EXPERT REPORT

(Final)

MATERIALS QUALITY CONTROL

Cores sampled from the pillar supporting aid to navigation FP (NLF 2181) on Île du Moine in Sainte-Anne-de-Sorel, QC

CLIENT CODE: **PECHES101**
F/N: **CA-17-2035**

October 13th, 2017

Fisheries and Oceans Canada

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(Final)

2017-10-13

OIQ 120593

Approved by

Michel Daoust, P.Eng.
Project manager
OIQ # 120593

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CONFIDENTIAL

Report presented to

Mr. Bienvenu Noumon, P.Eng.

Fisheries and Oceans Canada
101, Champlain Boulevard
Quebec (QC) G1K 7Y7

RECORD OF REVISIONS AND TRANSMISSIONS

Nº RÉV.	DATE	MODIFICATION DESCRIPTION AND/OR ISSUANCE
Final	2017-10-13	**Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181) on Île du Moine in Sainte-Anne-de-Sorel, QC**
Préliminary (French)	2017-08-04	**Expertise sur travaux de carottage du pilier supportant l'aide à la navigation FP (NLF 2181) sur l'Île du Moine à Sainte-Anne-de-Sorel, QC**

DISTRIBUTION

DESCRIPTION	NAME
One (1) PDF copy	**Mr. Tété Comlan Ago Bienvenu Noumon, P.Eng., Fisheries and Oceans Canada**
One (1) PDF copy	**Mr. Éric Boucher, P.Eng., M.Sc., EMS Ingénierie inc.**

NOTE TO THE READER

This engineering document is presented and destined to the attention of Mr. Tété Comlan Ago Bienvenu Noumon, P. Eng. for Fisheries and Oceans Canada. An electronic version of the report in pdf format has also been submitted to Mr. Eric Boucher, P.Eng., MASc. for EMS Ingénierie inc. This document has not been distributed nor transmitted to any other body, ministry, government or individual. This report contains confidential and legally privileged information.

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1. INTRODUCTION

Groupe ABS Inc. was mandated by Fisheries and Oceans Canda to core the pillar supporting the navigation aid FP (NLF 2181) on Île du Moine in Sainte-Anne-de-Sorel, QC. The pillar is located approximately 480 m from the western tip of the island.

The goal of this expert report is to determine the general condition of the concrete pillar walls so as to guide the repair work of the pillar in order to prolong its service life for approximately twenty (20) years, validate the thickness of the concrete overlay and to give our comments and recommendations on the potential of long term service life, the state of the concrete, its repair potential and if applicable, the suggested repair methods.

Groupe ABS proceeded with the following activities:

- Coring of the pillar walls.
- Measuring of the cores.
- Megascopic examination of the cores
- Compressive strength testing, microscopical determination of parameters of the air-void system in hardened concrete and absorption and voids in hardened concrete.
-

2. CORING

Coring of the pillar walls took place on July 21st 2017. All five (5) faces of the pillar were cored based on the coring locations provided by Fisheries and Oceans Canada, which was

- Sampling eight (8) cores 93 mm in diameter, destined to megascopic examinations and compressive strength testing. These cores are identified as F1 to F8
- Sampling twenty (20) supplementary cores 57 mm in diameter so as to determine the thickness of the concrete overlay. These cores are identified as A to T.

The location of the cores are shown on sketches in appendix A.

2.1. Observations

- The concrete in close proximity to the steel angles on the pillar's edges is deteriorated.
- Efflorescence emanating from cracks can be observed on the exterior walls.
- The use of a georadar allowed to locate reinforcing steel bars both horizontally and vertically at a spacing varying from 400 mm to 600 mm. The depth of the rebars, from the exterior surface of the walls varies from 75 to 150 mm.
- The concrete appears less deteriorated towards the top of the pillar than at its base.

- Inside the pillar, surface delamination is more or less generalized on approximately the first 50 mm. Several cracks were observed and white stalactites formed by efflorescence can be observed on the concrete ceiling slab. Exposed, corroded rebar can be observed in some areas. The concrete appears to be from the original construction as opposed to the exterior concrete overlay which is visibly more recent.
- Due to the concrete deterioration in certain areas, the 57 mm diameter cores were recovered in several pieces.
- Coring generally stopped in a layer that would break apart under the stress of the coring operations. In these instances, the cored concrete could not be recovered as it would not remain in the coring bit. This layer was within the original concrete dating back to 1906.

3. LABORATORY TESTING

The cores F1 to F8 were subjected to a megascopic examination and tested for compressive strength. The megascopic examination reports (*Description of cored sample)* are in appendix B. The compressive strength reports (Testing of concrete cores) are in appendix C. Cores A thru T were measured for length in order to determine the thickness of the overlay. A microscopical determination of parameters of the air-void system in hardened concrete and absorption and voids in hardened concrete was performed on some of the 57 mm cores. The testing results on cores A to T are also in appendix C. Photos of the site and of all cores are in appendix D.

3.1. Megascopic examinations

The megascopic examinations allowed to determine the presence of alkali-aggregate reactivity (AAR) by observing the presence of silica gel produced by AAR. The production of silica gel around the aggregates causes swelling of the concrete and induces cracking of the paste and aggregates. We can observe on cores F2 to F4 and cores F6 to F8 the presence of several cracks perpendicular to the cores' longitudinal axes. With time, these cracks, parallel to each other, will cause gradual delamination of the concrete starting from the outside face. An example of such delamination was observed on the south face of the pillar (photo 2, appendix B).

3.2. Compressive strength testing

Following the megascopic examinations, compressive strength testing was carried on cores F1 to F8 as per CSA A23.2-14C. Table 1 on the next page summarizes the compressive strength measured on cores F1 to F8. The average compressive strength of the pillar is 20.4 MPa. The cores from the south and south-west walls showed results that were all below 20 MPa whereas results on cores from East, North and North-West walls showed at least one result above 25 MPa. As a reference, the specified compressive strength for a residential foundation wall on the Québec market is 20 MPa and the commercial or institutional market often requires 25 or 30 MPa, depending on applicable loads on the foundations.

Table 1 – Summary of compressive strength testing

Core	Compressive strength(MPa)	Cardinal direction of wall
F1	14.9	South
F2	16.4	South
F3	17.8	East
F4	25.6	East
F5	27.3	North
F6	15.5	North
F7	29.2	North-West
F8	16.8	South-West

3.3 Thickness of concrete overlay

The pillar is built in such a way that it can be entered. It was required to sample an additional twenty (20) cores to measure the thickness of the overlay on the outside walls of the pillar. Table 2 below summarizes all the core lengths measured from F1 to F8 and A to T. All cores were sampled at a targeted depth of 400 mm. The average overlay thickness is 337 mm.

Table 2 – Thickness of overlay

South wall							
Core	F1	F2	Q	R	S	T	Average
Length of core (mm)	330	400	370	310	300	360	345
Overlay thickness (mm)	330	390	370	310	290	310	**333**
North-West wall							
Core	F7	I	J	K	L	-	Average
Length of core (mm)	370	325	350	260	390	-	339
Overlay thickness (mm)	370	325	350	260	340	-	**329**

...Table 2 continued

East wall							
Core	F3	F4	A	B	C	D	Average
Length of core (mm)	340	360	375	300	340	345	343
Overlay thickness (mm)	290	360	305	300	330	320	**318**
North wall							
Core	F5	F6	E	F	G	H	Average
Length of core (mm)	335	390	440	335	435	330	378
Overlay thickness (mm)	295	390	440	335	375	305	**357**
South-West wall							
Core	F8	M	N	O	P	-	Average
Length of core (mm)	370	270	340	370	390	-	348
Overlay thickness (mm)	355	270	340	370	365	-	**340**

3.4 Microscopical determination of parameters of the air-void system in hardened concrete

Microscopical determination of parameters of the air-void system in hardened concrete was performed as per ASTM C457 on core H. The measured air content on hardened concrete of 2.8 % combined with an average spacing factor of 583 µm and a specific surface of 10.7 mm^{-1} indicates there is no entrained air in the concrete overlay.

3.5 Water content, density, absorption and voids in hardened concrete, grout or mortar.

Two (2) cores from each wall were tested for absorption after boiling and voids content as per CSA A23.2-11C.

The results are summarized in table 3 on the next page.

Table 3 - Determination of air voids and absorption after boiling in hardened concrete

Core	Wall	Absorption (boiling) (%)	Density (immersion) (kg /m³)	Voids(%)
B	East	7.70	2368	17.0
C	East	7.18	2387	16.1
F	North	6.44	2405	14.6
G	North	6.78	2371	15.1
I	North-West	7.65	2366	16.9
K	North-West	6.46	2402	14.6
N	South-West	9.03	2300	19.4
O	South-West	6.85	2395	15.4
R	South	7.74	2343	16.9
S	South	7.90	2366	17.4
	Average	7.37	2370	16.3

4. DISCUSSION OF RESULTS AND OBSERVATIONS, AND RECOMMENDATIONS

4.1 Condition of concrete and effective lifespan

It was required to determine the condition of the concrete and the potential effective lifespan of the pillar:

The concrete of the pillar is without entrained air and is therefore not well protected against damage caused by freeze-thaw cycles. As such, the delaminating cracks observed in the cores are caused by freeze-thaw cycles. The concrete is also affected by AAR which causes the concrete to swell and induces cracking. The formation of white stalactites on the ceiling slab shows that water is seeping inside the pillar. The cracks observed will facilitate water ingress in the concrete and freeze-thaw cycles along with AAR will gradually make the cracks wider or more numerous and accelerate the degradation of the pillar. It was observed that the concrete overlay has begun to delaminate on the outside wall. The inside walls also show general delamination for approximately the first 50 mm.

As summarized in table 3 earlier, the concrete overly has an average absorption of 7.37%, an average density of 2370 kg/m³ and an average percentage of voids (volume of permeable pore space) of 16.3%. The average density measured corresponds to a normal density for non-air concrete. Standard 3101from Tome VII of the Ministère des transports, de la mobilité durable et de l'électrification des transports du Québec (MTMDET) classifies a normal density as between 2150 kg/m³ and 2500 kg/m³.

According to the *Manuel d'entretien des structures (2013-01)* from MTMDET, a concrete is considered to be of good quality when it has an adequate air void system, an absorption below 6.5% and an average compressive strength above 25 MPa. None of

these conditions are met in this case. However, the MTMDET criteria are for road structures and the service conditions are therefore not the same as for the pillar.

As a comparison, an article published in the winter 2010 issue of *Shotcrete* (*Shotcrete boiled water absorption* by Bolduc & Jolin from Laval University) references a table which defines the quality of concrete based on absorption and void values. In this table, concrete with an absorption from 6 to 8% and voids from 14 to 17% would be considered as "good".

Despite the pillar having acceptable absorption and voids values, these criteria are ineffective against AAR combined with freeze-thaw cycles.

It was observed that 15 of 28 cores broke appart under the coring stress at the overlay/original concrete interface and that the original concrete is delaminated on approximately 50 mm on the inside walls of the pillar.

The condition of the concrete is considered poor and its potential for a long term service life without repair is limited as the observed degradation will accelerate over time. Repairs are required to extend the life of the structure for another twenty (20) years.

4.2 Repair work

As mentioned earlier in Section 3.1, cracks perpendicular to the core axis (parallel to the wall surface) can be observed on several cores. These cracks, caused by freeze-thaw cycles, will contribute to the eventual delamination of the concrete. During repairs, concrete should be removed at least to the deepest delamination crack to ensure lasting repairs.

Table 4 below summarizes the depth of the delamination crack furthest away from the exterior wall for cores F1 to F8 and establishes a percentage of the concrete to be replaced based on the total wall thickness.

Table 4 – Observed depth of delamination cracks vs. wall thickness

Core	Wall	Depth of deepest delamination crack (mm)	Wall thickness* (mm)	Percentage of concrete to remove during repairs
F1	South	Not observed (100**)	1300	7.7 % **
F2	South	150	1300	11.5 %

F3	East	125	1300	9.6 %
F4	East	190	1300	14.6%
F5	North	Not observed (100**)	1300	7.7 %**
F6	North	155	1300	11.9 %
F7	North-West	110	1300	8.5 %
F8	South-West	230	1300	17.7 %
	Average	139	1300	11.2 %

*Minimal wall thickness as provided by Fisheries and Oceans Canada

**Since delamination cracks were not observed on these cores, at least 100 mm of concrete should be removed to reach 25 mm behind rebar, which corresponds to approximately 7.7 % % of replacement for cores F1 and F5.

The average concrete replacement rate for the pillar would be about 11.2 % for the overlay only. It was observed that the concrete was delaminated on average about 50 mm on the inside walls. Therefore, a minimum of 50 mm should be removed from the interior walls, which corresponds approximately to an additional 3.8% based on total wall thickness. If we consider the interior and exterior to be repaired, we would then need to replace approximately 15% of the concrete for the walls.

Since concrete is subject to AAR, it is recommended to determine whether the reaction process is still active or complete. This can be achieved by measuring concrete expansion over time or by expansion testing on cores from the structure.

AAR requires three conditions to take place: high relative humidity, reactive aggregate and high alkali content. Without being able to completely stop the AAR, if water infiltration is eliminated, the AAR process will be slowed down.

If the repair work is completed while the AAR process is still active and the concrete continues to expand, the repair will eventually delaminate from the rest of the pillar. The repair method would therefore need to be adapted to prevent or delay delaminating of the new concrete.

It is also recommended to determine the condition of reinforcing steel by a corrosion potential study to assess the viability of the steel.

For exterior repairs, the suggested method is to remove delaminated concrete down to sound concrete (variable thickness from 75 to 230 mm according to Table 4 above or an average of 11.2 % of the wall thickness) and pour new concrete with entrained air.

In order to extend the service life by twenty (20) years, it is recommended to use concrete with a minimum compressive strength of 30 MPa meeting exposure class F1 in

accordance with the latest version of CSA A23.1, providing 30 MPa is sufficient to meet structural requirements.

Water curing is the preferred curing method to maximize the durability of the structure. Water curing should be maintained for at least 7 days.

For interior repairs, delaminated concrete must be removed to sound concrete. Since there was no coring on the inside walls, sound concrete may be deeper than what was visible from the surface of the walls and ceiling. The same concrete as for the exterior should be used to ensure as uniform frost behaviour as possible throughout the structure.

For the roof slab, once sound concrete is reached, cracks must be sealed to make them watertight. In the case of progressive cracks, the sealant must be flexible to allow movement caused by AAR. A debonding material must be applied to the bottom of the crack to allow the sealant to expand freely. This means that cracks must be widened with a saw cut before applying the sealant. If the remaining concrete of the roof slab is structurally sufficient to support the loads, it is recommended to stop the repair after the cracks have been filled and to apply a 100% silane based water repellent to the original concrete. Otherwise, once the cracks have been sealed, a debonding material must be reapplied to the surface of the cracks. With the movement of cracks, the repair concrete will crack at the same location as the existing concrete, but the cracks will be watertight at the repair / old concrete interface. In the case of inactive cracks, the sealant may be rigid and there should be no crack reflection in the new concrete.

If repair concrete is required on the roof slab to add structural capacity, it can be repaired either with concrete pumped into ceiling formwork or with shotcrete.

In order to reduce water ingress in the concrete, and to reduce the level of AAR activity, a 100% silane sealer should be applied to the exterior surface of the walls. Good drainage at the base of the exterior walls will also help reduce water migration in the concrete.

When demolishing concrete, there is always the risk of more concrete will have to be removed than anticipated. If the remaining concrete thickness becomes too thin, the repair method must be adapted to ensure a good bond between the repair concrete and the existing concrete.

5. CONCLUSION

Groupe ABS Inc. was mandated by Fisheries and Oceans Canada to core the pillar supporting the navigation aid FP (NLF 2181) on Île du Moine in Sainte-Anne-de-Sorel, QC. The pillar is located approximately 480 m from the western tip of the island.

The goal of this expert report is to determine the general condition of the concrete pillar walls so as to guide the repair work of the pillar in order to prolong its service life for

approximately twenty (20) years, validate the thickness of the concrete overlay and to give our comments and recommendations on the potential of long term service life, the state of the concrete, its repair potential and if applicable, the suggested repair methods.

Coring of the pillar walls took place on July 21st 2017. Eight (8) cores 93 mm in diameter, identified F1 to F8, were sampled on walls to determine whether AAR was present, conduct compressive strength testing, and determine the overall condition of the concrete.
Twenty (20) cores 57 mm in diameter, identified A to T, were sampled to determine the thickness of overlay. A microscopical determination of parameters of the air-void system in hardened concrete was performed in accordance with standard ASTM C457 on core H and testing of water content, density, absorption and voids in hardened concrete, grout or mortar according to Standard CSA A23.2-11C were carried out on two 57-mm diameter cores for each wall.

The testing determined the following:

- The concrete overlay is affected by the alkali-aggregate reactivity (AAR).
- The average compressive strength of the concrete overlay on the walls of the pillar is 20.4 MPa.
- The average overlay thickness is 337 mm.
- The concrete overlay has an average air void spacing factor of 583 µm and air content on hardened concrete of 2.8 %. This indicates there is no entrained air in the concrete overlay.
- The average percentage of air voids is 16.3% and the absorption after boiling is 7.4 %.
- The general condition of the concrete surfaces is poor and its potential long term service life (20 years) is poor without repairs and acceptable with internal and external repairs

The concrete overlay repair of the pillar will extend the long term service life of the pillar for another twenty (20) years.

According to the cores obtained, the exterior concrete overlay must be removed to a minimum depth of 125 mm in the upper half of the pillar and to at least 165 mm in the lower half. In all cases, the concrete must be removed until sound concrete is reached at after the deepest delamination crack. The repair concrete shall be at least 30 MPa in order to meet the requirements of an exposure class F1 in accordance with the latest version of CSA A23.1, providing 30 MPa is sufficient to meet structural requirements. Water curing is recommended to maximize the durability of the structure. In order to limit water migration into the new concrete, a 100% silane sealer should be applied to the exterior surface of the pillar.

Although the roof slab has not been cored, it is recommended to repair it externally following the same procedure as for exterior concrete overlay of walls, i.e., removing the disintegrated concrete to the sound concrete, replacing it with exposure class F1 concrete and applying a 100% silane sealer. The exterior repair of the roof slab will eliminate water infiltration through the ceiling.

For interior repairs, delaminated concrete of the roof slab and the upper part of walls must be removed to ensure the safety of users entering the pillar to prevent them from being struck by a piece of concrete that could have separated from the ceiling, even if users only show up for sporadic maintenance visits. Replacing the delaminated concrete from the interior walls with a new concrete overlay will not significantly contribute to increase the long term service life to twenty (20) years. It would mostly be for aesthetics purposes.

It is recommended to seal the existing cracks that have been observed on the ceiling to make them watertight. This is to prevent water infiltration through the ceiling if cracks appear in the concrete covering the roof. In the case of progressive cracks, the sealant must be flexible to allow movement caused by AAR. A debonding material must be applied to the bottom of the crack to allow the sealant to expand freely. In the case of inactive cracks, the sealant may be rigid.

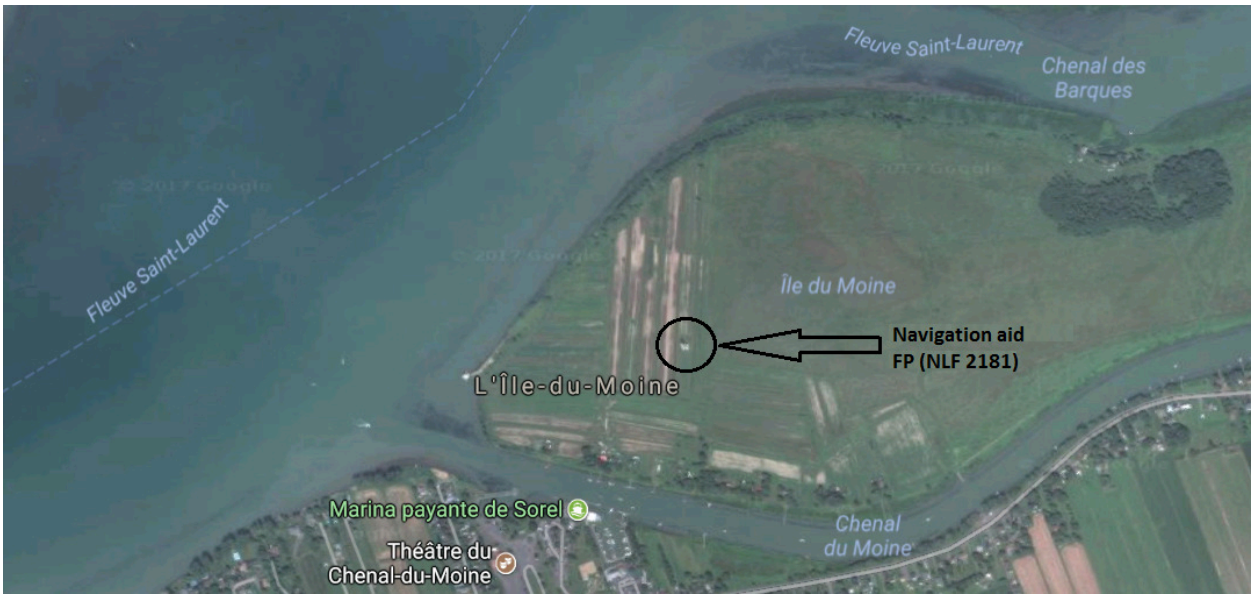
Good drainage at the base of the exterior walls is recommended to reduce water migration in the concrete, maintain a lower moisture content and therefore reduce AAR. A lack of drainage at the structure may cause the concrete at the base of the pillar to be in contact with a saturated soil either constantly or intermittently. Under saturated soil conditions, concrete will be prone to absorb more water and over the years, this water can slowly migrate up the structure by capillary action. A concrete that contains more water will thus be affected by freeze-thaw cycles more significantly and will therefore have an impact on the long term service life.

When removing concrete, there is always the risk that more concrete will need to be removed than anticipated. If the remaining sound concrete is too thin, the repair method must be adapted to ensure a good bond between the repair concrete and the existing concrete.

APPENDIX A

LOCATION OF CORES ON WALLS OF PILLAR

Location of pillar for aid to navigation FP (NLF 2181)
in Sainte-Anne-de-Sorel, Québec



Groupe ABS

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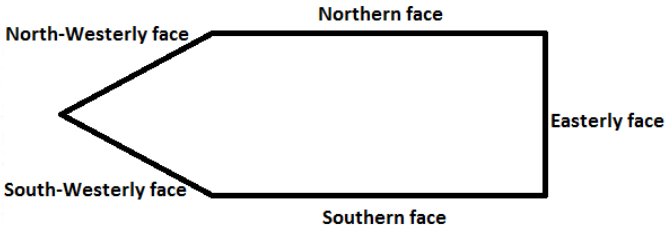
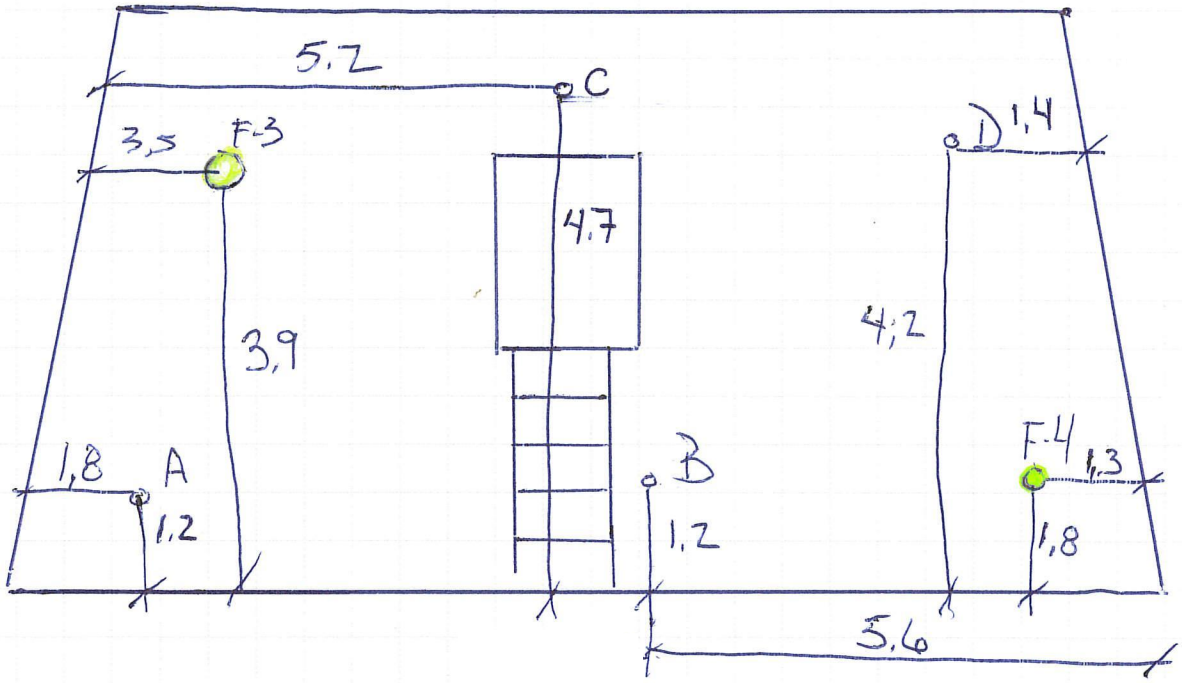
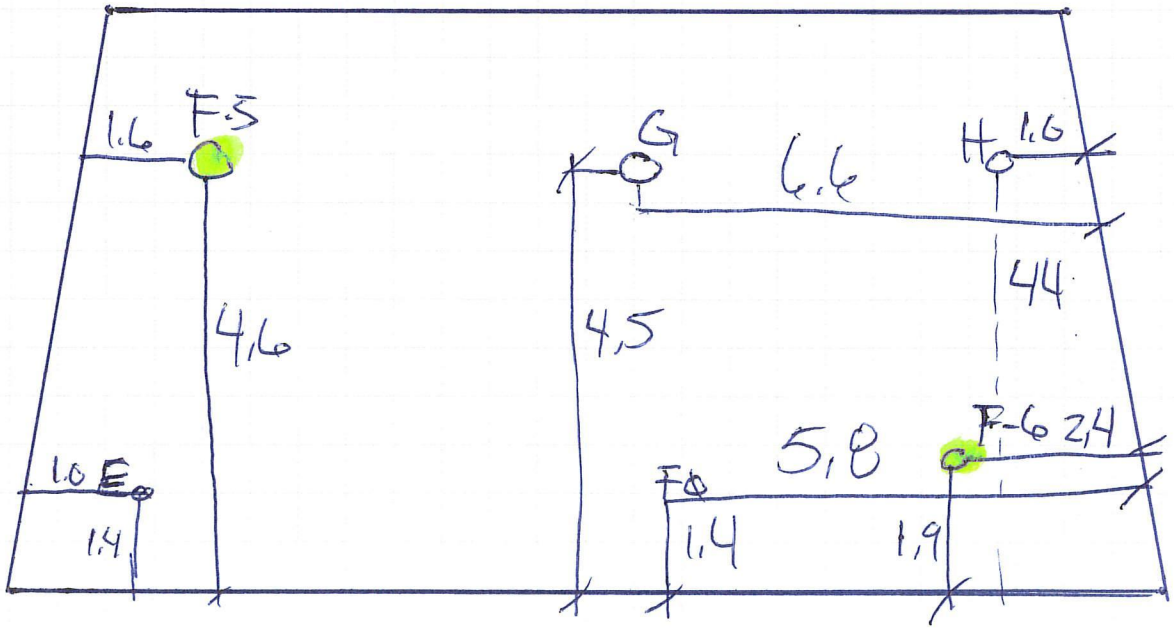
N/D : CA[illegible]1[illegible]0[illegible]5







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2017-08-04

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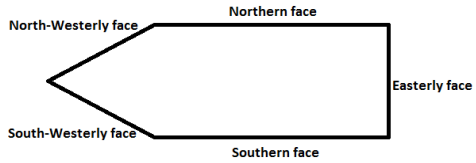

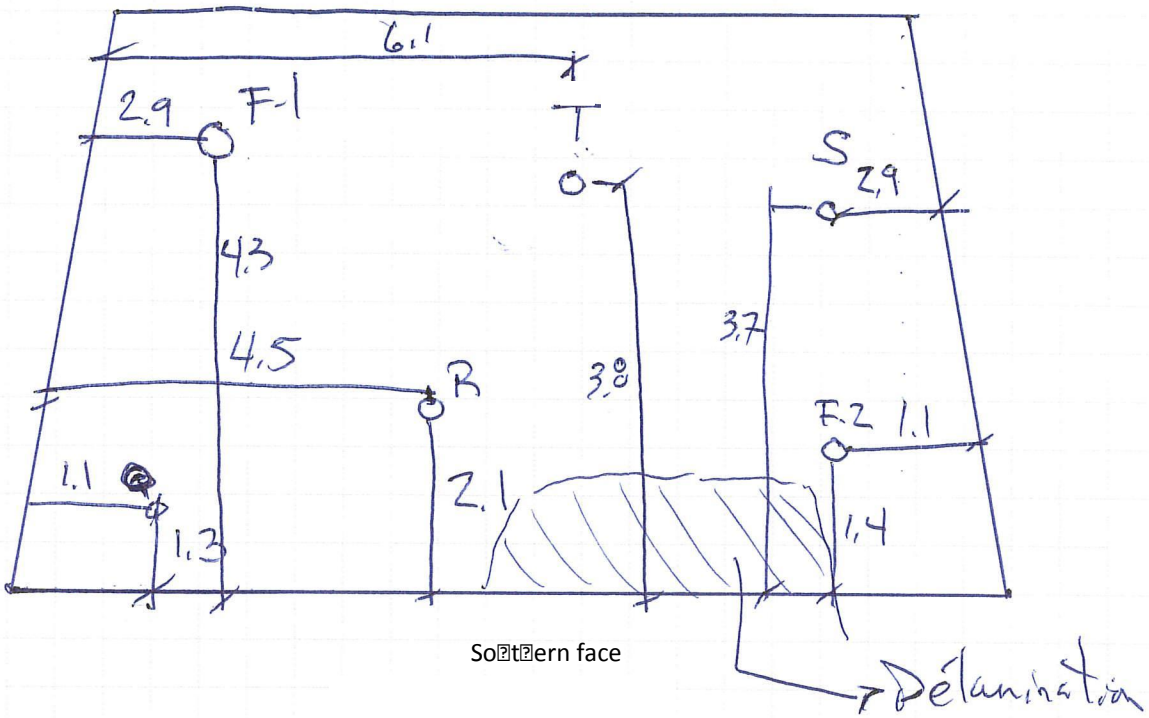

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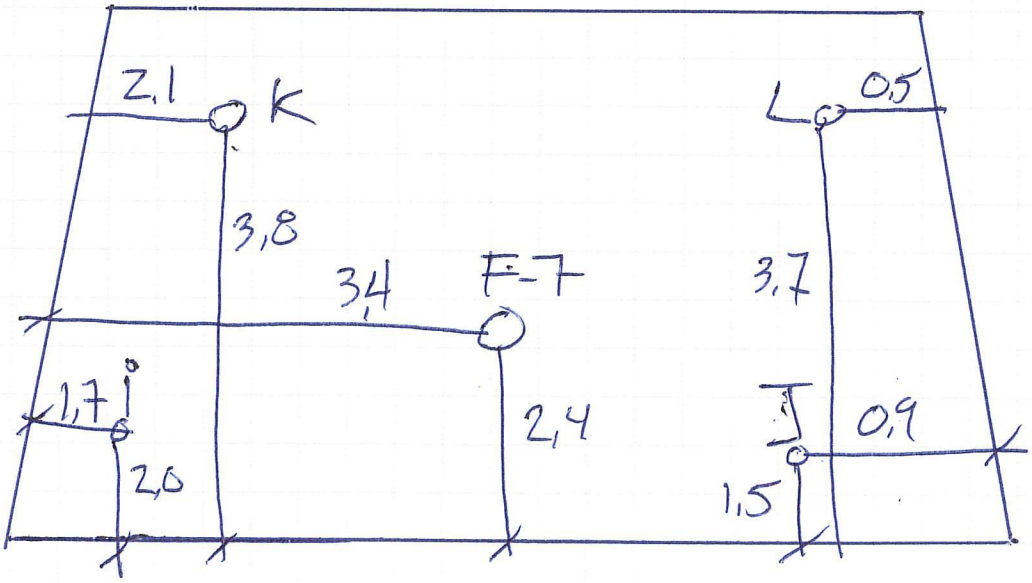

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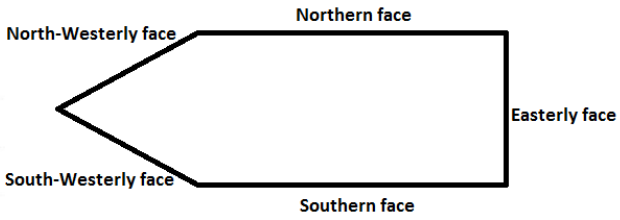

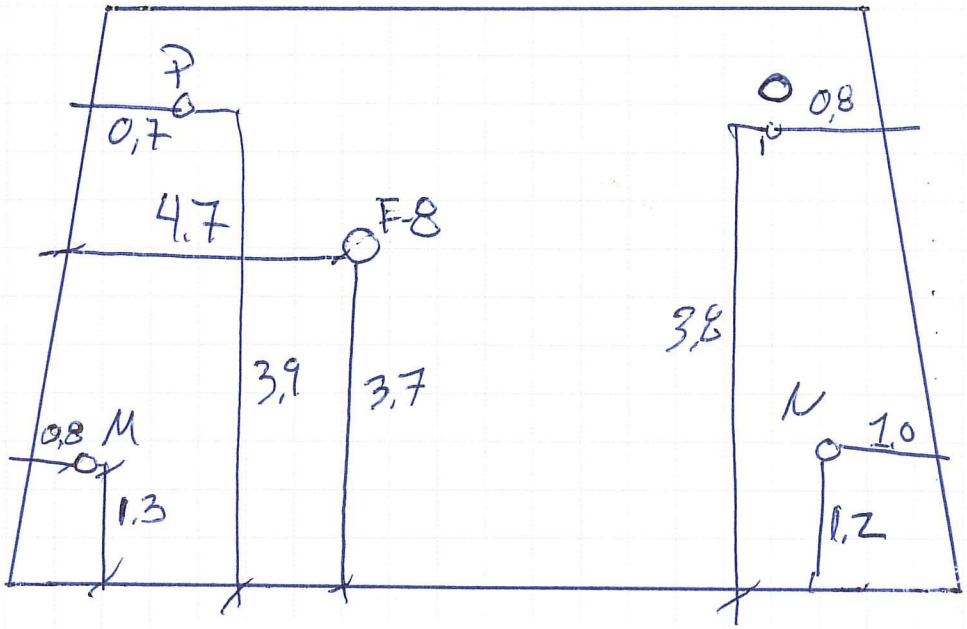

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Notes:

Cores F1 to F8, 100 mm diameter
Cores A to T, 50 mm diameter

Measurements on sketch are in meters

2017-08-04

OIQ 120593

APPENDIX B

MEGASCOPIC EXAMINATIONS

(Description of cored samples)

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

Location of sampling :	Sampling date : 2017-07-21
	Sample : Borehole F1
	Sample no. : 110218

1 – SAMPLE DESCRIPTION

Diameter (mm) :	93,30 mm
Lenght (mm) :	330 mm
Nomber of sections :	1
Nomber of layers:	1

Arrangement of layers :

	Material	Depth
1	☐ HMA ☒ PCC	0-330 mm
2	☐ HMA ☐ PCC	
3	☐ HMA ☐ PCC	
4	☐ HMA ☐ PCC	
5	☐ HMA ☐ PPC	

Other features :

2 CHARACTERISTICS OF MATERIALS – HOT MIX ASPHALT

Layer #HMA1	Layer #HMA2	Layer #HMA3
Thickness (mm):	Thickness (mm):	Thickness (mm):
Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20
Max density :	Max density :	Max density :
Gross density :	Gross density :	Gross density :
% of voids :	% of voids :	% of voids :
Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor
Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None

Membrane :	Thickness (mm):	Remarks :
	Adhesion : ☐ Good ☐ Moderate ☐ Poor	

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

3 - CHARACTERISTICS OF MATERIALS – PORTLAND CEMENT CONCRETE [ASTM C856]								
Layer #PCC1				**Layer #PCC2**				
Thickness (mm) :	**330**			Thickness (mm) :				
Depth (mm) :	**0-330 mm**			Depth (mm) :				
Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☐ >20	☒ **14**	Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☐ >20	☐ 14	
Rock type :	☒ **Limestone** ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____	Rock type :	☐ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____	
Adhesion of aggregates:	☒ **Good**	☐ Average	☐ Weak	Adhesion of aggregates:	☐ Good	☐ Average	☐ Weak	
Coating of aggregates:	☒ **Good**	☐ Average	☐ Weak	Coating of aggregates:	☐ Good	☐ Average	☐ Weak	
Cohesion :	☒ **Good**	☐ Average	☐ Weak	Cohesion :	☐ Good	☐ Average	☐ Weak	
Segregation :	☐ Yes	☒ **No**		Segregation :	☐ Yes	☐ No		
Degradation :	☒ **Yes***	☐ No		Degradation :	☐ Yes	☐ No		
Adhesion with the lower layer :	☐ Good ☒ **n/a**	☐ Average	☐ Weak	Adhesion with the lower layer :	☐ Good ☐ n/a	☐ Average	☐ Weak	
Reaction	☒ **Alkali-aggregate** ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a		Reaction	☐ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a		
Sand	☒ **Quartzo-Feldspat.** ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed		Sand	☐ Quartzo-granit. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed		
Rock-type of coarse aggregate :	**Limestone**			Rock-type of coarse aggregate :				
Matrix distribution :	☒ **Good**	☐ Average	☐ Weak	Matrix distribution :	☐ Good	☐ Average	☐ Weak	
Matrix color :	Light beige			Matrix color :				
Color distribution :	☐ Mottled	☐ **Even**	☐ Gradational changes : _____	Color distribution : Color :	☐ Mottled	☐ Even	☐ Gradational changes : _____	
Air :	☐ Air-entrained	☒ Non-air		Air :	☐ Air-entrained	☐ WAE		
Cracking :	☒ **Yes**	☐ No		Cracking :	☐ Yes	☐ No		
Voids :	☒ **Yes**	☐ No		Voids :	☐ Yes	☐ No		
Reinforcing steel:	☐ Yes	☒ **No**		Reinforcing rod :	☐ Yes	☐ No		
Remarks :				Remarks :				
Presence of a white deposit on the surface of the core.								
Presence of cracks in aggregates with silica gel in the cracks								
and around the aggregates.								
Silica gel in several air voids.								

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

4 - CHARACTERISTICS OF REINFORCING STEEL

Row #1	Row #2	Row #3
Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M
Depth (mm) :	Depth (mm) :	Depth (mm) :
Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice
Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None
Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak

5 – TESTS CARRIED OUT

Test	Test method	Results

6 – CORROSION POTENTIAL

Measured potential	Conclusion

7 - REMARKS

2017-10-13

OIQ 120593

Prepared by : Mélanie Leduc, P. Geo.	Approved by : Michel Daoust, P.Eng.
Date : 2017-07-31	Date : 2017-08-02

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

Location of sampling :	Sampling date : 2017-07-21
	Sample : Borehole F2
	Sample no. : 110223

1 – SAMPLE DESCRIPTION

Diameter (mm) :	93,50 mm
Lenght (mm) :	400 mm
Nomber of sections :	2
Nomber of layers:	1

Arrangement of layers :

	Material	Depth
1	☐HMA ☒PCC	0 - 400 mm
2	☐HMA ☐PCC	
3	☐HMA ☐PCC	
4	☐HMA ☐PCC	
5	☐HMA ☐PCC	

Other features :

2 CHARACTERISTICS OF MATERIALS – HOT MIX ASPHALT

Layer #HMA1	Layer #HMA2	Layer #HMA3
Thickness (mm):	Thickness (mm):	Thickness (mm):
Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20
Max density :	Max density :	Max density :
Gross density :	Gross density :	Gross density :
% of voids :	% of voids :	% of voids :
Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor
Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None

Membrane :	Thickness (mm):		Remarks :
	Adhesion :	☐ Good ☐Moderate ☐ Poor	

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

3 - CHARACTERISTICS OF MATERIALS – PORTLAND CEMENT CONCRETE [ASTM C856]

Layer #PCC1				Layer #PCC2			
Thickness (mm) :	400			Thickness (mm) :			
Depth (mm) :	0-400 mm			Depth (mm) :			
Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☐ >20	☒ 14	Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☐ >20	☐ 14
Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____	Rock type :	☐ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____
Adhesion of aggregates:	☒ Good	☐ Average	☐ Weak	Adhesion of aggregates:	☐ Good	☐ Average	☐ Weak
Coating of aggregates:	☒ Good	☐ Average	☐ Weak	Coating of aggregates:	☐ Good	☐ Average	☐ Weak
Cohesion :	☒ Good	☐ Average	☐ Weak	Cohesion :	☐ Good	☐ Average	☐ Weak
Segregation :	☐ Yes	☒ No		Segregation :	☐ Yes	☐ No	
Degradation :	☒ Yes	☐ No		Degradation :	☐ Yes	☐ No	
Adhesion with the lower layer :	☐ Good ☒ n/a	☐ Average	☐ Weak	Adhesion with the lower layer :	☐ Good ☐ n/a	☐ Average	☐ Weak
Reaction	☒ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a		Reaction	☐ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a	
Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed		Sand	☐ Quartzo- feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed	
Rock-type of coarse aggregate :	Limestone			Rock-type of coarse aggregate :			
Matrix distribution :	☒ Good	☐ Average	☐ Weak	Matrix distribution :	☐ Good	☐ Average	☐ Weak
Matrix color :	Light beige			Matrix color :			
Color distribution :	☒ Mottled	☐ Even	☐ Gradational changes : _____	Color distribution :	☒ Mottled	☐ Even	☐ Gradational changes : _____
Air :	☐ Air-entrained	☒ Non-air		Air :	☐ Air-entrained	☐ Non-air	
Cracking :	☒ Yes	☐ No		Cracking :	☐ Yes	☐ No	
Voids :	☒ Yes	☐ No		Voids :	☐ Yes	☐ No	
Reinforcing steel :	☐ Yes	☒ No		Reinforcing steel :	☐ Yes	☐ No	
Remarks :				Remarks :			
Presence of a white deposit on the surface of the core.							
Presence of cracks in aggregates with silica gel in the cracks and around the aggregates.							
Silica gel in several air voids.							
Large crack at 130 mm splitting the core in two parts.							

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

4 - CHARACTERISTICS OF REINFORCING STEEL

Row #1	Row #2	Row #3
Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M
Depth (mm) :	Depth (mm) :	Depth (mm) :
Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice
Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None
Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak

5 – TESTS CARRIED OUT

Test	Test method	Results

6 – CORROSION POTENTIAL

Measured potential	Conclusion

7 - REMARKS

2017-10-13

OIQ 120593

Prepared by : Mélanie Leduc, P. Geo.	Approved by : Michel Daoust, P. Eng.
Date : 2017-07-31	Date : 2017-08-02

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project :	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

Location of sampling :	Sampling date : 2017-07-21
	Sample : Borehole F3
	Sample no. : 110226

1 – SAMPLE DESCRIPTION

Diameter (mm) :	93,50 mm
Lenght (mm) :	340 mm
Nomber of sections :	1
Nomber of layers:	2

Arrangement of layers :

	Material	Depth
1	☐ HMA ☒ PCC	0-294 mm
2	☐ HMA ☐ PCC	294 – 340 mm
3	☐ HMA ☐ PCC	
4	☐ HMA ☐ PCC	
5	☐ HMA ☐ PCC	

Other features :

2 CHARACTERISTICS OF MATERIALS – HOT MIX ASPHALT

Layer #HMA1	Layer #HMA2	Layer #HMA3
Thickness (mm):	Thickness (mm):	Thickness (mm):
Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20
Max density :	Max density :	Max density :
Gross density :	Gross density :	Gross density :
% of voids :	% of voids :	% of voids :
Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor
Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None

Membrane :	Thickness (mm):		Remarks :
	Adhesion :	☐ Good ☐Moderate ☐ Poor	

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project :	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

3 - CHARACTERISTICS OF MATERIALS – PORTLAND CEMENT CONCRETE [ASTM C856]

	Layer #PCC1			Layer #PCC2			
Thickness (mm) :	294			Thickness (mm) :	46 mm		
Depth (mm) :	0 - 294 mm			Depth (mm) :	294 mm – 340 mm		
Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☐ >20	☒ 14	Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☒ >20	☐ 14
Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____	Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____
Adhesion of aggregates:	☒ Good	☐ Average	☐ Weak	Adhesion of aggregates:	☒ Good	☐ Average	☐ Weak
Coating of aggregates:	☒ Good	☐ Average	☐ Weak	Coating of aggregates:	☐ Good	☐ Average	☒ Weak
Cohesion :	☒ Good	☐ Average	☐ Weak	Cohesion :	☒ Good	☐ Average	☐ Weak
Segregation :	☐ Yes	☒ No		Segregation :	☐ Yes	☒ No	
Degradation :	☒ Yes	☐ No		Degradation :	☒ Yes	☐ No	
Adhesion with the lower layer :	☒ Good ☐ n/a	☐ Average	☐ Weak	Adhesion with the lower layer :	☐ Good ☒ n/a	☐ Average	☐ Weak
Reaction	☒ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a		Reaction	☐ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☒ Sulfatation? ☐ n/a	
Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed		Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed	
Rock-type of coarse aggregate :	Limestone			Rock-type of coarse aggregate :	Limestone		
Matrix distribution :	☒ Good	☐ Average	☐ Weak	Matrix distribution :	☒ Good	☐ Average	☐ Weak
Matrix color :	Light beige			Matrix color :	Beige-pink		
Color distribution :	☐ Mottled	☒ Even	☐ Gradational changes : _____	Color distribution :	☐ Mottled	☒ Even	☐ Gradational changes : _____
Air :	☐ Air-entrained	☒ Non-air		Air :	☐ Air-entrained	☐ Non-air	
Cracking :	☒ Yes	☐ No		Cracking :	☒ Yes	☐ No	
Voids :	☒ Yes	☐ No		Voids :	☒ Yes	☐ No	
Reinforcing steel :	☐ Yes	☒ No		Reinforcing steel :	☐ Yes	☒ No	
Remarks :				Remarks :			
Presence of a white deposit on the surface of the core.				Aggregates have a diameter between 30 to 60 mm.			
Presence of cracks in aggregates with silica gel in the cracks				Cement is delaminating and desintegrating.			
and around the aggregates.							
Silica gel in several air voids.							

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project :	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

4 - CHARACTERISTICS OF REINFORCING STEEL

Row #1	Row #2	Row #3
Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M
Depth (mm) :	Depth (mm) :	Depth (mm) :
Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice
Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None
Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak

5 – TESTS CARRIED OUT

Test	Test method	Results

6 – CORROSION POTENTIAL

Measured potential	Conclusion

7 - REMARKS

2017-10-13

OIQ 120593

Prepared by : Mélanie Leduc, P. Geo.	Approved by : Michel Daoust, P. Eng.
Date : 2017-07-28	Date : 2017-08-02

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

Location of sampling :	Sampling date : 2017-07-21
	Sample : Borehole F4
	Sample no. : 110227

1 – SAMPLE DESCRIPTION

Diameter (mm) :	93,15 mm
Lenght (mm) :	360 mm
Nomber of sections :	3
Nomber of layers:	1

Arrangement of layers :

	Material	Depth
1	☐ HMA ☒ PCC	0-360 mm
2	☐ HMA ☐ PCC	
3	☐ HMA ☐ PCC	
4	☐ HMA ☐ PCC	
5	☐ HMA ☐ PCC	

Other features :

2 CHARACTERISTICS OF MATERIALS – HOT MIX ASPHALT

Layer #HMA1	Layer #HMA2	Layer #HMA3
Thickness (mm):	Thickness (mm):	Thickness (mm):
Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20
Max density :	Max density :	Max density :
Gross density :	Gross density :	Gross density :
% of voids :	% of voids :	% of voids :
Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor
Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None

Membrane :	Thickness (mm):		Remarks :
	Adhesion :	☐ Good ☐Moderate ☐ Poor	

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

3 - CHARACTERISTICS OF MATERIALS – PORTLAND CEMENT CONCRETE [ASTM C856]

Layer #PCC1				Layer #PCC2			
Thickness (mm) :	360			Thickness (mm) :			
Depth (mm) :	0-360 mm			Depth (mm) :			
Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☒ >20	☒ 14	Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☐ >20	☐ 14
Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____	Rock type :	☐ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____
Adhesion of aggregates:	☒ Good	☐ Average	☐ Weak	Adhesion of aggregates:	☐ Good	☐ Average	☐ Weak
Coating of aggregates:	☒ Good	☐ Average	☐ Weak	Coating of aggregates:	☐ Good	☐ Average	☐ Weak
Cohesion :	☒ Good	☐ Average	☐ Weak	Cohesion :	☐ Good	☐ Average	☐ Weak
Segregation :	☐ Yes	☒ No		Segregation :	☐ Yes	☐ No	
Degradation :	☒ Yes	☐ No		Degradation :	☐ Yes	☐ No	
Adhesion with the lower layer :	☐ Good ☒ n/a	☐ Average	☐ Weak	Adhesion with the lower layer :	☐ Good ☐ n/a	☐ Average	☐ Weak
Reaction	☒ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a		Reaction	☐ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a	
Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed		Sand	☐ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed	
Rock-type of coarse aggregate :	Limestone			Rock-type of coarse aggregate :			
Matrix distribution :	☒ Good	☐ Average	☐ Weak	Matrix distribution :	☐ Good	☐ Average	☐ Weak
Matrix color :	Light beige			Matrix color :			
Color distribution :	☒ Mottled	☐ Even	☐ Gradational changes : _____	Color distribution :	☐ Mottled	☐ Even	☐ Gradational changes : _____
Air :	☐ Air-entrained	☒ Non-air		Air :	☐ Air-entrained	☐ Non-air	
Cracking :	☒ Yes	☐ No		Cracking :	☐ Yes	☐ No	
Voids :	☒ Yes	☐ No		Voids :	☐ Yes	☐ No	
Reinforcing steel :	☐ Yes	☒ No		Reinforcing steel :	☐ Yes	☐ No	
Remarks :				Remarks :			
Presence of a white deposit on the surface of the core.							
Presence of cracks in aggregates with silica gel in the cracks							
and around the aggregates.							
Silica gel in several air voids.							

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

4 - CHARACTERISTICS OF REINFORCING STEEL

Row #1	Row #2	Row #3
Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M
Depth (mm) :	Depth (mm) :	Depth (mm) :
Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice
Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None
Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak

5 – TESTS CARRIED OUT

Test	Test method	Results

6 – CORROSION POTENTIAL

Measured potential	Conclusion

7 - REMARKS

2017-10-13

OIQ 120593

Prepared by : Mélanie Leduc, P. Geo.	Approved by : Michel Daoust, P. Eng.
Date : 2017-07-31	Date : 2017-08-02

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

Location of sampling :	Sampling date : 2017-07-21
	Sample : Borehole F5
	Sample no. : 110229

1 – SAMPLE DESCRIPTION

Diameter (mm) :	93,60 mm
Lenght (mm) :	335 mm
Nomber of sections :	1
Nomber of layers:	2

Arrangement of layers :

	Material	Depth
1	☐ HMA ☒ PCC	0-312 mm
2	☐ HMA ☒ PCC	312 – 335 mm
3	☐ HMA ☐ PCC	
4	☐ HMA ☐ PCC	
5	☐ HMA ☐ PCC	

Other features :

2 CHARACTERISTICS OF MATERIALS – HOT MIX ASPHALT

Layer #HMA1	Layer #HMA2	Layer #HMA3
Thickness (mm):	Thickness (mm):	Thickness (mm):
Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20
Max density :	Max density :	Max density :
Gross density :	Gross density :	Gross density :
% of voids :	% of voids :	% of voids :
Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor
Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None

Membrane :	Thickness (mm):		Remarks :
	Adhesion :	☐ Good ☐Moderate ☐ Poor	

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

3 - CHARACTERISTICS OF MATERIALS – PORTLAND CEMENT CONCRETE [ASTM C856]

Layer #PCC1				Layer #PCC2			
Thickness (mm) :	312 mm			Thickness (mm) :	23 mm		
Depth (mm) :	0-312 mm			Depth (mm) :	312 – 335 mm		
Aggregate ømax (mm) :	☐ 5 ☒ 20	☐ 10 ☐ >20	☐ 14	Aggregate ømax (mm) :	☐ 5 ☒ 20	☐ 10 ☐ >20	☐ 14
Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____	Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____
Adhesion of aggregates:	☒ Good	☐ Average	☐ Weak	Adhesion of aggregates:	☒ Good	☐ Average	☐ Weak
Coating of aggregates:	☒ Good	☐ Average	☐ Weak	Coating of aggregates:	☒ Good	☐ Average	☐ Weak
Cohesion :	☒ Good	☐ Average	☐ Weak	Cohesion :	☒ Good	☐ Average	☐ Weak
Segregation :	☐ Yes	☒ No		Segregation :	☐ Yes	☒ No	
Degradation :	☒ Yes	☐ No		Degradation :	☒ Yes	☐ No	
Adhesion with the lower layer :	☒ Good ☐ n/a	☐ Average	☐ Weak	Adhesion with the lower layer :	☐ Good ☒ n/a	☐ Average	☐ Weak
Reaction	☒ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a		Reaction	☐ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☒ n/a	
Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed		Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed	
Rock-type of coarse aggregate :	Limestone			Rock-type of coarse aggregate :	Limestone		
Matrix distribution :	☒ Good	☐ Average	☐ Weak	Matrix distribution :	☒ Good	☐ Average	☐ Weak
Matrix color :	Light beige			Matrix color :	Light beige		
Color distribution :	☐ Mottled	☒ Even	☐ Gradational changes : _____	Color distribution :	☐ Mottled	☒ Even	☐ Gradational changes : _____
Air :	☐ Air-entrained	☒ Non-air		Air :	☐ Air-entrained	☐ Non-air	
Cracking :	☒ Yes	☐ No		Cracking :	☒ Yes	☐ No	
Voids :	☒ Yes	☐ No		Voids :	☒ Yes	☐ No	
Reinforcing steel :	☐ Yes	☒ No		Reinforcing steel :	☐ Yes	☒ No	
Remarks :				Remarks :			
Presence of a white deposit on the surface of the core.							
Presence of cracks in aggregates with silica gel in the cracks and around the aggregates.							
Silica gel in several air voids.							

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

4 - CHARACTERISTICS OF REINFORCING STEEL

Row #1	Row #2	Row #3
Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M
Depth (mm) :	Depth (mm) :	Depth (mm) :
Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice
Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None
Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak

5 – TESTS CARRIED OUT

Test	Test method	Results

6 – CORROSION POTENTIAL

Measured potential	Conclusion

7 - REMARKS

2017-10-13

OIQ 120593

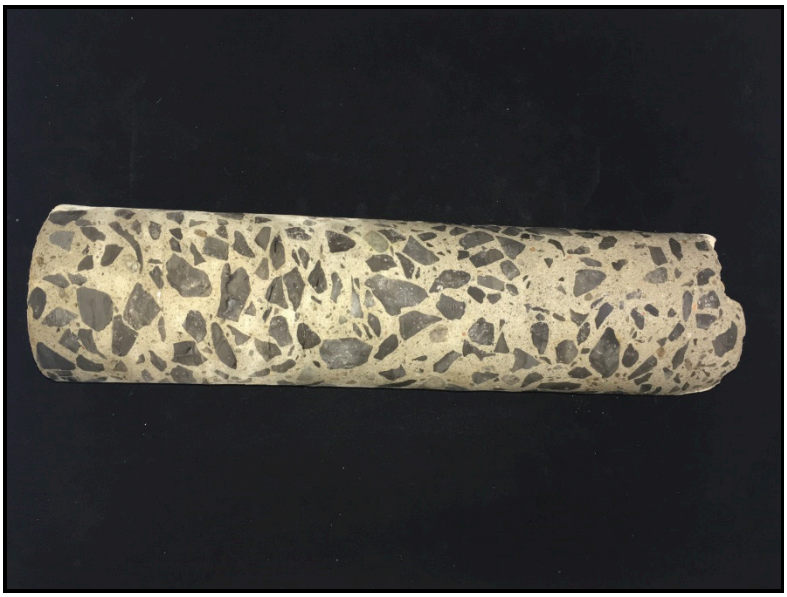
Prepared by : Mélanie Leduc, P. Geo.	Approved by : Michel Daoust, P. Eng.
Date : 2017-07-31	Date : 2017-08-02

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

Location of sampling :	Sampling date : 2017-07-21
	Sample : Borehole F6
	Sample no. : 110231

1 – SAMPLE DESCRIPTION



Diameter (mm) :	93,40 mm
Lenght (mm) :	390 mm
Nomber of sections :	1
Nomber of layers:	1

Arrangement of layers :

	Material	Depth
1	☐ HMA ☒ PCC	0-390 mm
2	☐ HMA ☐ PCC	
3	☐ HMA ☐ PCC	
4	☐ HMA ☐ PCC	
5	☐ HMA ☐ PCC	

Other features :

2 CHARACTERISTICS OF MATERIALS – HOT MIX ASPHALT

Layer #HMA1	Layer #HMA2	Layer #HMA3
Thickness (mm):	Thickness (mm):	Thickness (mm):
Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20
Max density :	Max density :	Max density :
Gross density :	Gross density :	Gross density :
% of voids :	% of voids :	% of voids :
Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor
Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None

Membrane :	Thickness (mm):		Remarks :
	Adhesion :	☐ Good ☐Moderate ☐ Poor	

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

3 - CHARACTERISTICS OF MATERIALS – PORTLAND CEMENT CONCRETE [ASTM C856]

Layer #PCC1				Layer #PCC2			
Thickness (mm) :	390			Thickness (mm) :			
Depth (mm) :	0-390 mm			Depth (mm) :			
Aggregate ømax (mm) :	☐ 5 ☒ 20	☐ 10 ☐ >20	☐ 14	Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☐ >20	☐ 14
Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____	Rock type :	☐ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____
Adhesion of aggregates:	☒ Good	☐ Average	☐ Weak	Adhesion of aggregates:	☐ Good	☐ Average	☐ Weak
Coating of aggregates:	☒ Good	☐ Average	☐ Weak	Coating of aggregates:	☐ Good	☐ Average	☐ Weak
Cohesion :	☒ Good	☐ Average	☐ Weak	Cohesion :	☐ Good	☐ Average	☐ Weak
Segregation :	☐ Yes	☒ No		Segregation :	☐ Yes	☐ No	
Degradation :	☒ Yes	☐ No		Degradation :	☐ Yes	☐ No	
Adhesion with the lower layer :	☐ Good ☒ n/a	☐ Average	☐ Weak	Adhesion with the lower layer :	☐ Good ☐ n/a	☐ Average	☐ Weak
Reaction	☒ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a		Reaction	☐ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a	
Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed		Sand	☐ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed	
Rock-type of coarse aggregate :	Limestone			Rock-type of coarse aggregate :			
Matrix distribution :	☒ Good	☐ Average	☐ Weak	Matrix distribution :	☐ Good	☐ Average	☐ Weak
Matrix color :	Light beige			Matrix color :			
Color distribution :	☒ Mottled	☐ Even	☐ Gradational changes : _____	Color distribution :	☐ Mottled	☐ Even	☐ Gradational changes : _____
Air :	☐ Air-entrained	☒ Non-air		Air :	☐ Air-entrained	☐ Non-air	
Cracking :	☒ Yes	☐ No		Cracking :	☐ Yes	☐ No	
Voids :	☒ Yes	☐ No		Voids :	☐ Yes	☐ No	
Reinforcing steel :	☐ Yes	☒ No		Reinforcing steel :	☐ Yes	☐ No	
Remarks :				Remarks :			
Presence of a white deposit on the surface of the core.							
Presence of cracks in aggregates with silica gel in the cracks							
and around the aggregates.							
Silica gel in several air voids.							

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

4 - CHARACTERISTICS OF REINFORCING STEEL

Row #1	Row #2	Row #3
Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M
Depth (mm) :	Depth (mm) :	Depth (mm) :
Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice
Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None
Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak

5 – TESTS CARRIED OUT

Test	Test method	Results

6 – CORROSION POTENTIAL

Measured potential	Conclusion

7 - REMARKS

2017-10-13

OIQ 120593

Prepared by : Mélanie Leduc, P. Geo.	Approved by : Michel Daoust, P. Eng.
Date : 2017-07-31	Date : 2017-08-02

Description of cored sample

Client:	Fisheries and Oceans Canada	Client #	PECHES101	F/N:	CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)				
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC			Date:	2017-07-28

Location of sampling :	Sampling date :	2017-07-21
	Sample :	Borehole F7
	Sample no. :	110233

1 – SAMPLE DESCRIPTION

Diameter (mm) :	93,60 mm
Lenght (mm) :	370 mm
Nomber of sections :	2
Nomber of layers:	1

Arrangement of layers :

	Material	Depth
1	☐ HMA ☒ PCC	0-370 mm
2	☐ HMA ☐ PCC	
3	☐ HMA ☐ PCC	
4	☐ HMA ☐ PCC	
5	☐ HMA ☐ PCC	

Other features :

2 CHARACTERISTICS OF MATERIALS – HOT MIX ASPHALT

Layer #BC1	Layer #BC2	Layer #BC3
Thickness (mm):	Thickness (mm):	Thickness (mm):
Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20
Max density :	Max density :	Max density :
Gross density :	Gross density :	Gross density :
% of voids :	% of voids :	% of voids :
Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor
Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None

Membrane :	Thickness (mm):		Remarks :
	Adhesion :	☐ Good ☐Moderate ☐ Poor	

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

3 - CHARACTERISTICS OF MATERIALS – PORTLAND CEMENT CONCRETE [ASTM C856]

Layer #PCC1				Layer #PCC2			
Thickness (mm) :	370			Thickness (mm) :			
Depth (mm) :	0-370 mm			Depth (mm) :			
Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☐ >20	☒ 14	Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☐ >20	☐ 14
Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____	Rock type :	☐ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____
Adhesion of aggregates:	☒ Good	☐ Average	☐ Weak	Adhesion of aggregates:	☐ Good	☐ Average	☐ Weak
Coating of aggregates:	☒ Good	☐ Average	☐ Weak	Coating of aggregates:	☐ Good	☐ Average	☐ Weak
Cohesion :	☒ Good	☐ Average	☐ Weak	Cohesion :	☐ Good	☐ Average	☐ Weak
Segregation :	☐ Yes	☒ No		Segregation :	☐ Yes	☐ No	
Degradation :	☒ Yes	☐ No		Degradation :	☐ Yes	☐ No	
Adhesion with the lower layer :	☐ Good ☒ n/a	☐ Average	☐ Weak	Adhesion with the lower layer :	☐ Good ☐ n/a	☐ Average	☐ Weak
Reaction	☒ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a		Reaction	☐ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a	
Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed		Sand	☐ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed	
Rock-type of coarse aggregate :	Limestone			Rock-type of coarse aggregate :			
Matrix distribution :	☒ Good	☐ Average	☐ Weak	Matrix distribution :	☐ Good	☐ Average	☐ Weak
Matrix color :	Light beige			Matrix color :			
Color distribution :	☒ Mottled	☐ Even	☐ Gradational changes : _____	Color distribution :	☐ Mottled	☐ Even	☐ Gradational changes : _____
Air :	☐ Air-entrained	☒ Non-air		Air :	☐ Air-entrained	☐ Non-air	
Cracking :	☒ Yes	☐ No		Cracking :	☐ Yes	☐ No	
Voids :	☒ Yes	☐ No		Voids :	☐ Yes	☐ No	
Reinforcing steel :	☐ Yes	☒ No		Reinforcing steel :	☐ Yes	☐ No	
Remarks :				Remarks :			
Presence of a white deposit on the surface of the core.							
Presence of cracks in aggregates with silica gel in the cracks and around the aggregates.							
Silica gel in several air voids.							

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

4 - CHARACTERISTICS OF REINFORCING STEEL

Row #1	Row #2	Row #3
Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M
Depth (mm) :	Depth (mm) :	Depth (mm) :
Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice
Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None
Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak

5 – TESTS CARRIED OUT

Test	Test method	Results

6 – CORROSION POTENTIAL

Measured potential	Conclusion

7 - REMARKS

2017-10-13

OIQ 120593

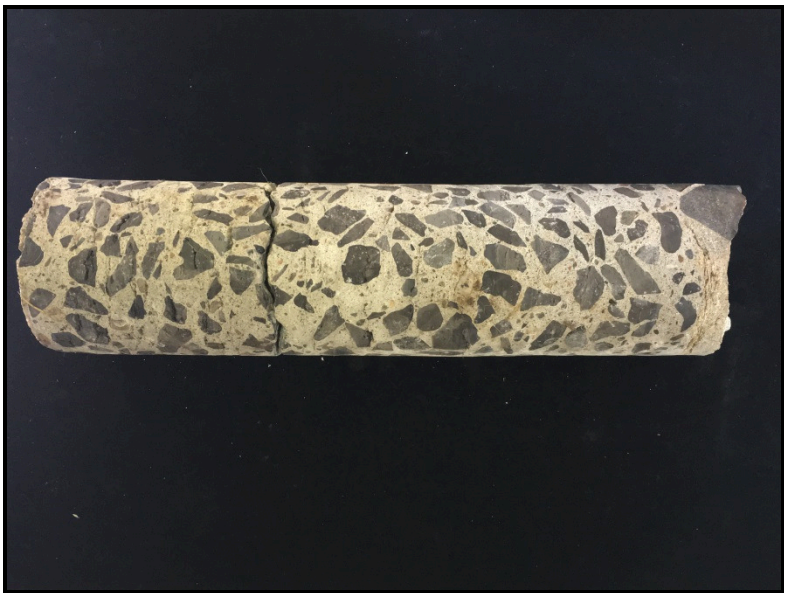
Prepared by : Mélanie Leduc, P. Geo.	Approved by : Michel Daoust, P. Eng.
Date : 2017-07-31	Date : 2017-08-02

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

Location of sampling :	Sampling date : 2017-07-21
	Sample : Borehole F8
	Sample no. : 110234

1 – SAMPLE DESCRIPTION



Diameter (mm) :	93,65 mm
Lenght (mm) :	370 mm
Nomber of sections :	2
Nomber of layers:	2

Arrangement of layers :

	Material	Depth
1	☐ HMA ☒ PCC	0-350 mm
2	☐ HMA ☒ PCC	350 – 370 mm
3	☐ HMA ☐ PCC	
4	☐ HMA ☐ PCC	
5	☐ HMA ☐ PCC	

Other features :

2 CHARACTERISTICS OF MATERIALS – HOT MIX ASPHALT

Layer #HMA1	Layer #HMA2	Layer #HMA3
Thickness (mm):	Thickness (mm):	Thickness (mm):
Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20	Aggregate ømax (mm) : ☐5 ☐10 ☐14 ☐20 ☐>20
Max density :	Max density :	Max density :
Gross density :	Gross density :	Gross density :
% of voids :	% of voids :	% of voids :
Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor	Cohesion : ☐ Good ☐ Moderate ☐ Poor
Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None	Adhesion with the lower layer : ☐ Good ☐ Moderate ☐ Poor ☐ None

Membrane :	Thickness (mm):		Remarks :
	Adhesion :	☐ Good ☐Moderate ☐ Poor	

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

3 - CHARACTERISTICS OF MATERIALS – PORTLAND CEMENT CONCRETE [ASTM C856]

Layer #PCC1				Layer #PCC2			
Thickness (mm) :	350 mm			Thickness (mm) :	20 mm		
Depth (mm) :	0-350 mm			Depth (mm) :	350 – 370 mm		
Aggregate ømax (mm) :	☐ 5 ☒ 20	☐ 10 ☐ >20	☐ 14	Aggregate ømax (mm) :	☐ 5 ☐ 20	☐ 10 ☒ >20	☐ 14
Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____	Rock type :	☒ Limestone ☐ Natural	☐ Granite ☐ Crushed	☐ Other : _____
Adhesion of aggregates:	☒ Good	☐ Average	☐ Weak	Adhesion of aggregates:	☐ Good	☒ Average	☐ Weak
Coating of aggregates:	☒ Good	☐ Average	☐ Weak	Coating of aggregates:	☐ Good	☐ Average	☒ Weak
Cohesion :	☒ Good	☐ Average	☐ Weak	Cohesion :	☒ Good	☐ Average	☐ Weak
Segregation :	☐ Yes	☒ No		Segregation :	☐ Yes	☒ No	
Degradation :	☒ Yes	☐ No		Degradation :	☒ Yes	☐ No	
Adhesion with the lower layer :	☒ Good ☐ n/a	☐ Average	☐ Weak	Adhesion with the lower layer :	☐ Good ☒ n/a	☐ Average	☐ Weak
Reaction	☒ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☐ n/a		Reaction	☐ Alkali-aggregate ☐ Pyrite ☐ Carbonatation	☐ Sulfatation ☒ n/a	
Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed		Sand	☒ Quartzo-feldsp. ☐ Natural ☐ Other :	☐ Limestone ☐ Crushed	
Rock-type of coarse aggregate :	Limestone			Rock-type of coarse aggregate :	Limestone		
Matrix distribution :	☒ Good	☐ Average	☐ Weak	Matrix distribution :	☒ Good	☐ Average	☐ Weak
Matrix color :	Light beige			Matrix color :	Beige		
Color distribution :	☒ Mottled	☐ Even	☐ Gradational changes : _____	Color distribution :	☐ Mottled	☐ Even	☒ Gradational changes : _____
Air :	☐ Air-entrained	☒ Non-air		Air :	☐ Air-entrained	☒ Non-air	
Cracking :	☒ Yes	☐ No		Cracking :	☒ Yes	☐ No	
Voids :	☒ Yes	☐ No		Voids :	☐ Yes	☒ No	
Reinforcing steel :	☐ Yes	☒ No		Reinforcing steel :	☐ Yes	☒ No	
Remarks :				Remarks :			
Presence of a white deposit on the surface of the core.				Delamination and disintegration of concrete.			
Presence of cracks in aggregates with silica gel in the cracks							
and around the aggregates.							
Silica gel in several air voids.							

ABS

Description of cored sample

Client:	Fisheries and Oceans Canada	Client # PECHES101	F/N: CA-17-2035-00
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC		Date: 2017-07-28

4 - CHARACTERISTICS OF REINFORCING STEEL

Row #1	Row #2	Row #3
Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M	Diameter: ☐<10M ☐10M ☐15M ☐20M ☐25M ☐>25M
Depth (mm) :	Depth (mm) :	Depth (mm) :
Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice	Characteristics : ☐ Round ☐ Square ☐ Crenellated ☐ smooth ☐ Lattice
Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None	Corrosion state : ☐Corroded ☐Loss of section ☐Trace ☐None
Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak	Steel coating : ☐ Good ☐ Weak

5 – TESTS CARRIED OUT

Test	Test method	Results

6 – CORROSION POTENTIAL

Measured potential	Conclusion

7 - REMARKS

2017-10-13

OIQ 120593

Prepared by : Mélanie Leduc, P. Geo.	Approved by : Michel Daoust, P. Eng.
Date : 2017-07-31	Date : 2017-08-02

APPENDIX C

RESULTS OF COMPRESSIVE STRENGTH TESTING, MICROSCOPICAL DETERMINATION OF PARAMETERS OF THE AIR-VOID SYSTEM IN HARDENED CONCRETE AND *WATER CONTENT, DENSITY, ABSORPTION, AND VOIDS IN HARDENED CONCRETE, GROUT, OR MORTAR*

(Testing on concrete cores)

ABS
17 Industrie Street, St-Rémi, QC, J0L 2L0

HARDENED CONCRETE CORE TESTING

F/N: CA-17-2035-00
Client: PECHES101
Date: 2017-08-01

Client	Fisheries and Oceans Canada
Project	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)
Location	Île du Moine in Sainte-Anne-de-Sorel, QC
Contractor	Not applicable

SAMPLING OF CONCRETE CORES						
Core number	F1	F2	F3	F4	F5	F6
Sampling date/time	2017-07-21	2017-07-21	2017-07-21	2017-07-21	2017-07-21	2017-07-21
Lab #	110 691	110 692	110 693	110 694	110 695	110 696
Recovery length (mm)	330.00	400.00	340.00	360.00	335.00	390.00
Coring conducted by	TB	TB	TB	TB	TB	TB
COMPRESSIVE STRENGTH (CAN/CSA-A23,2-14C)						
Compressive strength testing: date/time	2017-08-01	2017-08-01	2017-08-01	2017-08-01	2017-08-01	2017-08-01
End preparation by sawing	Yes	Yes	Yes	Yes	Yes	Yes
Length after cutting (mm)	184.50	186.60	187.00	142.80	183.70	186.70
Length after cover (mm)	N/A	N/A	N/A	N/A	N/A	N/A
Core diameter (mm)	93.30	93.50	93.50	93.15	93.60	93.40
Core density (g)	2931.9	3047.0	3042.9	2184.5	2974.9	3033.2
Ratio height/diameter	1.98	2.00	2.00	1.53	1.96	2.00
Correction factor	0.9984	1.0000	1.0000	0.9624	0.9968	1.0000
Breaking load (N)	102000	112850	122500	181350	188400	105950
Area (mm^2)	6837	6866	6866	6815	6881	6851
Compressive strength (MPa)	14.9	16.4	17.8	25.6	27.3	15.5
PARAMETER OF THE AIR-VOID SYSTEM (BNQ 2621-905)						
Air content (%)	-	-	-	-	-	-
Specific area (1/mm)	-	-	-	-	-	-
Spacing factor (µm)	-	-	-	-	-	-
CHLORIDE ION CONTENT (CSA A23.2-4B)						
Test at 0-25 mm surface (ppm)	-	-	-	-	-	-
Test at 50-75 mm surface (ppm)	-	-	-	-	-	-
Test at 100-125 mm surface (ppm)	-	-	-	-	-	-
Test at 150-175 mm surface (ppm)	-	-	-	-	-	-
CHLORIDE ION PENETRATION (ASTM C 1202)						
Permeability test (coulombs)	-	-	-	-	-	-

Results sent to: _____ Firm: _____

☐ Orally ☐ Memo ☐ Copy of the report

Unless otherwise specified, specimens will be kept in the laboratory for a period of 60 days.

2017-10-13

Verified by: P.Hinse, Sr Tech. Approved by: Michel Daoust, P.Eng. OIQ 120593 Date: 2017-08-01

ABS
17 Industrie Street, St-Rémi, QC, J0L 2L0

HARDENED CONCRETE CORE TESTING

F/N: CA-17-2035-00
Client: PECHES101
Date: 2017-08-01

Client	Fisheries and Oceans Canada
Project	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)
Location	Île du Moine in Sainte-Anne-de-Sorel, QC
Contractor	Not applicable

SAMPLING OF CONCRETE CORES						
Core number	F7	F8				
Sampling date/time	2017-07-21	2017-07-21				
Lab #	110 697	110 698				
Recovery length (mm)	370.00	370.00				
Coring conducted by	TB	TB				
COMPRESSIVE STRENGTH (CAN/CSA-A23,2-14C)						
Compressive strength testing: date/time	2017-08-01	2017-08-01				
End preparation by sawing	Yes	Yes				
Length after cutting (mm)	179.10	187.30				
Length after cover (mm)	N/A	N/A				
Core diameter (mm)	93.60	93.65				
Core density (g)	2863.0	2999.0				
Ratio height/diameter	1.91	2.00				
Correction factor	0.9928	1.0000				
Breaking load (N)	202600	115800				
Area (mm^2)	6881	6888				
Compressive strength (MPa)	29.2	16.8				
PARAMETER OF THE AIR-VOID SYSTEM (BNQ 2621-905)						
Air content (%)	-	-				
Specific area (1/mm)	-	-				
Spacing factor (µm)	-	-				
CHLORIDE ION CONTENT (CSA A23.2-4B)						
Test at 0-25 mm surface (ppm)	-	-				
Test at 50-75 mm surface (ppm)	-	-				
Test at 100-125 mm surface (ppm)	-	-				
Test at 150-175 mm surface (ppm)	-	-				
CHLORIDE ION PENETRATION (ASTM C 1202)						
Permeability test (coulombs)	-	-	-	-	-	-

Results sent to: _____ Firm: _____

☐ Orally ☐ Memo ☐ Copy of the report

Unless otherwise specified, specimens will be kept in the laboratory for a period of 60 days.

Verified by: P.Hinse, Sr Tech.

Approved by: Michel Daoust, P.Eng. 2017-10-13
Michel Daoust, inc.
OIQ 120593

Date: 2017-08-01

Microscopical determination of parameters of the air-void system in hardened concrete

ASTM C457

7 rue de l'Industrie, St-Rémi, Qc, J0L 2L(

N/D : CA17203500

V/D : F3051-170046

Date : 2017-09-01

Client:	Fisheries and Oceans Canada	#Client:	PECHES101
Project:	Coring of navigation aid FP (NLF 2181) on Île du Moine	#Laboratory:	113 086

INFORMATIONS ON THE SAMPLE

Sampling location :	☑ construction site ☐ concrete plant	Location:	
Type of sample:	Concrete core	Date:	
Dimensions:	57 mm x 158 mm	Orientation of the sample cut.:	Parallel to the core's axis

MIXTURE SPECIFICATIONS

Supplier:	**Materials**	**Type-grade / Source**	**Quantity (kg/m³)**
Source:	Cement:		
#Plant:	Blended Aggregate:		
#Mix:			
Coarse agregate (nominal):			
Type or class:			
Strengh (Mpa):	**Admixtures**	**Product / Manufacturer**	**Quantity (ml/100Kg)**
W/C ratio:	Air entrainer:		
	Water reducers:		
	Set retarders:		
	Superplasticizers:		
	Other:		

TESTING PARAMETERS | PROCEDURE B - Modified point-count method

	Measured values	Requirements		Measured values	Requirements
Number of stops (S_t):	***4716***	1200 (min)	Distance between stops (l) (mm):	***0.75***	0.6 à 5.0 mm
Number of stops in air voids (S_a):	***133***	-	Length of traverse (T_t) (mm):	**3537**	2032 mm (min)
Number of stops in paste,(S_p):	***1293***	-	Surface area covered (cm²):	**290**	65 cm² (min)
Number of air voids intersected (N):	***268***	-	Microscope magnification:	**125X**	50X à 125X

RESULTS

Sample's characteristics	Calculated values
Air content (A) =	***2.8*** %
Void frequency (n) =	***0.1***
Paste-Air ratio (S_p / S_a) =	***9.7***
Specific surface (α) =	***10.7*** mm^{-1}
Spacing factor ($\bar{L}$) (µm) =	***583*** µm

REQUIREMENTS - Spacing factor ($\bar{L}$)

CSA ***A23.1***	(Individual result)	W/C **≤ 0.36**	≤ 300 µm
		W/C **> 0.36**	≤ 260 µm
MTQ ***Norm 3101*** (table 3101-2)		Every types	≤ 230 µm
		except **XIV-S** et **XVI-15**	≤ 300 µm
		except **XIII** (to the pump outlet)	≤ 325 µm
		except **XIV-C** et **XIV-R** (to the pump outlet)	< 260 µm

NOTES

Tested on core H

☐ schema

Unknow concrete source

2017-09-01

Michel Daoust, ing.

OIQ 120593

Prepared by :	Dominic Ste-Marie, Sr. tech.	Verified by:	Michel Daoust, P.Eng.
Date:	2017-09-01	Date:	2017-09-01

ABS

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada	F/N:	CA17203500	Lab. #:	113093
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)	Analyzed by:	S.Bégin	Date:	2017-08-25
Client #:	PECHES101	Calculated by:	S.Bégin	Date:	2017-09-01
Sample description:	Core B	Verified by:	P.Hinse	Date:	
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description: 57 mm diameter core

Coarse aggregates: N/D

Mix number: N/D

Sampling date: 2017-07-21

Concrete sample: n/a

Density of the dry weight core (A):	868.9 g	***Density of the core after immersion into water (B)***	931.7 g
Density of the core after immersion into boiling water (C) :	935.8 g	***Density of the core into water (D):***	542.4 g
Absorption after immersion =	**7.23** %	*Apparent density =*	2661 kg/m³
Absorption after immersion (boiling) =	**7.70** %	*Volume of permeable pore spaces =*	17.0 %
Density (dry weight) =	**2209** kg/m³		
Density (after immersion) =	**2368** kg/m³		
Density = (after immersion into boiling water)	**2379** kg/m³		

Notes:

2017-10-13

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. OIQ 120593 **Date:** 2017-09-01

ABS

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada	F/N:	CA17203500	Lab. #:	113093
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)	Analyzed by:	S.Bégin	Date:	25-08-2017
Client #:	PECHES101	Calculated by:	S.Bégin	Date:	01-09-2017
Sample description:	Core C	Verified by:	P.Hinse	Date:	
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description: 57 mm diameter core

Coarse aggregates: N/D

Mix number: N/D

Sampling date: 2017-07-21

Concrete sample: n/a

Density of the dry weight core (A):	896.7 g	***Density of the core after immersion into water (B)***	957 g
Density of the core after immersion into boiling water (C) :	961.1 g	***Density of the core into water (D):***	560.1 g
Absorption after immersion =	**6.72** %	*Apparent density =*	2664 kg/m³
Absorption after immersion (boiling) =	**7.18** %	*Volume of permeable pore spaces =*	16.1 %
Density (dry weight) =	**2236** kg/m³		
Density (after immersion) =	**2387** kg/m³		
Density = (after immersion into boiling water)	**2397** kg/m³		

Notes:

2017-10-13

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. OIQ 120593 **Date:** 2017-09-01

N/Ref. LB005 (R01 24-01-11)

ABS

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada	F/N:	CA17203500	Lab. #:	113096
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)	Analyzed by:	S.Bégin	Date:	25-08-2017
Client #:	PECHES101	Calculated by:	S.Bégin	Date:	01-09-2017
Sample description:	Core F	Verified by:	P.Hinse	Date:	
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description:	57 mm diameter core	Coarse aggregates:	N/D
Mix number:	N/D	Sampling date:	2017-07-21
Concrete sample:	n/a		

Density of the dry weight core (A):	1075.8	g	***Density of the core after immersion into water (B)***	1141.1	g
Density of the core after immersion into boiling water (C)	1145.1	g	***Density of the core into water (D):***	670.7	g
Absorption after immersion =	**6.07**	%	*Apparent density =*	2656	kg/m³
Absorption after immersion (boiling) =	**6.44**	%	*Volume of permeable pore spaces =*	14.6	%
Density (dry weight) =	**2268**	kg/m³			
Density (after immersion) =	**2405**	kg/m³			
Density = (after immersion into boiling water)	**2414**	kg/m³			

Notes:

2017-10-13

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. OIQ 120593 **Date:** 2017-09-01

ABS

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada	F/N:	CA17203500	Lab. #:	113097
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)	Analyzed by:	S.Bégin	Date:	25-08-2017
Client #:	PECHES101	Calculated by:	S.Bégin	Date:	01-09-2017
Sample description:	Core G	Verified by:	P.Hinse	Date:	
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description: 57 mm diameter core

Coarse aggregates: N/D

Mix number: N/D

Sampling date: 2017-07-21

Concrete sample: n/a

Density of the dry weight core (A):	917.8 g	***Density of the core after immersion into water (B)***	973.7 g
Density of the core after immersion into boiling water (C) :	980 g	***Density of the core into water (D):***	569.4 g
Absorption after immersion =	**6.09** %	*Apparent density =*	2634 kg/m³
Absorption after immersion (boiling) =	**6.78** %	*Volume of permeable pore spaces =*	15.1 %
Density (dry weight) =	**2235** kg/m³		
Density (after immersion) =	**2371** kg/m³		
Density = (after immersion into boiling water)	**2387** kg/m³		

Notes:

2017-10-13

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. OIQ 120593 **Date:** 2017-09-01

ABS

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada	F/N:	CA17203500	Lab. #:	113098
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)	Analyzed by:	S.Bégin	Date:	25-08-2017
Client #:	PECHES101	Calculated by:	S.Bégin	Date:	01-09-2017
Sample description:	Core i	Verified by:	P.Hinse	Date:	
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description:	57 mm diameter core	Coarse aggregates:	N/D
Mix number:	N/D	Sampling date:	2017-07-21
Concrete sample:	n/a		

Density of the dry weight core (A):	969.0	g	***Density of the core after immersion into water (B)***	1039	g
Density of the core after immersion into boiling water (C) :	1043.1	g	***Density of the core into water (D):***	604.0	g
Absorption after immersion =	**7.22**	%	*Apparent density =*	2655	kg/m³
Absorption after immersion (boiling) =	**7.65**	%	*Volume of permeable pore spaces =*	16.9	%
Density (dry weight) =	**2207**	kg/m³			
Density (after immersion) =	**2366**	kg/m³			
Density (after immersion into boiling water) =	**2376**	kg/m³			

Notes:

2017-10-13

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. OIQ 120593 **Date:** 2017-09-01

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada		F/N:	CA17203500	Lab. #: 113099
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)		Analyzed by:	S.Bégin	Date: 25-08-2017
Client #:	PECHES101		Calculated by:	S.Bégin	Date: 01-09-2017
Sample description:	Core K		Verified by:	P.Hinse	Date:
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description: 57 mm diameter core

Coarse aggregates: N/D

Mix number: N/D

Sampling date: 2017-07-21

Concrete sample: n/a

Density of the dry weight core (A):	954.4 g	***Density of the core after immersion into water (B)***	1015.6 g
Density of the core after immersion into boiling water (C)	1016.1 g	***Density of the core into water (D):***	593.2 g
Absorption after immersion =	**6.41** %	*Apparent density =*	2642 kg/m³
Absorption after immersion (boiling) =	**6.46** %	*Volume of permeable pore spaces =*	14.6 %
Density (dry weight) =	**2257** kg/m³		
Density (after immersion) =	**2402** kg/m³		
Density = (after immersion into boiling water)	**2403** kg/m³		

Notes:

2017-10-13

Michel Daoust, inc. OIQ 120593

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. **Date:** 2017-09-01

ABS

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada	F/N:	CA17203500	Lab. #:	113101
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)	Analyzed by:	S.Bégin	Date:	25-08-2017
Client #:	PECHES101	Calculated by:	S.Bégin	Date:	01-09-2017
Sample description:	Core N	Verified by:	P.Hinse	Date:	
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description: 57 mm diameter core

Coarse aggregates: N/D

Mix number: N/D

Sampling date: 2017-07-21

Concrete sample: n/a

Density of the dry weight core (A):	920.4 g	***Density of the core after immersion into water (B)***	985.2 g
Density of the core after immersion into boiling water (C) :	1003.5 g	***Density of the core into water (D):***	575.2 g
Absorption after immersion =	**7.04** %	*Apparent density =*	2666 kg/m³
Absorption after immersion (boiling) =	**9.03** %	*Volume of permeable pore spaces =*	19.4 %
Density (dry weight) =	**2149** kg/m³		
Density (after immersion) =	**2300** kg/m³		
Density = (after immersion into boiling water)	**2343** kg/m³		

Notes:

2017-10-13

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. OIQ 120593 **Date:** 2017-09-01

ABS

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada	F/N:	CA17203500	Lab. #:	113102
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)	Analyzed by:	S.Bégin	Date:	25-08-2017
Client #:	PECHES101	Calculated by:	S.Bégin	Date:	01-09-2017
Sample description:	Core O	Verified by:	P.Hinse	Date:	
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description: 57 mm diameter core

Coarse aggregates: N/D

Mix number: N/D

Sampling date: 2017-07-21

Concrete sample: n/a

Density of the dry weight core (A):	1091.0 g	***Density of the core after immersion into water (B)***	1160.5 g
Density of the core after immersion into boiling water (C)	1165.7 g	***Density of the core into water (D):***	681.2 g
Absorption after immersion =	**6.37** %	*Apparent density =*	2662 kg/m³
Absorption after immersion (boiling) =	**6.85** %	*Volume of permeable pore spaces =*	15.4 %
Density (dry weight) =	**2252** kg/m³		
Density (after immersion) =	**2395** kg/m³		
Density = (after immersion into boiling water)	**2406** kg/m³		

Notes:

2017-10-13

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. OIQ 120593 **Date:** 2017-09-01

ABS

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada	F/N:	CA17203500	Lab. #:	113103
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)	Analyzed by:	S.Bégin	Date:	25-08-2017
Client #:	PECHES101	Calculated by:	S.Bégin	Date:	01-09-2017
Sample description:	Core R	Verified by:	P.Hinse	Date:	
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description: 57 mm diameter core

Coarse aggregates: N/D

Mix number: N/D

Sampling date: 2017-07-21

Concrete sample: n/a

Density of the dry weight core (A):	996.5 g	***Density of the core after immersion into water (B)***	1068.4 g
Density of the core after immersion into boiling water (C)	1073.6 g	***Density of the core into water (D):***	617.7 g
Absorption after immersion =	**7.22** %	*Apparent density =*	2631 kg/m³
Absorption after immersion (boiling) =	**7.74** %	*Volume of permeable pore spaces =*	16.9 %
Density (dry weight) =	**2186** kg/m³		
Density (after immersion) =	**2343** kg/m³		
Density = (after immersion into boiling water)	**2355** kg/m³		

Notes:

2017-10-13

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. OIQ 120593 **Date:** 2017-09-01

ABS

Water content, density, absorption and voids in hardened concrete, grout or mortar

CSA A23.2 - 11C

Client:	Fisheries and Oceans Canada	F/N:	CA17203500	Lab. #:	113104
Project:	Expert report on cores sampled from the pillar supporting aid to navigation FP (NLF 2181)	Analyzed by:	S.Bégin	Date:	25-08-2017
Client #:	PECHES101	Calculated by:	S.Bégin	Date:	01-09-2017
Sample description:	Core S	Verified by:	P.Hinse	Date:	
Location:	Île du Moine in Sainte-Anne-de-Sorel, QC				
Request number:	N/D				

Concrete description: 57 mm diameter core

Coarse aggregates: N/D

Mix number: N/D

Sampling date: 2017-07-21

Concrete sample: n/a

Density of the dry weight core (A):	1088.5 g	***Density of the core after immersion into water (B)***	1167.7 g
Density of the core after immersion into boiling water (C)	1174.5 g	***Density of the core into water (D):***	681.0 g
Absorption after immersion =	**7.28** %	*Apparent density =*	2671 kg/m³
Absorption after immersion (boiling) =	**7.90** %	*Volume of permeable pore spaces =*	17.4 %
Density (dry weight) =	**2206** kg/m³		
Density (after immersion) =	**2366** kg/m³		
Density = (after immersion into boiling water)	**2380** kg/m³		

Notes:

2017-10-13

Michel Daoust, inc.

OIQ 120593

Prepared by: Patrice Hinse, Sr Tech. **Approved by:** Michel Daoust, Eng. **Date:** 2017-09-01

APPENDIX D

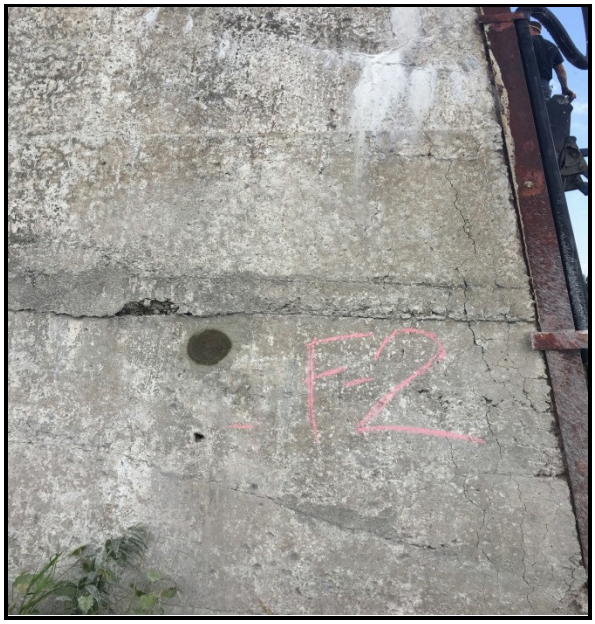
PHOTOS OF SITE AND SAMPLED CORES

PHOTOS – SOUTH SIDE

PHOTO 1:

Location of core F1

PHOTO 2:



Location of core F2

PHOTO 3:

Delaminated concrete and location of additionnal cores

PHOTOS – EAST SIDE

PHOTO 4:

Location of core F3

PHOTO 5:

Location of core F4

PHOTOS – NORTH SIDE

PHOTO 6:

Location of core F5

PHOTO 7:

Typical cracking caused by the alkali-aggregate reactivity (AAR)

PHOTOS – NORTH AND NORTHWEST SIDES

PHOTO 8:

Location of core F6 on the north wall and overview of the northwest wall

PHOTO 9:

Positioning of the coring drill on the northwest wall for core F7

PHOTO 10:

Location of core F7 on the northwest wall

VIEW OF NORTHWEST AND SOUTHWEST SIDES

PHOTO 11:

Northwest (left) and southwest (right) sides

INSIDE OF THE PILLAR

PHOTO 12:

PHOTO 13:

INSIDE OF THE PILLAR

PHOTO 14:

PHOTO 15:

CORES F1 TO F8

PHOTO 16:

Core F1. Overview of core F1.

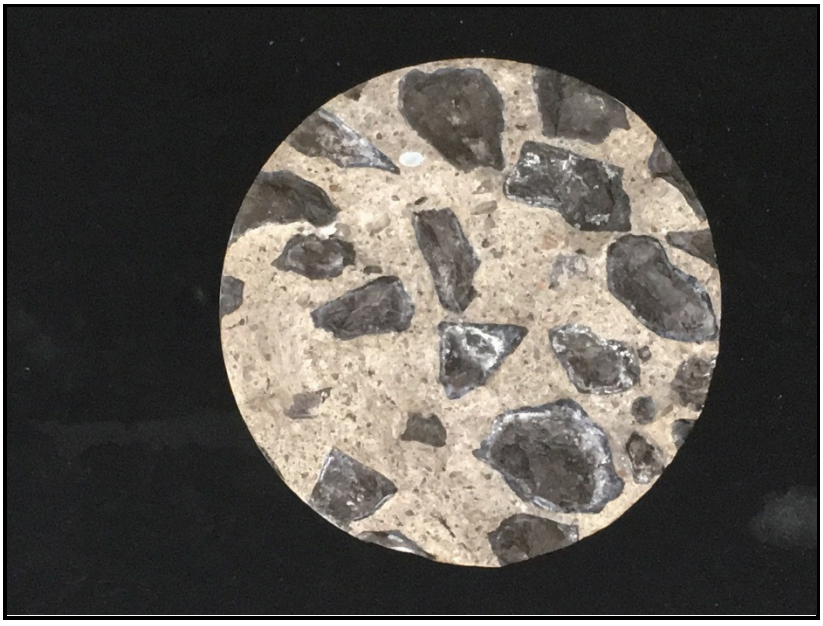
PHOTO 17:

Core F1. Silica gel around aggregates indicating an alkali-aggregate reactivity. Silica gel is also present inside concrete voids.

PHOTO 18:

Core F2. Overview of core F2.

PHOTO 19:

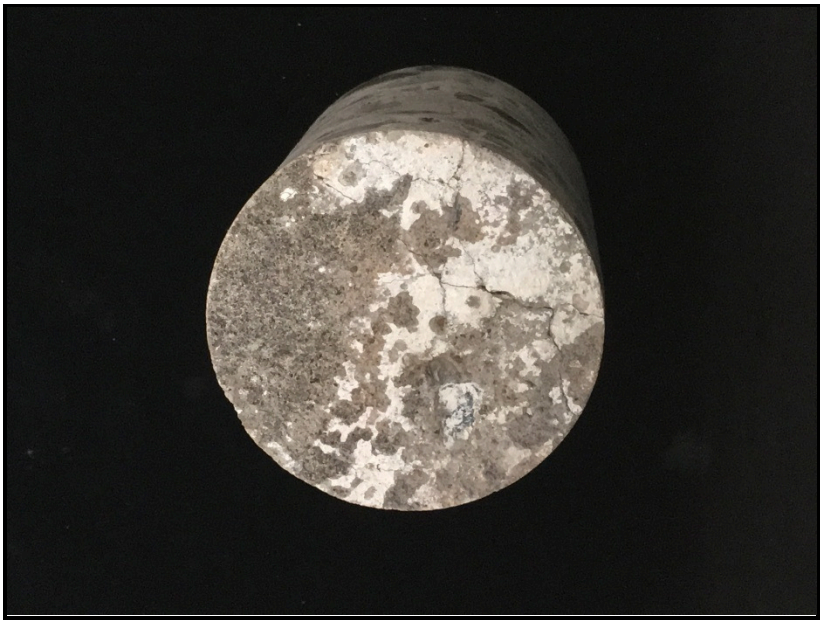


Core F2. Core surface at the crack. Silica gel has formed on the surface of the aggregates.

PHOTO 20:

Core F2. Close-up view of aggregates. Silica gel and cracks are visible through the aggregates and cement paste

PHOTO 21:

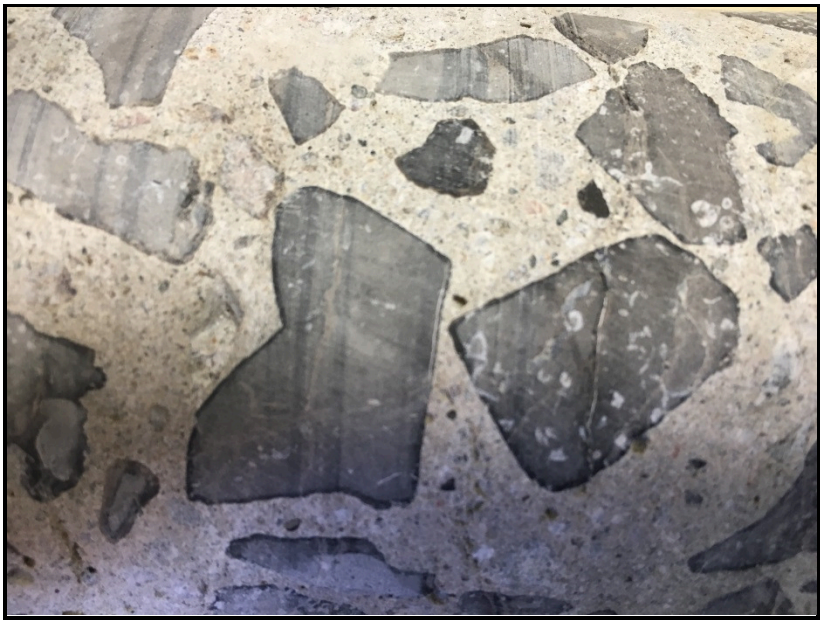


Core F2. Whitish deposits on the surface of the core

PHOTO 22:

Core F3. Overview of core F3

PHOTO 23:



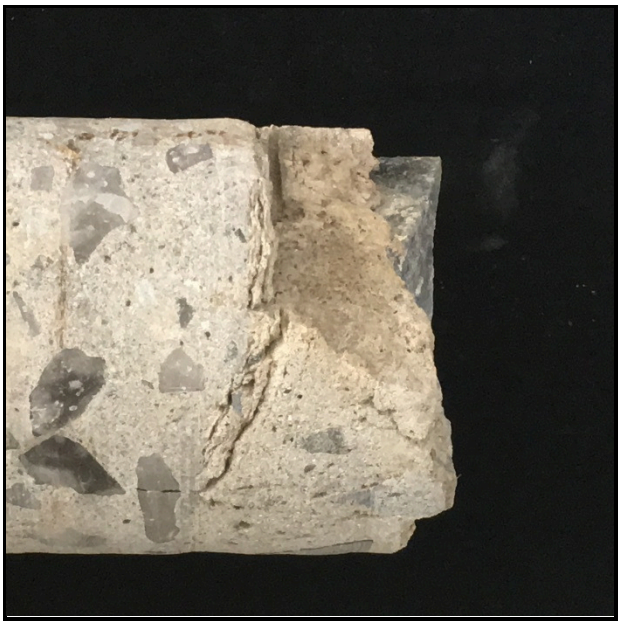
Core F3. Silica gel around aggregates and cracks with silica gel passing through the aggregates

PHOTO 24:

Core F3. A different concrete is seen on the inner side of the core.

The large aggregate on far right has a size of 30 to 60 mm

PHOTO 25:

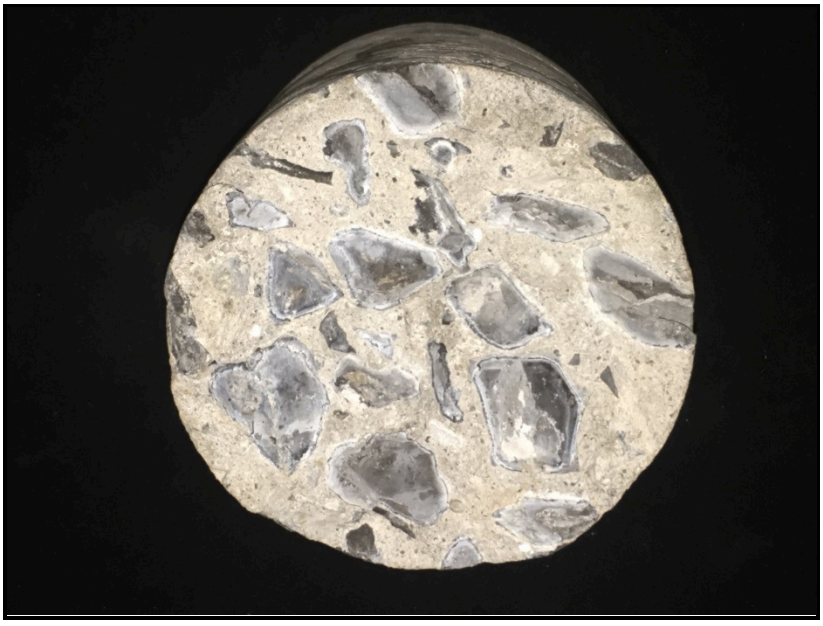


Core F3. Concrete delamination

PHOTO 26:

Core F4. Overview of core F4.

PHOTO 27:



Core F4. Silica gel around aggregates

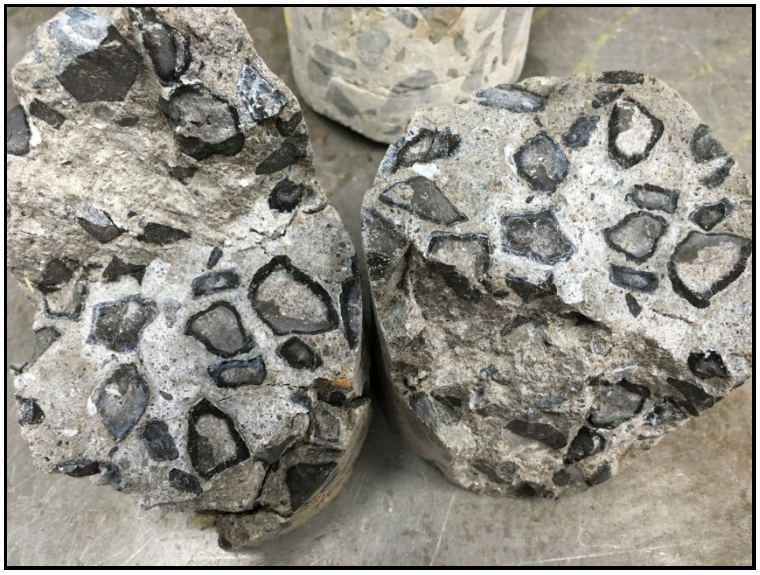
PHOTO 28:

Core F4. Upper part of the concrete core showing large cracks and what appears to be wood in the core

PHOTO 29:

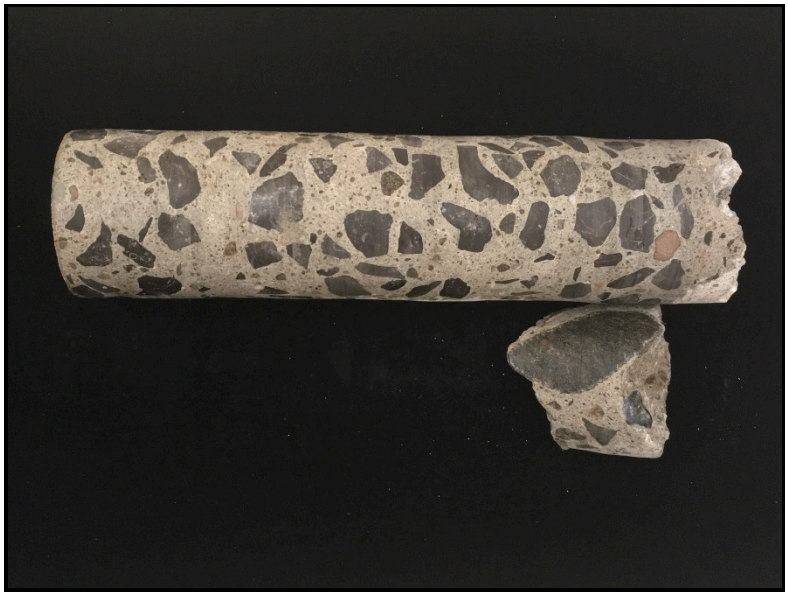
Core F4. After the compression break, wood is clearly visible in the concrete.

PHOTO 30:



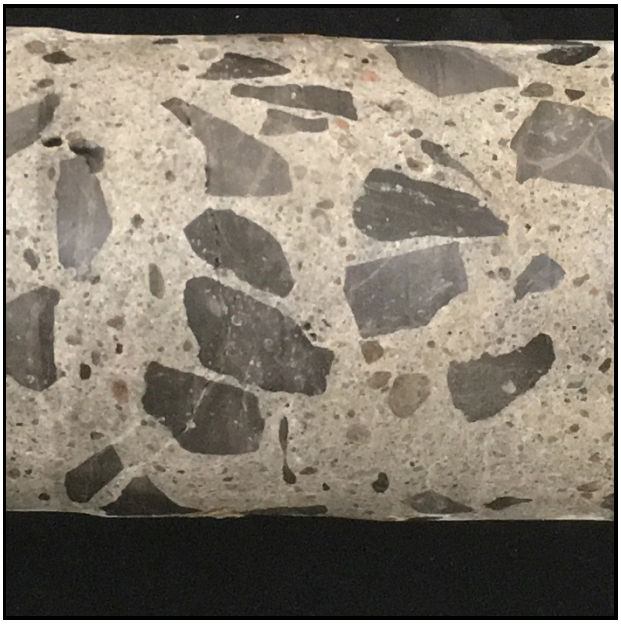
Core F4. After the compression break. Rings around the aggregates are clearly visible.

PHOTO 31:



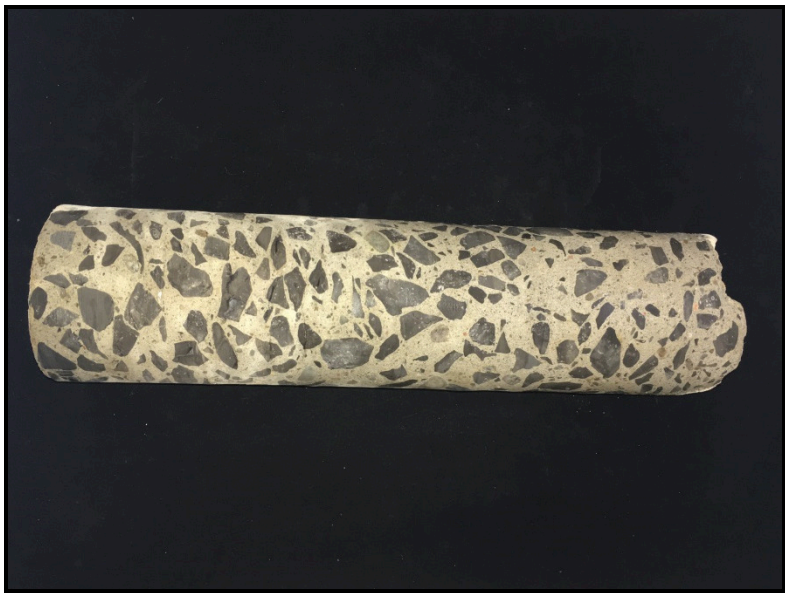
Core F5. Overview of core F5

PHOTO 32:



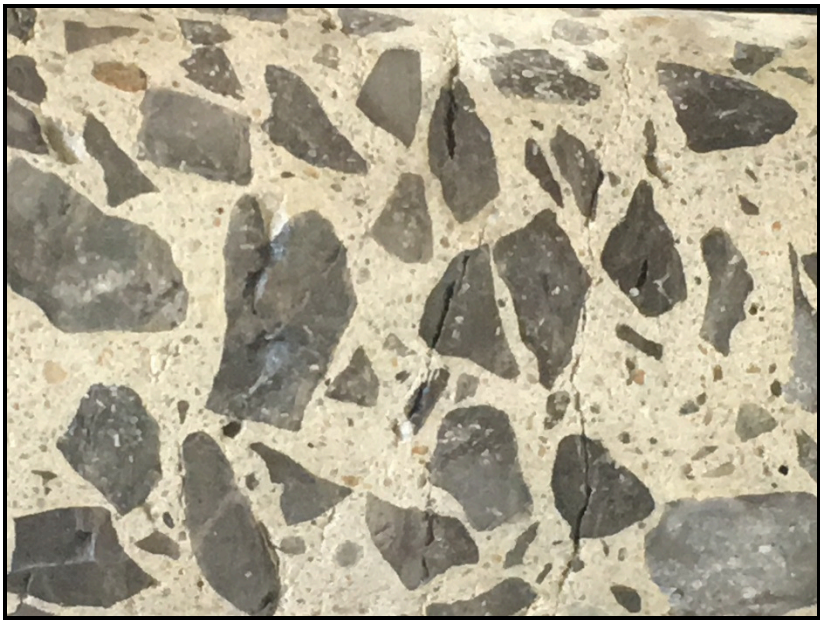
Core F5. Close-up view of the core with cracks passing through the aggregates

PHOTO 33:



Core F6. Overview of core F6

PHOTO 34:

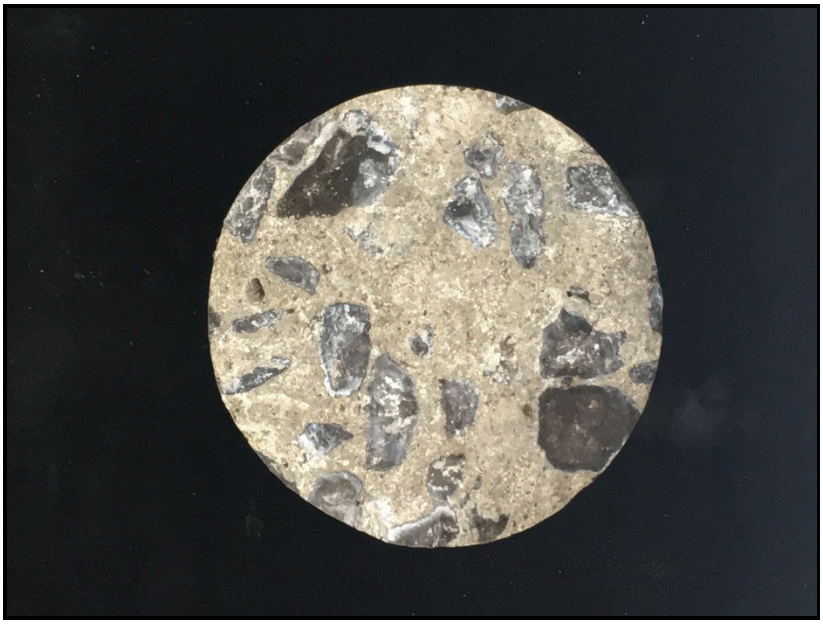


Core F6. Several cracks passing through the aggregates

PHOTO 35:

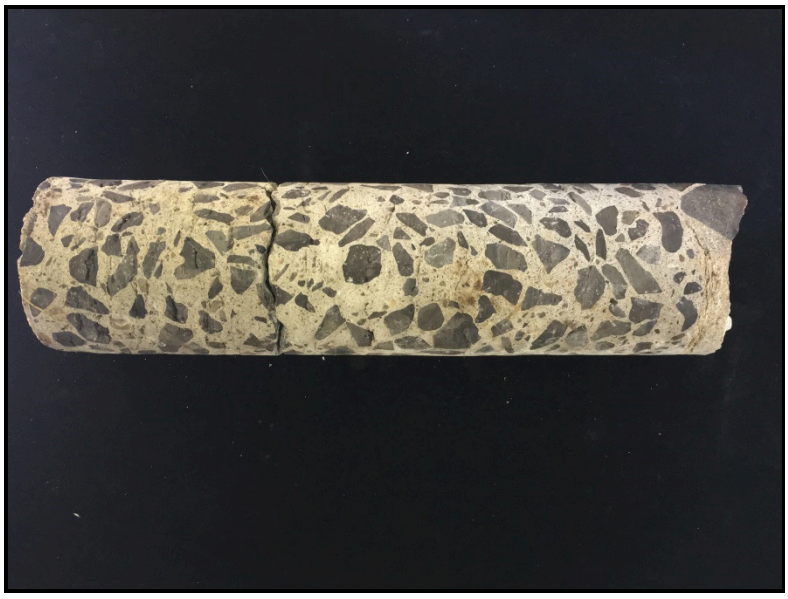
Core F7. Overview of core F7

PHOTO 36:



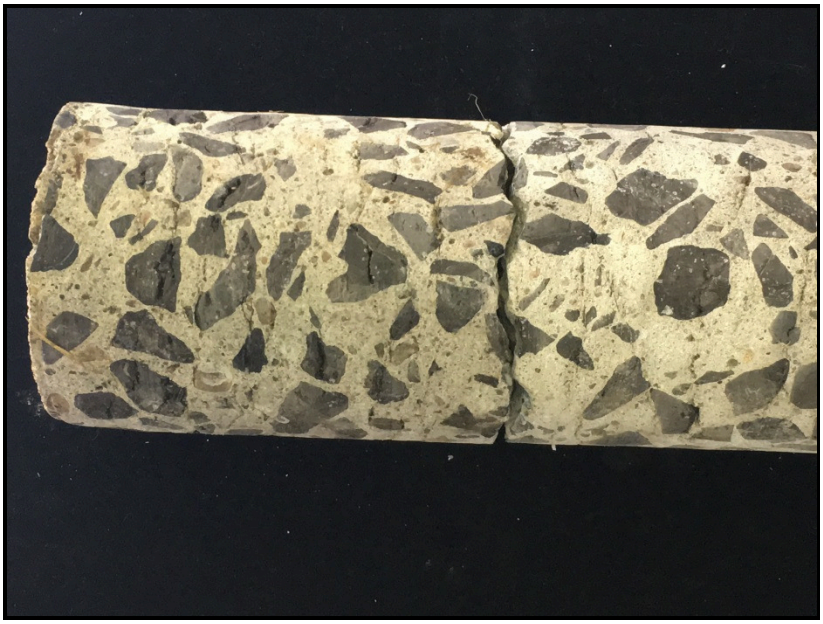
Core F7. Silica gel int the aggregates

PHOTO 37:



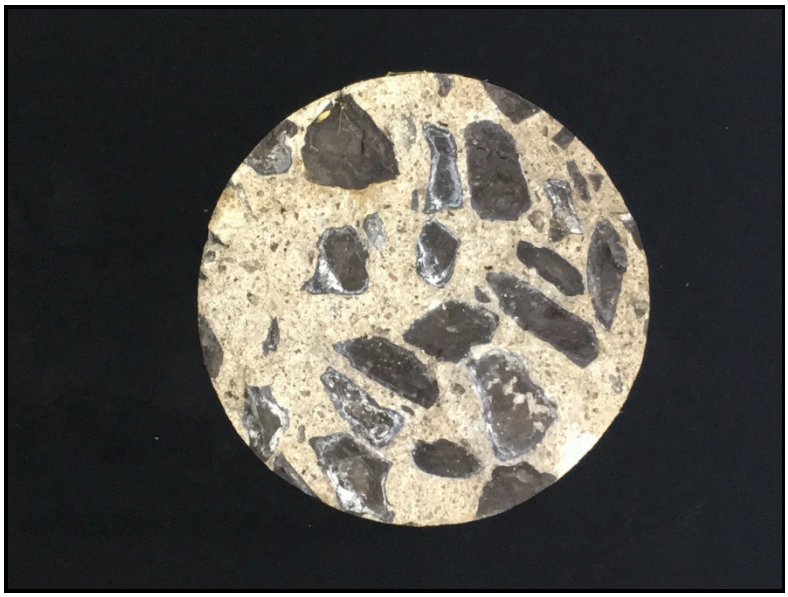
Core F8. Overview of core F8

PHOTO 38:



Core F8. Several cracks passing through the aggregates

PHOTO 39:



Core F8. Silica gel around the aggregates

PHOTO 40:

Core F8. A different concrete can be seen on the inner side of the core, with an aggregate size greater than 30 mm.

SUPPLEMENTARY CORES

PHOTO 41 :

Core A

PHOTO 42 :

Core B

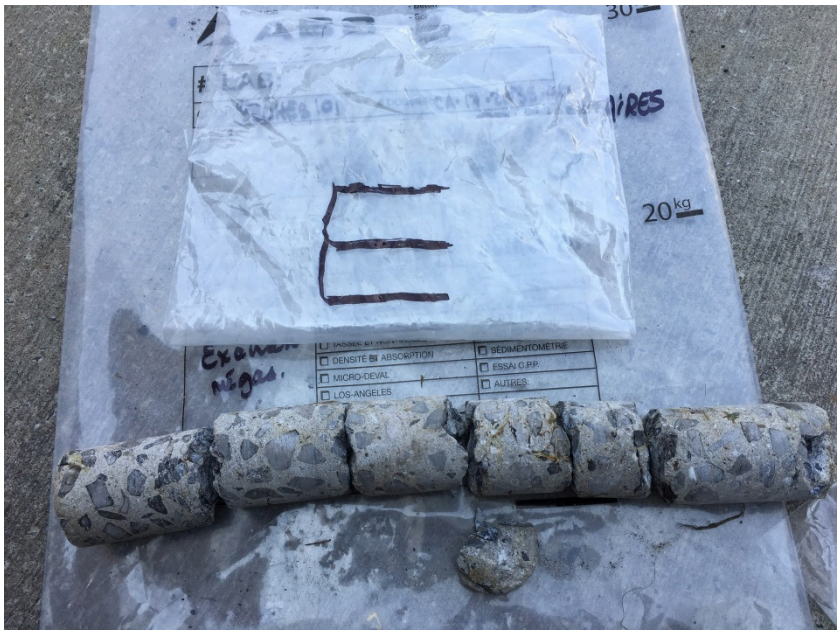
PHOTO 43 :

Core C

PHOTO 44 :

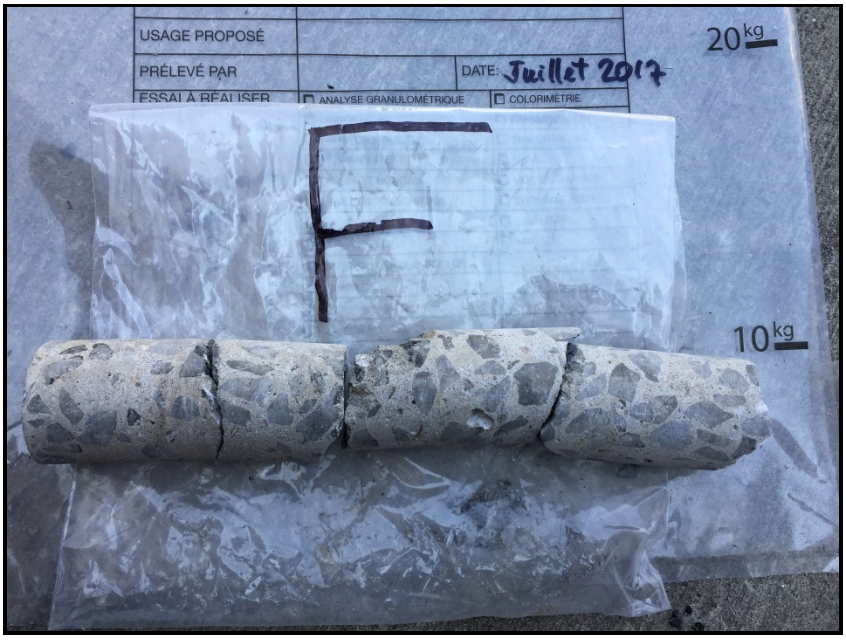
Core D

PHOTO 45 :



Core E

PHOTO 46 :



Core F

PHOTO 47 :

Core G

PHOTO 48 :

Core H

PHOTO 49 :

Core I

PHOTO 50 :

Core J

PHOTO 51 :

Core K

PHOTO 52 :

Core L

PHOTO 53 :

Core M

PHOTO 54 :

Core N

PHOTO 55 :

Core O

PHOTO 56 :

Core P

PHOTO 57 :

Core Q

PHOTO 58 :

Core R

PHOTO 59 :

Core S

PHOTO 60 :

Core T