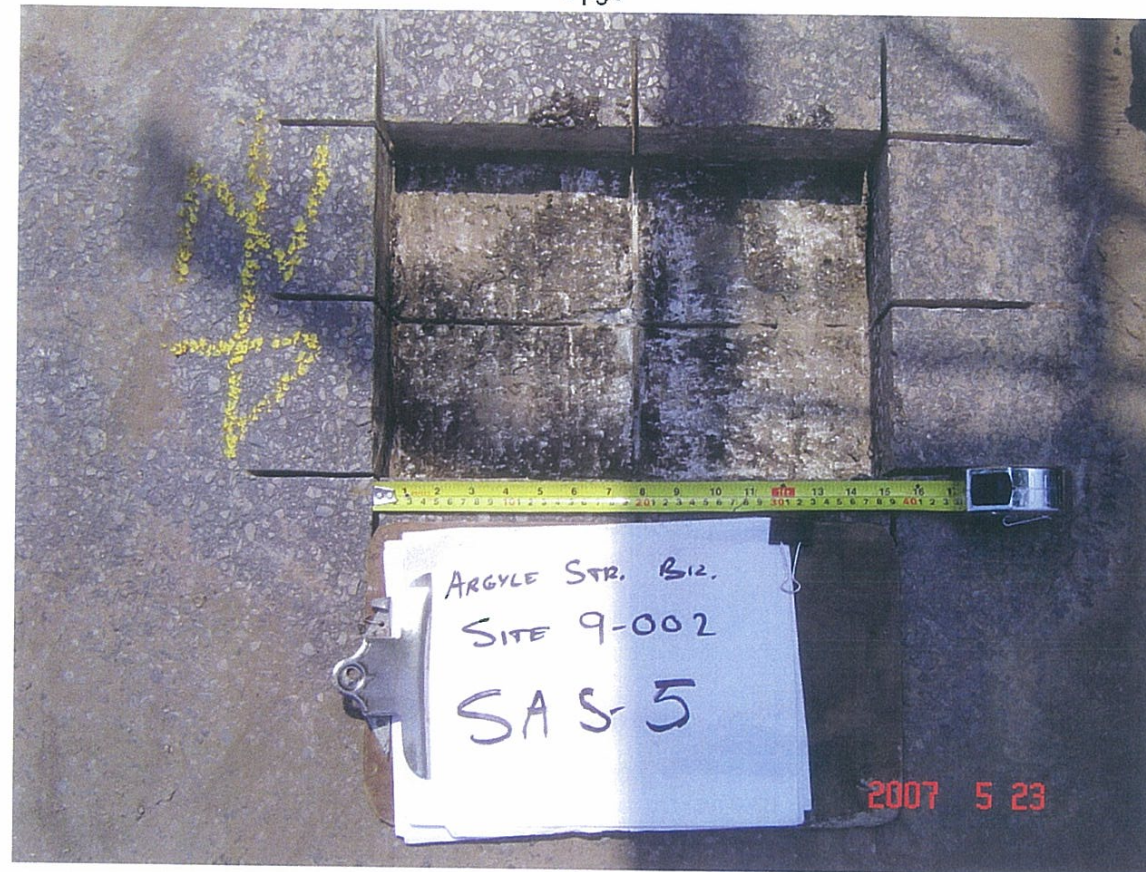


SAS-2



SAS-4

- F3 -



SAS-5

- F4 -



SAS-7



SAS-6



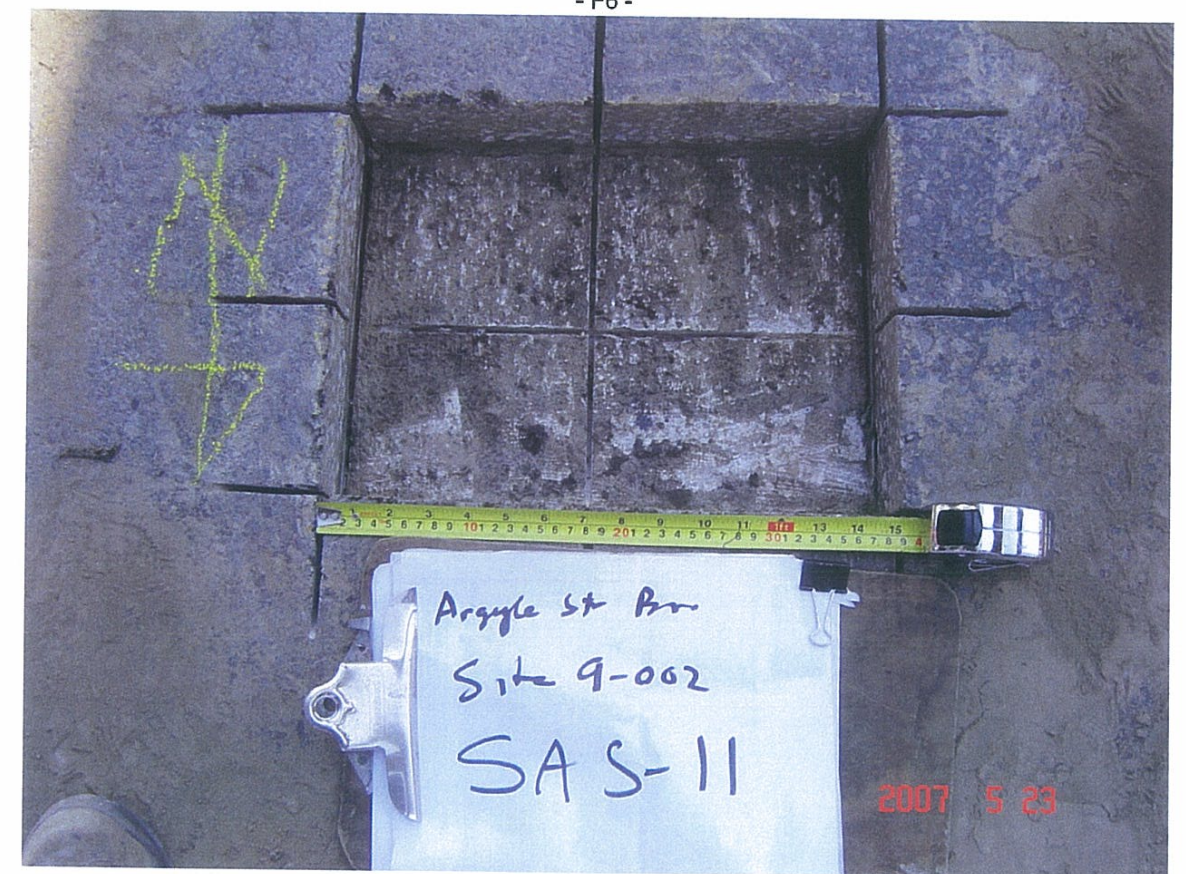
SAS-8

- F5 -



SAS-9

- F6 -



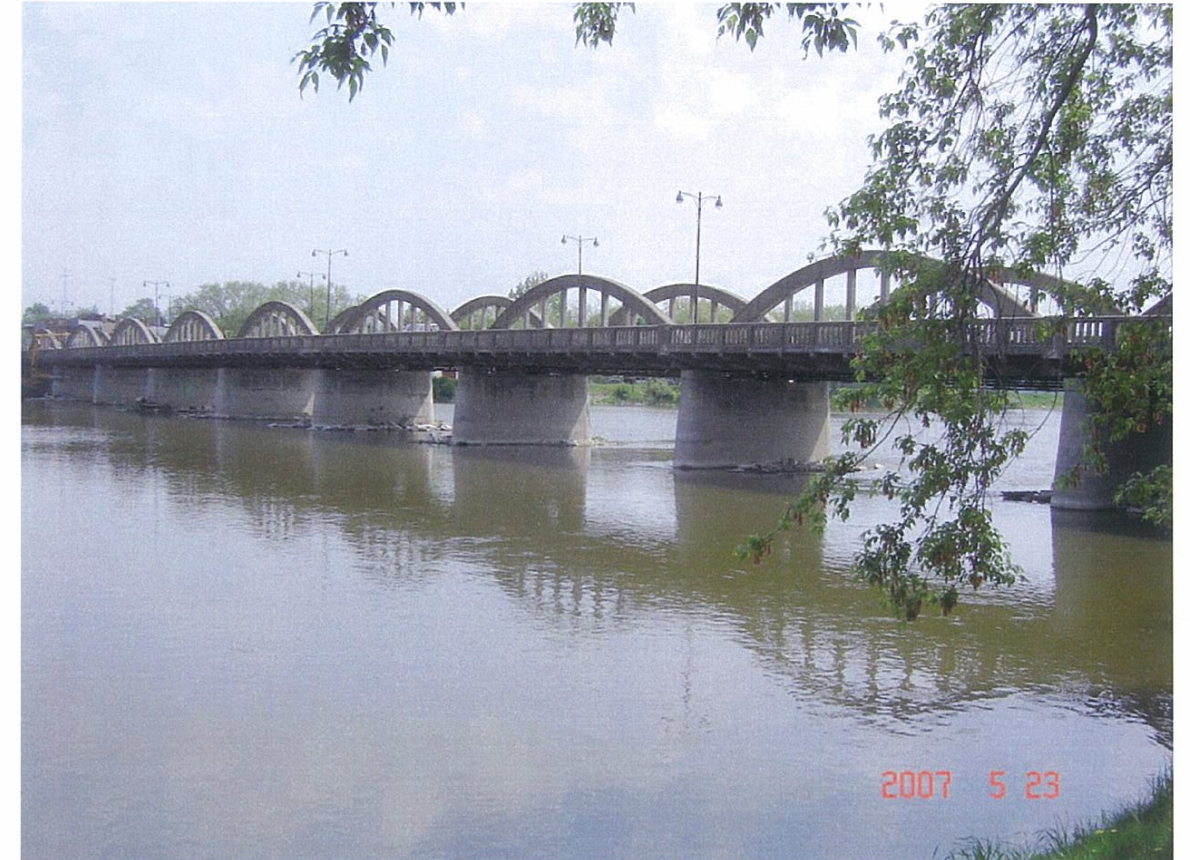
SAS-11



SAS-10

APPENDIX G
Site Photographs

- G 1 -



01 West Elevation, looking North



02 Bridge from South Approach

- G 2 -



03 Bridge from North Approach

- G 3 -



05 Deck asphalt surface from North end

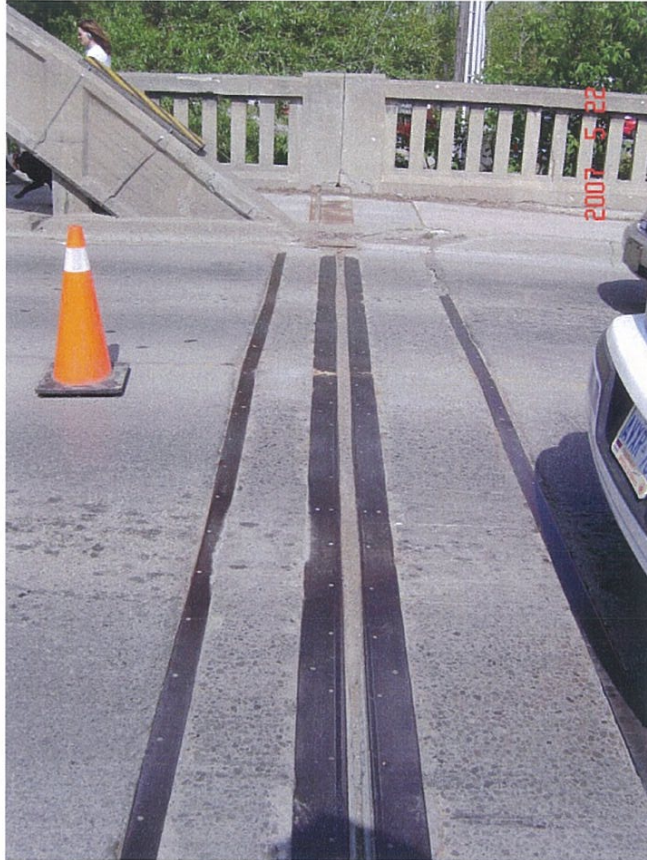


04 General view of deck, looking South



06 Light depression with cracks at NW corner of Span 8

- G 4 -



07 North Abutment Joint

- G 5 -



09 Local spalled on concrete end-dam (TYP)



08 Typical Expansion Joint at Piers



10 Missing section of armouring steel angle @ North Abutment Joint

- G 6 -



11 Damaged expansion joint armouring steel @ Pier 2 (TYP)

- G 7 -



13 Minor delamination & spalled at top of W arch, Span 3



12 General view of Arch at deck surface (west arch, looking south shown)



14 Cracked & Spalled south end of east arch @ Span 7

- G 8 -



15 Typical cracks, delamination and spalls on arch hangers

- G 9 -



17 East Sidewalk, looking North



16 West Sidewalk, looking South



18 Delamination & Spalls on outside face of W Rail (TYP), Span 5

- G 10 -



19 Lengthy horizontal crack on E rail, Span 5

- G 11 -



21 North Approach



20 South Approach



22 General view of deck underside, looking South

- G 12 -



23 Typical exterior soffit

- G 13 -



25 Typical delamination and patched areas on soffit at deck drain



24 Typical interior soffit, Span 2 from south shown



26 Typical spalled pocket on soffit

- G 14 -



27 Cracked, Delamination and Spalled on bottom chord adjacent to a drain pipe in Span 4 (TYP)

- G 15 -



29 Large cavity in bottom E chord, Span 2



28 Typical cracked & delaminated bottom chord at end, east arch @ Pier 8 shown



30 Exposed bars in cavity in bottom E chord, Span 2

- G 16 -



31 Sealed diagonal crack in west bottom chord west of Pier 6 (TYP)

- G 17 -



33 Exposed bent steel anchorage plate at north end of Span 8 bottom east chord, Pier 7



32 Diagonal crack on bottom west chord, south of Pier 1 (TYP)



34 Spalled on floor beam under east sidewalk at Pier 7 (TYP)



35 Typical spalled on intermediate floor beam



37 Typical bridge bearings, east Bearings on Pier 6 shown



36 Cracked and delaminated interior floor beam at Span 2



38 Steel pedestal for bearings at Pier 3 (TYP)



39 Typical pier profile , north elevation of Pier 3 shown



41 Wide crack across top of Pier 2



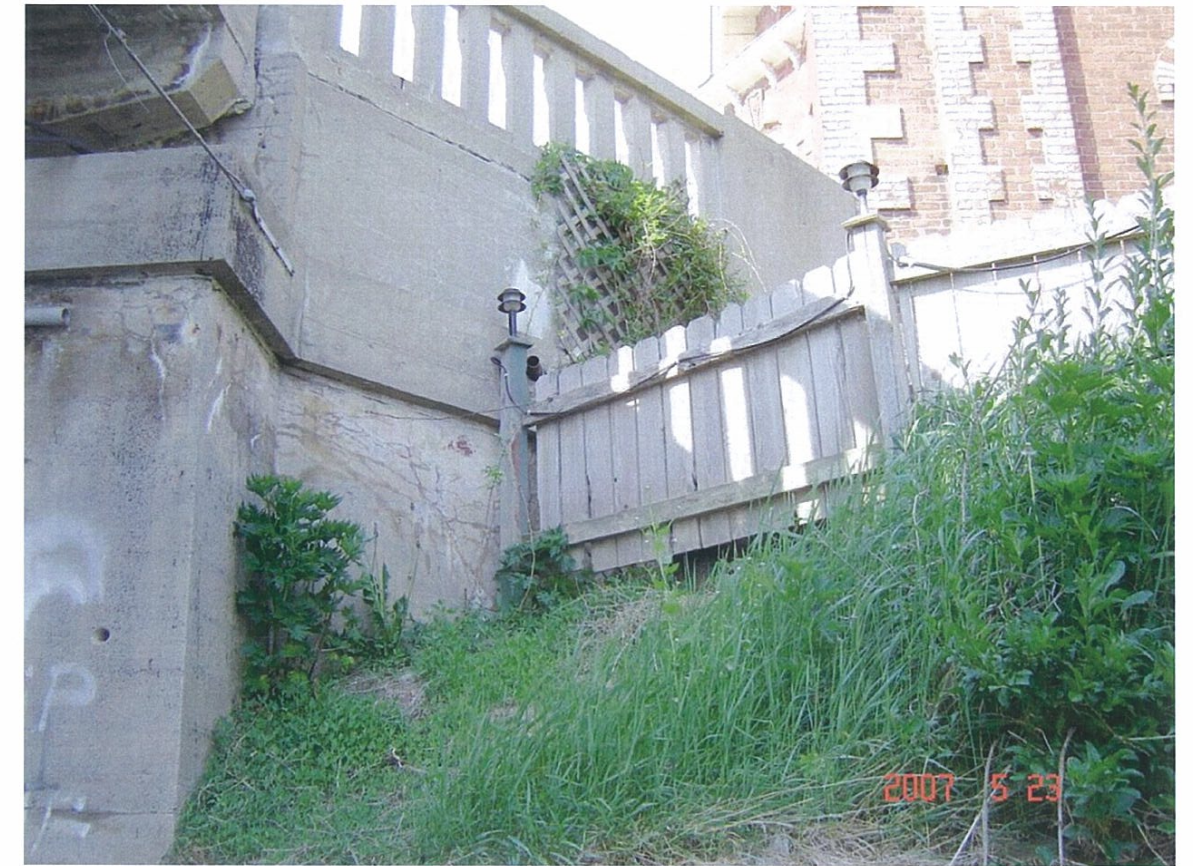
40 Localized delamination on east side of Pier 5 (TYP)



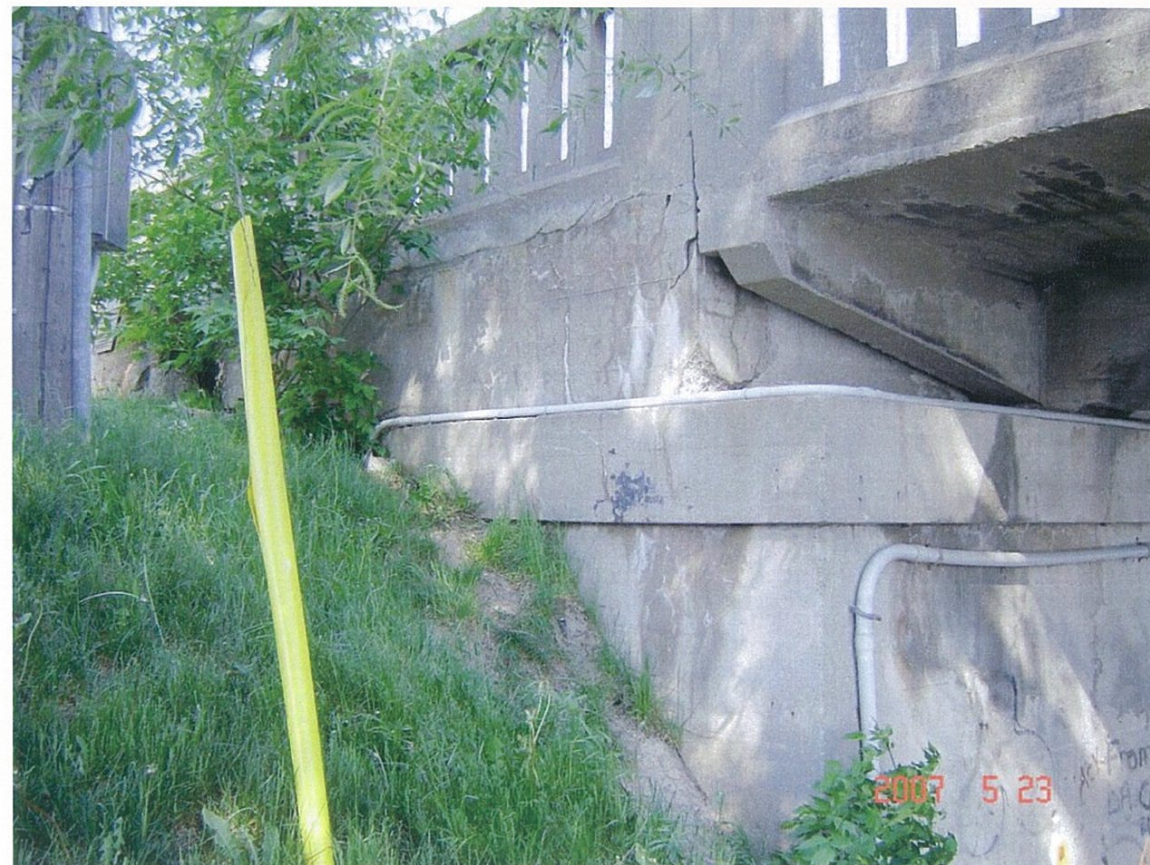
42 Local shallow spalled atop Pier 6



43 North Abutment



45 NE Wingwall



44 NW Wingwall



46 NE Retaining Wall



47 South Abutment



49 SE Wingwall



48 SW Wingwall



50 Boardwalk @ South Embankment

APPENDIX H
Drawings