

APPENDIX 'C'

**PAVEMENT CORES BRIDGE DECK AND
SUBSTRUCTURE**



Stantec Consulting Ltd.
199 Henlow Bay, Winnipeg MB R3Y 1G4

June 9, 2016
File: 123312551

Attention: Mr. Mike Lau
1558 Willson Place
Winnipeg, MB R3T 0Y4

Good day Mike,

Reference: Fermor Avenue Bridge Over Seine River

On May 18th and 25th, 2016, Stantec Consulting Ltd. was retained to recover a total of twenty-eight (28) core samples from the Fermor Avenue Bridge over the Seine River in Winnipeg, Manitoba. Twelve (12) core samples were obtained from the bridge deck, which the remaining sixteen (16) core samples were recovered from the substructure. The purpose of the coring program was to determine the compressive strength, air-void parameters, and chloride content of the concrete. As instructed by Dillon Consulting, all testing conducted on the deck concrete was performed below the high density concrete overlay. Photographs of the core samples are attached to this report. The testing performed and the corresponding results for each core sample are identified below.

Unit Weight

Ten (10) core samples (2 from the bridge deck and 8 from the substructure) were tested for unit weight in accordance with section 9.1.1 of *ASTM C1084, Standard Test Method for Portland-Cement of Hardened Hydraulic Concrete*.

The unit weight results for the bridge deck were 2381 and 2298 kg/m³ with an average of 2340 kg/m³. The unit weight results for the substructure ranged from 2351 to 2402 kg/m³ with an average of 2371 kg/m³. A summary of the unit weight results are provided in the attached Table 1.

Compressive Strength

Ten (10) core samples (2 from the bridge deck and 8 from the substructure) were tested for compressive strength in accordance with *CSA A23.2-14C, Obtaining and Testing Drilled Cores for Compressive Strength*. The core samples were conditions in water at room temperature for 48 hours prior to testing.

The compressive strength results for the bridge deck were 45.5 and 22.7 MPa with an average of 34.0 MPa. The compressive strength for the substructure ranged from 34.7 to 75.2 MPa with an average of 52.3 MPa. A summary of the compressive strength results are provided in the attached Table 1.



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Chloride Content

Thirteen (13) core samples (5 from the bridge deck and 8 from the substructure) were prepared for chloride content determination by trimming 10 mm slices at prescribed depths from the surface of the core sample. Testing of the 10 mm slices were performed in accordance with *CSA A23.2-4B, Sampling and Determination of Water-Soluble Chloride Ion Content in Hardened Grout or Concrete*. The chloride content results are summarized in the attached Table 2.

The chloride threshold necessary to permit corrosion in the reinforcing steel with the presence of oxygen and moisture has to be greater than 0.025% by mass of concrete (in accordance with OSRM manual, April 2007). The chloride results that exceed this threshold are highlighted in Table 2.

Hardened Air-Void Parameters

Five (5) core samples obtained from the bridge deck were tested for air-void parameters in accordance with the modified linear point count method outlined in *ASTM C457, Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete*. The air void parameters for the concrete core samples testing are summarized in the attached Table 3.

The air-void parameter results for core nos. D2, D4, and D6 (as highlighted in Table 3) do not meet CSA A23.1 specification limits for frost resistant concrete. It should be noted that the concrete represented by these three core samples was obtained from the original construction of the bridge deck.

We appreciate the opportunity to assist you on this project. Please contact the undersigned if you have any questions regarding this report.

Regards,

STANTEC CONSULTING LTD.

A handwritten signature in black ink, appearing to read 'Jason Thompson'.

Jason Thompson, C.E.T.
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Manager, Materials Testing Services
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Attachment: Table 1 – Unit Weight & Compressive Strength Test Data
Table 2 – Chloride Content Test Data
Table 3 – Air Void Parameter Test Data

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TABLE 1
UNIT WEIGHT & COMPRESSIVE STRENGTH TEST DATA

Core No.	Core Identification		Unit Weight (kg/m ³)	Compressive Strength (MPa)
	Structure	Location		
D3	Deck	Eastbound curb lane, 8.9 m east of west expansion joint, 4.5 m south of median	2381	45.5
D9	Deck	Eastbound shoulder, 3.9 m east of west expansion joint, 2.4 m north of traffic barrier	2298	22.7
P2	East Pier	East face of pier, 1.5 m south of 2 nd girder from north side, 0.7 m below top of pier	2387	34.7
P4	East Pier	East face of pier, 1.1 m south of 7 th girder from north side, 0.4 m below top of pier	2382	68.8
P6	West Pier	West face of pier, 0.7 m south of 2 nd girder from north side, 0.4 m below top of pier	2337	42.1
P8	West Pier	West face of pier, below 7 th girder from north side, 0.8 m below top of pier	2351	52.5
A2	East Abutment	West face of abutment, 1.7 m south of 1 st girder from north side, 0.2 m from bearing seat area	2402	46.6
A3	East Abutment	West face of abutment, 0.6 m south of 6 th girder from north side, 0.4 m from bearing seat area	2366	75.2
A6	West Abutment	East face of abutment, 1.5 m south of 1 st girder from north side, 0.5 m from bearing seat	2381	38.7
A8	West Abutment	East face of abutment, 1 m south of 6 th girder from north side, 0.4 m from bearing seat	2360	60.0

Notes:

1. Core nos. D3, P4, P8, A3, and A8 were obtained from the portion of the bridge that is noted as the original construction.
2. Core nos. D9, P2, P6, A2, and A6 were obtained from the portion of the bridge that was added on during widening of the bridge structure.



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**TABLE 2
 CHLORIDE CONTENT TEST DATA**

Core No.	Core Identification		Depth from Surface (mm)	Chloride Content (% by mass of concrete)
	Structure	Location		
D1	Deck	Eastbound curb lane, 2.9 m east of west expansion joint, 4.6 m south of median	120 to 130	0.030
			150 to 160	0.016
			180 to 190	0.014
D5	Deck	Eastbound curb lane, 27.8 m east of west expansion joint, 4.9 m south of median	105 to 115	0.042
			145 to 155	0.015
			190 to 200	0.014
D7	Deck	Eastbound curb lane, 3 m west of east expansion joint, 4.7 m south of median	135 to 145	0.014
			165 to 175	0.014
			195 to 205	0.017
D8	Deck	Eastbound shoulder, 3.3 m east of west expansion joint, 2.5 m north of traffic barrier	125 to 135	0.011
			155 to 165	0.019
			190 to 200	0.028
D12	Deck	Eastbound shoulder, 3.1 m west of east expansion joint, 2.2 m north of traffic barrier	125 to 135	0.013
			150 to 160	0.013
			175 to 185	0.018
P1	East Pier	East face of pier, 1.5 m south of 2 nd girder from north side, 0.7 m below top of pier	85 to 95	0.021
P3	East Pier	East face of pier, 1.1 m south of 7 th girder from north side, 0.4 m below top of pier	85 to 95	0.016
P5	West Pier	West face of pier, 0.7 m south of 2 nd girder from north side, 0.4 m below top of pier	85 to 95	0.007
P7	West Pier	West face of pier, below 7 th girder from north side, 0.8 m below top of pier	85 to 95	0.036
A1	East Abutment	West face of abutment, 1.4 m south of 1 st girder from north side, 0.3 m from bearing seat area	50 to 60	0.226
A4	East Abutment	West face of abutment, 1.2 m south of 6 th girder from north side, 0.3 m from bearing seat area	50 to 60	0.202
A5	West Abutment	East face of abutment, 1.3 m south of 1 st girder from north side, 0.3 m from bearing seat	50 to 60	0.322



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TABLE 2 (Cont'd)
CHLORIDE CONTENT TEST DATA

Core No.	Core Identification		Depth from Surface (mm)	Chloride Content (% by mass of concrete)
	Structure	Location		
A7	West Abutment	East face of abutment, 1.1 m south of 6 th girder from north side, 0.4 m from bearing seat	50 to 60	0.292

Notes:

1. Core nos. D1, D5, D7, P3, P7, A4 and A7 were obtained from the portion of the bridge that is noted as the original construction.
2. Core nos. D8, D12, P1, P5, A1, and A5 were obtained from the portion of the bridge that was added on during widening of the bridge structure.
3. The chloride threshold necessary to permit corrosion in the reinforcing steel with the presence of oxygen and moisture has to be greater than 0.025% by mass of concrete (in accordance with OSRM manual, April 2007). The chloride results that exceed this threshold are highlighted in Table 2 above.



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**TABLE 3
 AIR VOID PARAMETER TEST DATA**

Core No.	Core Identification		Air Content (%)	Specific Surface (mm ⁻¹)	Paste Content (%)	Spacing Factor (µm)
	Structure	Location				
D2	Deck	Eastbound curb lane, 4.2 m east of west expansion joint, 4.7 m south of median	2.1	11.0	20.0	562
D4	Deck	Eastbound curb lane, 27.5 m west of east expansion joint, 4.9 m south of median	3.4	6.8	21.4	753
D6	Deck	Eastbound curb lane, 9.1 m west of east expansion joint, 4.8 m south of median	2.8	6.8	23.7	873
D10	Deck	Eastbound shoulder, 8.8 m east of west expansion joint, 2.4 m north of traffic barrier	6.9	24.2	19.0	114
D11	Deck	Eastbound shoulder, 9.2 m west of east expansion joint, 2.3 m north of traffic barrier	9.2	15.5	17.0	119
CSA A23.1 specification limits for frost resistant concrete			3.0 min.	no limit	no limit	260 max.

Notes:

1. Core nos. D2, D4, and D6 were obtained from the portion of the bridge that is noted as the original construction.
2. Core nos. D10 & D11 were obtained from the portion of the bridge that was added on during widening of the bridge structure.
3. Core nos. D2, D4, and D6, as highlighted in the table above, did not comply with CSA A23.1 specification limits for frost resistant concrete.



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Figure 1 – Core no. D1, eastbound curb lane



Figure 2 – Core no. D2, eastbound curb lane



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Figure 3 – Core no. D3, eastbound curb lane



Figure 4 – Core no. D4, eastbound curb lane



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Figure 5 – Core no. D5, eastbound curb lane



Figure 6 – Core no. D6, eastbound curb lane



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Figure 7 – Core no. D7, eastbound shoulder



Figure 8 – Core no. D8, eastbound shoulder



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Figure 9 – Core no. D9, eastbound shoulder



Figure 10 – Core no. D10, eastbound shoulder



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Figure 11 – Core no. D11, eastbound shoulder



Figure 12 – Core no. D12, eastbound shoulder



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Figure 13 – Core no. P1, east pier



Figure 14 – Core no. P2, east pier



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Figure 15 – Core no. P3, east pier



Figure 16 – Core no. P4, east pier



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Figure 17 – Core no. P5, west pier



Figure 18 – Core no. P6, west pier



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Figure 19 – Core no. P7, west pier



Figure 20 – Core no. P8, west pier



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Figure 21 – Core no. A1, east abutment



Figure 22 – Core no. A2, east abutment



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Figure 23 – Core no. A3, east abutment



Figure 24 – Core no. A4, east abutment



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Figure 25 – Core no. A5, west abutment



Figure 26 – Core no. A6, west abutment



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Figure 27 - Core no. A7, west abutment



Figure 28 - Core no. A8, west abutment