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ATR-036

PG Binder Test Section Montreal International Airport - Dorval Construction Report

R&D PROJECT

PG Binders for Canadian Airport Pavements
Dorval Field Trial

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***Study of asphalt surfacing
as part of the rehabilitation of
runway 06L-24R at Montreal Airport
Construction Report***

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1.0 INTRODUCTION

As part of its mandate, the Airport Engineering Division of Public Works and Government Services Canada (PWGSC) is responsible for developing and maintaining guidelines and recommended practices for runway surfaces at Canadian airports. The Strategic Highway Research Program (SHRP) has to varying degrees led provincial agencies and municipalities to adopt new “Superpave” specifications and testing protocols for asphalt and asphalt mixes.

PWGSC, in cooperation with Transport Canada, Calgary International Airport and the Montreal Airports, undertook testing and monitoring programs to evaluate the specifications and compare a selection of asphalt binders that meet the Canadian CGSB standards or the SHRP standards for PG Binders.

This report documents the construction of a test section using a Superpave performance-graded (PG) binder at the Montreal International Airport in Dorval as part of the rehabilitation of runway 06L-24R.

1.1 Background

The Strategic Highway Research Program (SHRP) has developed new testing protocols and new specifications for asphalt binders and a new mix design method referred to by the name Superpave. An initial study carried out for Public Works and Government Services Canada [PWGSC, 1997] provides documentation on the implementation of Superpave asphalt on pavements at Canadian airports. In a second study, guidelines were developed for selecting PG binders for pavements at Canadian airports [PWGSC, 1998].

The choice of Superpave binders for a specific project is based primarily on an estimate of the project specific in service pavement temperature. The site specific air temperatures during the summer (average 7 day maximum) and winter (average minimum) are used to predict the pavement surface temperatures at both extremes. The asphalt grade is then selected based on the design temperatures and the desired degree of reliability at both low and high temperatures.

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The binder selection process developed under SHRP is intended to solve the most significant pavement runway surface performance problems, such as: low-temperature performance, illustrated by thermal cracking; moderate-temperature, relative to fatigue cracking; and high-temperature performance in relation to rutting caused by the instability of the asphalt mix. Even though the final specifications for Superpave binders are still being developed, it appears that the basic principles underlying the current specifications will not be significantly affected by future changes.

1.2 Objectives

The main objective of the test section built at the Montreal International Airport in Dorval was to:

- evaluate the performance of the PG binder selected on the basis of the new selection criteria;
- provide a means of validating the selection criteria for PG binder; and
- determine the constructability of the asphalt concrete mix made with the selected PG binder for the project.

Another objective was to validate the applicability of the SHRP/C-SHRP (TAC) temperature algorithms to airport pavements with thick granular base/subbases. To accomplish this, instruments were embedded in the runway to measure the temperature at various depths.

This report documents the construction of the test section, the material properties, quality assurance during construction and the post-construction rheological testing. It also includes a brief review of the temperature monitoring devices embedded in the runway.

2.0 PAVEMENT DESIGN

Several options were considered as part of the rehabilitation of runway 06L-24R at the Dorval Airport. The project was carried out in three phases: holding bay 24R and the first third of the runway in May and June 1998, followed by the middle section (phase II), and then the 06L holding bay and the last third of the runway (phase III) in May and June 1999. This approach was chosen for operational and technical reasons given the scope of the project and the technologies involved.

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The option of a stabilized recycled base covered with a flexible hot mix asphalt concrete material proved to be the best compromise considering time constraints, structural capacity and costs over 20 years. Figures 1A and 1B show two typical cross sections of the existing runway 06L-24R and the proposed design.

The structure of the existing runway from threshold 06L is:

- 200 to 250 mm of hot mix asphalt concrete;
- 600+ mm of waterbound macadam with 0-40 mm crushed stone;
- 100 mm of 0-6 mm screened stone.

For the reconstruction, central section and edge of runway are different. The existing profile of the macadam granular base was adjusted by removing small quantities of material in some areas and adding materials in some areas on the edges.

On top of the 0-40 mm of macadam, a 200 mm stabilized base was placed followed 125 mm of hot mix asphalt concrete in the central section and at intersections with threshold apron and taxiways. For the edges, the profile of the macadam was raised with 0-40 mm crushed stone covered with 125 mm of hot mix asphalt concrete.

3.0 CONSTRUCTION

Construction related to the rehabilitation of runway 06L-24R was carried out in 1998 (phase I) and 1999 (phases II and III). The test section with the PG58-34 binder was constructed in phase III of the project.

3.1 Granular Base

The existing granular base is comprised of crushed stone macadam with a nominal size of 40 to 50 millimetres. The particles in the fine part of the material are slightly coarse, which means the base drains very well but also offers excellent structural capacity. Plate load tests carried out during construction showed that the structural capacity of the base below the stabilized base layer was in the same order of magnitude of the anticipated values, i.e. a modulus of elasticity greater than 300 MPa. The particle size distribution of the new 0-40 mm crushed stone was similar to the existing macadam and presented more or less the same permeability and bearing capacity.

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3.2 Stabilized Base

The rehabilitation methods and cross-section profiles were optimized taking into consideration the existing pavement structures. The eastern end had slabs of cement concrete, while the surface consisted primarily of multiple mixes for phases II and III. Runway 06L-24R is more than 40 years old and has been extended and modified over the years; as a result, the method of reconstruction varies from one section to another.

For the central section of the runway, which is 30 metres wide, 200 millimetres of stabilized base was placed. The stabilized base is composed of crushed cement concrete and milled and screened hot mix asphalt concrete to which a CSS-1 asphalt emulsion and cement powder to promote curing.

The proportions of the granular components were established through in-laboratory California Bearing Ratio (CBR) testing using variable proportions of each ingredient. Formulations were done in the laboratory before the project started in order to determine the optimum proportions and draft a tender document specifically identifying the expected properties.

The recommended approach was intended to obtain the mix richest in asphalt, taking dry and saturated stability into consideration, and satisfactory in-service structural capacity. The formulation chosen for the project was:

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TABLE 3.1
PROPORTIONS – THEORETICAL FORMULA
Modified formula 98-06

Percentage of mixture	Material
71.7%	crushed cement concrete
24.0%	crushed hot mix asphalt concrete
1.5%	type 10 cement
2.8%	added asphalt cement

TABLE 3.2
THEORETICAL FORMULA – STABILIZED BASE

Grading Sieve	Requirements	Formula
28.000	100.000	100
14.000	68-93	81
5.000	35-60	47
1.250	19-38	24
0.315	9-17	10
0.080	2-8	5
% minimum added asphalt cement	3.00 minimum	2.8 *
Marshall stability, N	10,000 minimum	13880
Flow, mm	2-4	3.7
Bearing capacity, MPa after Metcalf	1.0 minimum	1.55
Retained stability, %	80 minimum	92.2
Coating, %	90 minimum	90.0
Bulk gross density, kg/cm ³		2.002
% type 10 cement content	1.5 maximum	1.2 – 1.5**
Optimum water content on compaction***	+ 0%, 1%	6.0
* Following the first set of tests, the added asphalt cement content was changed to 2.8% minimum.		
** 1.2% cement in phase I (1998); 1.5% in phases II and III (1999).		
*** Optimum water content obtained during mix design.		

The mechanical and physical characteristics of the components are illustrated in Table 3.3.

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**TABLE 3.3
MECHANICAL AND PHYSICAL CHARACTERISTICS OF THE COMPONENTS**

	Crushed cement concrete	Recycled hot mix asphalt concrete	Theoretical combination
Micro Deval (%)	15.6	20.6	16.9
Los Angeles (%)	30.6	30.6	30.9
MgSO ₄ (%)	4.5	39.7	13.3

CBR tests were conducted on the mixture (crushed cement concrete + crushed asphalt cement concrete) in order to evaluate the bearing capacity. The tests were done on samples taken from the stockpiles at the construction site. The mixture was recreated in the laboratory with the optimum water content. The results at 56 blows for displacement of 0.2 inches are in the order of 75%.

3.2.1 Production Control

A total of 42 samples were taken during production (phases II and III), and 33,325 tonnes were produced. The analyses showed that the average percentage of added residual asphalt was 2.98%, average retained stability was 83.1% and Marshall stability was greater than 10,000 N.

The plate load tests carried out during construction, after an average of five days depending on the phase, showed that the average modulus was between 1,000 and 1,300 MPa, while HWD tests after one year showed an increase in the modulus of more than 20%.

3.3 Asphalt Cement Mixes

3.3.1 Mix Design

The asphalt surfacing mixes chosen for the project are the Public Works and Government Services Canada mixes. The Marshall properties were determined using manual compaction of 50 blows per face. Minimum asphalt contents were set out in the specifications: 4.8% and 5.6% by total mass mix respectively for the lower and upper asphalt layers.

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It was specified that fine and coarse particles should be from 100% crushed quarry stone.

The other requirements were the same as those normally specified for airports: a stability of 9.0 kN on the samples that weren't reheated and 50 blows per face. The briquettes were produced at the construction site immediately after the samples were taken.

For phases II and III, which were carried out in 1999, mix design studies were conducted in a laboratory during the winter (1999), and the mixes were also placed in a gyratory compactor even though the contract requirements were met. All the aggregates in the subject mixes were from crushed quarry material.

The above mix designs were used for the test section as part of this project. The mixes ultimately proved difficult to produce because the aggregate grading imposed fairly high limits on the percentage of screenings. In mixes with 100% crushed particles, it is not as easy to control the voids within the gradation curve and the shape of the particles tends to produce higher-density mixes. When the minimum asphalt contents are relatively high, these mixes are harder to produce unless there is a large proportion of washed fine particles.

Asphalt cement test slabs were conducted in order to validate the compaction behaviour of the mixes and check the texture of the surface mix, which has to provide adequate friction.

The effort spent on the mix design provided with mixes that should perform very well:

- high stability values;
- voids and flow are close to median values;
- binder-particle adhesion should provide good stripping resistance;
- the asphalt surface of the material is sufficiently rough;
- the required compaction was attained with compaction in accordance with the standards;
- the mix did not present any significant tendency to crack or shift (tenderness) during compaction.

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**TABLE 3.3.1
AVERAGE MIX PRODUCTION**

Sieve	BASE MIX			SURFACE MIX		
	Formula	Production average 120-150	Production average PG 58-34	Formula	Production average 120-150	Production average PG 58-34
25.0	100.0	100.0	100.00	--	--	--
19.0	--	97.0	96.00	--	--	--
12.5	82.0	81.0	84.00	100.0	100.0	100.0
9.5	--	78.0	81.00	--	94.0	93.0
4.750	65.0	64.6	68.50	65.0	64.0	62.2
2.0	42.0	41.0	44.00	42.0	41.0	41.0
0.425	15.0	16.0	17.00	15.0	15.0	16.0
0.180	9.0	9.0	10.00	8.0	8.0	9.0
0.075	5.3	5.2	5.40	4.5	4.6	4.6
% asphalt	4.8	4.79	4.81	5.6	5.5	5.4
% voids	4	3.1	3.50	3.0	2.9	2.6
VMA %	14	14.0	14.2	16.0	15.3	15.0
Stability N	13000	13322	13592	12000	11891	11111
Flow	3	3.1	3.0	3.0	3.1	3.5
Bulk density	2.44	2.444	2.440	2.410	2.423	2.432
Max. density	2.529	2.524	2.528	2.497	2.494	2.497

3.3.2 Production and Placing

For phases II and III, the mixes were produced using an Aztec double barrel plant. This mixer-dryer drum plant was capable of producing an average of approximately 250 tonnes an hour. Test results show that production was consistent; production averages were close to the developed formulas, and the characteristics of the mixes were for all intents and purposes the same as those obtained at the design stage. Aside from a few discrepancies attributable to mechanical defects, production was very satisfactory.

For phase I, the mix was produced using a batch plant. Test results show that production was more variable.

For phases II and III, 25,653.61 tonnes of mix with 120-150 asphalt were placed as the base layer and 20,963.33 tonnes as the surface layer. For the test section (phase III),

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2,442.61 tonnes of mix with PG 58-34 asphalt were placed as the base layer and 1,543.8 tonnes as the surface layer.

Three or four rollers, including a pneumatic roller, were used to compact the mix. The typical rolling pattern was to use the steel roller without vibration for the initial pass followed by one or two passes in vibrate mode, then the pneumatic roller in the middle followed by another pass of the steel roller without or without vibration depending on the temperature of the mix.

The densities obtained were on average very close to the 50 blow Marshall density; the requirement of 98% was always met.

It is important to bear in mind that the work was carried out in warm temperatures with roller compaction of 50 to 60 tonnes per hour of compaction. All the joints were heated using an infrared device mounted on the paver when the joint temperature was below 90°C.

The compaction of the mixes was not significantly different for the 120-150 or PG 58-34 binders.

A summary of all the results for each mix are given in the appendix by type of mix.

3.3.3 Surface Texture

Sand patch tests were conducted in the fall of 1999. The results are summarized in Table 9 in Appendix 1.

The results show that the material used in phases II and III has a rougher texture than the material used in phase I, despite the fact that it had been exposed to winter conditions. These results confirm our on-site observations. The material is also slightly rougher than the material used in test slabs on Hervé-Saint-Martin Street.

These tests have to be repeated this year in order to track the performance of the materials.

Photographs taken during the sand patch tests appear in Appendix 3.

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3.4 Binder Tests

Analyses were carried out on the 120-150 and PG58-34 binders provided by Petro-Canada.

Both types of binder underwent conventional CGSB and Superpave testing protocols to compare their characteristics. The following conventional CGSB protocol tests were conducted: penetration at 25°C, kinematic viscosity at 135°C, Brookfield viscosity at 135°C and 165°C, flash point, solubility in trichlorethylene, storage stability, elastic recovery at 10°C and penetration at 25°C on residue after short-term curing (RTFOT-accelerated curing in thin films). The following Superpave protocol tests were conducted: beam bending resistance (BBR) and dynamic shear resistance (DSR) after short-term curing (RTFOT) and after long-term curing in a pressurized vessel (RTFOT + PAV).

Samples were taken from the mixing plant supply tank. Two samples of the 120-150 asphalt binder were analysed (one taken during the work done in 1998, the other from the work done in 1999), while one sample of PG 58-34 asphalt binder taken in 1999 was analyzed.

Tests were conducted on asphalt samples from cores samples collected on site after runway 06L-24R opened. At the time the cores were taken, the material had been in place for approximately 125 days.

The results of the analyses are summarized in Table 7 (conventional tests) and Table 8 (Superpave tests). Figure 2 shows the standing of the two binders in relation to the requirements of standard CAN/CGSB-16.3-M90.

Overall, the test results for the two binders were in line with their respective requirements. Regarding the modified PG58-34 asphalt binder, it should be noted that the slope of the bending test at -24°C on the residue after curing was 0.296, where a minimum of 0.300 is required. The Quebec Department of Transport has issued a directive on this subject because of the many instances of non-compliance, the effect of which is to tolerate such discrepancies. The slope for the same test on the asphalt taken from the runway pavement core samples was 0.305, which is satisfactory.

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The mass change in the 120-150 asphalt was slightly lower in the RTFOT test than the PG 58-34 asphalt (-0.20% for the 120-150 and -0.17% for the PG 58-34). The ratio between penetration after the RTFOT test and the original penetration was also slightly lower (54.3% 120-150 and 55.8% PG 58-34). The PG 58-34 asphalt is slightly softer and more viscous than the 120-150 asphalt, which makes it less susceptible to thermal contraction at low temperatures. Figure 3 shows the changes in the properties of the binders as a function of temperature. The curve represents the thermal susceptibility of the asphalt binder. The curve dips to lower viscosity levels at low temperatures for 120-150 grade asphalt binder. This results in a paraffin-rich asphalt, P grade under the Heukelom system, resulting in asphalt that is brittle at low temperatures because of paraffin crystallization. The curve for the PG 58-34 asphalt is more linear, which means that the asphalt is straight-run asphalt with little paraffin: D grade under the Heukelom system.

The PG 58-34 asphalt has better storage stability than the 120-150 asphalt. Variations of 0.3 to 0.6°C were measured between the upper and lower portions of the test cylinders of the PG 58-34, and of 1 to 2°C in the test cylinders of the 120-150.

Tests carried out on the asphalt core samples collected after 125 days had a penetration relatively close to the measured penetration after the RTFOT test of the asphalt in the tanks, particularly for the 120-150 asphalt. The PG 58-34 asphalt presented higher penetration after 125 days of curing. The ratio of penetration after 125 days of curing and the original penetration is 69.2% for the PG 58-34 and 54.9% for the 120-150. The tests show that the PG 58-34 asphalt performs better at low temperatures.

The results of the Superpave tests of the original asphalt mixes show that the complex modulus under dynamic shear is virtually the same for the two types of asphalt (1.2 kPa at 58°C). However, stiffness values were different. The PG 58-34 was less stiff than the 120-150 at the same test temperature (-24 °C, ten degrees lower than the design temperature). The results of the tests carried out after long-term curing in a pressurized vessel (RTFOT + PAV) produced the same result. This means that the PG 58-34 has a lower stiffness than the 120-150 at the same test temperature. Consequently, the PG 58-34 performs better at low temperatures than the 120-150.

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The results of the Superpave tests carried out on the asphalt taken from the cores collected after construction follow the same trend. At the test temperature of -24 °C, the stiffness of the PG 58-34 was lower and the slope higher. At high temperatures, the PG 58-34 was more viscous than the 120-150, as its phase angle was lower.

Comparison of the two test methods (conventional CGSB and Superpave) leads to the same conclusion : the PG 58-34 asphalt is less susceptible to thermal contraction than the 120-150 asphalt. However, the Superpave method makes it possible to directly measure the properties of asphalt at low temperatures, compared with conventional tests.

4.0 CONSTRUCTION OF TEST SECTION

The test section (built in 1999) is located between the stations 5+000 and 5+195 of runway 06L-24R, at full width adjacent to the holding bay and partly on the north side.

The characteristics of the base layer of this section are the same as those described above for the whole project.

4.1 Thermocouple Installation

A total of 17 thermocouples were installed in the runway at station 5+114.

Three 250 mm diameter holes were drilled into the pavement to install the thermocouples. The holes were drilled at the centre line, 10 and 20 metres offset from the right side.

Thermocouples were installed at depths of 20, 75, 125, 225 and 325 millimetres.

Two additional thermocouples were installed on the centre line at a depth of 20 and 75 millimetres beneath a painted line in order to compare the temperature of the bare pavement to the pavement temperature beneath the painted areas.

The thermocouples were routed under the runway in 50 millimetre PVC conduit, and access shafts were placed in various locations on the runway.

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The thermocouples were linked to the data collection station, installed by the FAA in cooperation with PWGSC. The station is located near the glide path on the south side of runway 06L-24R near runway 10-28.

The telephone line and power supply were installed in cooperation with NAV.CANADA, which manages glide path facilities.

A table indicating the numbers assigned to the thermocouples and figures 4A and 4B show the location is presented in Appendix 2. Photographs of the thermocouples are in Appendix 3.

5.0 CONCLUSION

The same mix design was chosen for the CGSB 120-150 and PG 58-34 asphalt mixes. In both cases, the mixes were placed and compacted without difficulty.

It must be remembered, however, that CGSB asphalt is not modified and that PG asphalt may be modified based on the temperature differential observed depending on the high and low design temperatures.

PG asphalt grades allows the designer to choose asphalt binder based on the performance which will be satisfactory with respect to the climatic conditions in the region.

Because the CGSB asphalt is not modified, it offers satisfactory performance in all regions with a maritime climate.

For regions with a harsh continental climate, where there is greater variation between hot and cold periods, the asphalt has to be modified to obtain satisfactory performance at extreme temperatures.

If the high-low temperature differential exceeds 90°C, the asphalt will have to be slightly modified. If the differential exceeds 100°C, it will have to be extensively modified.

A 'Group A' CGSB asphalt can compare with a PG asphalt with a temperature differential of 85°C and no additional cost is associated with that choice.

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The additional costs associated with a PG asphalt binders are related to a number of factors:

- The high-low temperature differential: the higher the temperature differential, the more costly the asphalt.
- Availability in the area and the quantities involved.

For the project at the Montreal International Airport, Dorval, the additional cost was \$8 per metric tonne of mix for the PG 58-34 asphalt in reference to the CGSB 120-150 asphalt.

With regard to application, highly modified asphalt has a higher viscosity. The asphalt mixes will be harder to compact in unfavourable weather conditions.

An effort should be made to avoid working in cold weather. Applying these materials in places that are difficult to reach or that require spreading by hand is usually very labour intensive.

As the compaction results show, similar compaction results can be expected if the usual precautions are taken during application.

Finally, we feel there are a number of points that should be given immediate consideration:

- The aprons, runways and taxiways are not subject to equal volumes of traffic. High- and low-temperature PG asphalt is suitable for general conditions and must be considered for the specific conditions of the project.
- The prescribed grading ranges match the lower limit of the SHRP restriction zones, which means it is impossible to formulate mixes below those zones.
- This is not a serious problem for mixes that contain natural sand, but is too limiting if crushed stone only is to be used.
- Sand patch tests should be prescribed in order to validate the roughness of the runway surfaces. Modified asphalt is shinier than conventional asphalt; it can give the impression, when viewed from a low angle, that the surface is slippery or shimmering.

We would like to thank PWGSC and Montreal Airports and their representatives who made this study possible and cooperated fully to ensure the success of this project.

We will report immediately any observations regarding the behaviour of the materials laid as part of this project.

Appendix I

Tables

**TABLE 1: ASPHALT MIX, 1999 COMPILATION
120-150 ASPHALT BASE LAYER**

Type of Mix	: Base	Formula No.	: 457-5	Our File	: 70840-500
Type of Asphalt	: Petro-Canada 120-150	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases I and II		
Accuracy Factor	: 0.14	Particle Density	: 2.706		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS							
				Screen in mm						Screen in µm									
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density	
																		Gross	Maximum
49	05	27	97.05 tonnes	100	95	76	73	59.5	37	14	8	4.6	4.59	3.4	13.8	13,210	3.1	2.444	2.529
50	05	27	715 tonnes	100	98	79	77	64.6	42	16	9	5.5	4.67	3.2	13.7	13,397	3.1	2.449	2.529
52	05	27	1,219.71 tonnes	100	97	82	79	65.4	41	15	8	4.9	4.70	3.5	14.1	13,795	3.1	2.438	2.526
55	05	28		100	99	80	76	64.2	40	15	8	5.0	4.69	3.8	14.4	14,490	3.2	2.429	2.525
56	05	28		100	100	81	78	64.5	40	15	8	5.1	4.84	3.6	14.4	13,671	3.1	2.433	2.525
57	05	28		100	98	80	75	62.6	42	17	10	5.5	4.74	3.7	14.2	14,692	3.0	2.437	2.531
58	05	28		100	96	82	80	66.6	42	16	9	5.3	4.87	2.3	13.7	13,643	2.8	2.454	2.513
59	05	28		100	98	79	76	61.3	37	14	8	4.9	4.60	3.4	13.6	14,330	2.8	2.448	2.535
63	05	30	4,235.06 tonnes	100	99	88	83	68.7	41	17	10	6.4	4.85	2.6	13.3	14,451	3.1	2.463	2.530
67	05	31	4,918 tonnes	100	97	84	82	67.6	43	17	10	6.0	4.85	2.8	13.7	13,201	3.6	2.453	2.524
68	05	31	5,428 tonnes	100	99	83	79	64.5	41	16	10	6.1	4.69	2.3	13.0	13,596	3.7	2.468	2.526
69	05	31	5,818 tonnes	100	99	84	82	68.2	42	16	9	5.6	4.85	2.3	13.5	13,615	3.3	2.460	2.519
70	05	31	6,428 tonnes	100	97	82	79	65.3	41	16	9	5.7	4.73	2.2	13.1	13,870	3.4	2.467	2.522
72	05	31	6,978 tonnes	100	98	80	77	62.4	39	15	9	5.0	4.59	3.2	13.8	12,985	3.0	2.443	2.523
73	05	31	7,211 tonnes	100	97	81	77	62.0	41	16	9	5.0	4.42	3.2	13.4	14,039	2.9	2.451	2.532
75	05	31	7,688 tonnes	100	98	84	81	64.8	40	15	9	5.1	4.66	3.4	13.8	13,794	3.2	2.446	2.532
76	05	31	8,044 tonnes	100	97	84	81	65.4	41	15	8	4.8	4.66	3.5	14.0	13,337	3.2	2.442	2.531
77	06	01		100	97	82	79	64.7	40	15	8	4.8	4.69	3.7	14.5	12,103	3.1	2.427	2.519
78	06	01		100	97	85	83	68.2	42	15	9	5.0	4.86	4.9	15.2	11,135	3.2	2.411	2.536
104	06	04	9,811 tonnes	100	98	78	76	63.1	40	15	9	5.0	4.21	5.3	14.6	11,434	3.0	2.410	2.546
106	06	04		100	97	82	79	64.7	41	16	9	5.2	4.95	2.4	14.1	13,075	3.1	2.447	2.508

Non-compliant result

**TABLE 1: ASPHALT MIX, 1999 COMPILATION
120-150 ASPHALT BASE LAYER**

Type of Mix	: Base	Formula No.	: 457-5	Our File	: 70840-500
Type of Asphalt	: Petro-Canada 120-150	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases I and II		
Accuracy Factor	: 0.14	Particle Density	: 2.706		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS							
				Screen in mm						Screen in µm									
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density	
																		Gross	Maximum
107	06	04		100	97	86	83	67.1	43	17	10	5.5	5.13	2.4	14.1	12,419	3.5	2.451	2.511
113	06	05	11,074 tonnes	100	94	77	74	61.2	40	16	9	5.1	4.75	3.0	13.9	12,658	3.1	2.446	2.523
114	06	05	11,574 tonnes	100	96	83	81	66.5	42	16	9	5.2	4.65	3.4	13.9	13,391	3.1	2.444	2.529
115	06	05	11,947 tonnes (1)										5.03						
116	06	05	12,198 tonnes	100	95	83	80	67.7	43	16	10	5.8	5.21	2.2	14.0	13,062	3.7	2.456	2.512
117	06	05	12,476 tonnes (1)										4.89						
118	06	05	12,762 tonnes	100	96	80	78	63.8	40	16	9	5.2	5.03	3.2	14.4	13,602	3.5	2.439	2.519
123	06	05	13,067 tonnes (1)										5.16						
124	06	05	13,266 tonnes	100	94	73	70	55.4	35	14	8	5.0	4.54	2.8	13.6	13,511	3.5	2.450	2.520
125	06	05	13,527 tonnes (1)										4.95						
126	06	05	13,790 tonnes	100	97	79	75	62.0	40	16	9	5.2	4.71	2.6	13.5	13,886	3.0	2.456	2.521
127	06	05	14,101 tonnes (1)										4.75						
128	06	05	14,343 tonnes	100	98	82	80	67.3	43	16	9	5.5	5.15	2.4	14.2	13,422	3.1	2.447	2.508
129	06	05	14,625 tonnes (1)										4.84						
138	06	06		100	96	79	75	60.6	38	16	10	6.4	5.30	1.6	13.7	11,276	4.1	2.466	2.505
139	06	06	(1)										4.70						
140	06	06		100	94	76	72	58.7	37	14	8	4.9	4.57	3.2	13.7	11,611	2.9	2.448	2.528
150	06	07	15,885 tonnes (1)										5.04						
151	06	07	16,115 tonnes	100	98	88	87	71.6	44	16	9	5.7	5.20	2.6	14.3	12,796	2.9	2.447	2.513
152	06	07	16,459 tonnes (1)										4.67						
153	06	07	16,661 tonnes	100	99	83	79	63.9	40	15	9	5.4	4.85	3.4	14.1	13,050	2.9	2.444	2.531

Non-compliant result

**TABLE 1: ASPHALT MIX, 1999 COMPILATION
120-150 ASPHALT BASE LAYER**

Type of Mix	: Base	Formula No.	: 457-5	Our File	: 70840-500
Type of Asphalt	: Petro-Canada 120-150	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases I and II		
Accuracy Factor	: 0.14	Particle Density	: 2.706		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS								
				Screen in mm						Screen in µm										
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density		
																		Gross	Maximum	
154	06	07	16,951 tonnes (1)										4.66							
155	06	07	17,199 tonnes	100	97	78	75	58.7	36	14	8	4.6	4.49	4.2	14.2	11,649	2.7	2.430	2.535	
168	06	09	17,494 tonnes (1)										4.98							
169	06	09	17,763 tonnes	100	99	82	81	65.9	42	16	9	5.4	4.83	2.6	13.6	14,694	3.0	2.457	2.524	
170	06	09	18,002 tonnes (1)										4.71							
171	06	09	18,239 tonnes	100	99	85	82	68.6	43	16	9	5.1	4.89	3.1	14.1	14,739	2.9	2.445	2.524	
172	06	09	18,498 tonnes (1)										4.73							
173	06	09	18,673 tonnes	100	95	80	77	63.3	40	16	9	5.1	4.66	2.3	13.1	14,476	2.7	2.467	2.525	
Phase 3																				
195	07	03	5+570 strip 1 left	100	97	83	81	68.0	45	17	9	4.9	4.94	2.9	14.2	13,098	3.3	2.439	2.511	
196	07	03	5+480 strip 5 left	100	99	85	82	66.2	43	17	9	5.1	4.98	3.1	14.1	13,602	2.9	2.442	2.522	
197	07	03	5+500 strip 3 right	100	98	85	84	70.4	45	17	9	4.9	5.21	3.2	14.5	13,565	2.8	2.437	2.516	
200	07	04	5+480 strip 6 right	100	99	86	84	69.8	46	18	10	5.2	5.16	3.2	14.3	12,762	3.3	2.441	2.521	
201	07	04	5+080 strip 4 left	100	98	83	80	66.3	43	17	9	5.1	4.96	3.2	14.1	14,158	3.2	2.441	2.521	
213	07	05	5+420 strip 6 left	100	94	71	65	55.6	37	15	8	4.7	4.57	4.1	14.2	11,963	3.1	2.428	2.531	
214	07	05	5+300 strip 5 left (1)										4.42							
215	07	05	5+250 strip 6 left (1)										4.92							
216	07	07	5+000 at 5 m l. C.L.	100	98	84	81	67.4	43	16	9	4.6	4.74	4.6	15.1	12,283	2.7	2.410	2.527	
217	07	07	5+440 strip 5 right	100	99	87	84	70.3	46	17	9	5.0	4.92	4.1	15.2	12,376	3.0	2.415	2.517	
225	07	09	5+425 centre line	100	94	85	84	70.9	45	17	9	5.5	5.01	3.1	14.3	13,056	2.9	2.441	2.519	
226	07	09	5+340 strip 4 right	100	97	75	72	58.0	38	15	8	4.9	4.40	3.8	13.5	14,692	2.9	2.448	2.544	

Non-compliant result

**TABLE 1: ASPHALT MIX, 1999 COMPILATION
120-150 ASPHALT BASE LAYER**

Type of Mix	: Base	Formula No.	: 457-5	Our File	: 70840-500
Type of Asphalt	: Petro-Canada 120-150	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases I and II		
Accuracy Factor	: 0.14	Particle Density	: 2.706		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS							
				Screen in mm						Screen in µm									
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density	
																		Gross	Maximum
227	07	09	5+305 strip 2 left	100	98	80	78	62.7	40	15	8	4.9	4.52	3.8	14.1	13,914	3.0	2.436	2.532
228	07	11	5+410 strip 4 left	100	94	77	75	62.9	42	16	9	4.6	4.63	3.1	13.6	14,226	3.1	2.452	2.530
231	07	12	5+260 strip 6 right	100	95	74	71	58.6	38	15	8	4.7	4.60	3.1	13.9	14,201	2.9	2.443	2.522
251	07	14	4+990 at 15 m C.L.	100	97	81	78	64.8	43	16	9	5.1	4.91	3.0	14.2	13,398	3.4	2.442	2.519
Average				100	97	81	78	64.6	41	16	9	5.2	4.79	3.1	14.0	13,322	3.1	2.444	2.524
Formula				100		82		65.0	42	15	9	5.3	4.80	4.0	14.0	13,000	3.0	2.440	2.529
Measured deviation (Ef/m)				0		1		0.4	1	1	0	0.1	0.01	0.9	0.0	322	0.1	0.001	0.005
Allowable deviation						5		5	4	3	2	1	0.25						
REQUIREMENTS			Minimum	100		70		40	30	15	5	3	4.8	2	13	9.0	2		
- BASE -			Maximum			85		65	50	30	20	8		4			4		
Comments: Sample 104 – result is average of two tests (4.12 and 4.30%). Sample 213 – result is average of two tests (4.33 and 4.81%). (1) Additional sample taken at approximately 250 tonnes. Repeated asphalt content tests were not taken into account in calculating the average asphalt content of output.																			
Prepared by: Marie Bellemare, ing.				Date: 99-08-23				Approved by: Marie Bellemare, ing.				Date: 99-08-23							

Non-compliant result

**TABLE 2: ASPHALT MIX, 1999 COMPILATION
120-150 ASPHALT SURFACE LAYER**

Type of Mix	: Surface	Formula No.	: 458-11b	Our File	: 70840-500
Type of Asphalt	: Petro-Canada 120-150	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases II and III		
Accuracy Factor	: 0.14	Particle Density	: 2.704		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS								
				Screen in mm						Screen in µm										
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density		
																			Gross	Maximum
62	05	30	154.2 tonnes			100	93	65.0	42	16	9	4.9	5.41	2.6	14.9	11,980	3.1	2.432	2.498	
64	05	30	662.64 tonnes			100	93	62.2	39	15	9	5.2	5.19	2.6	14.4	12,923	2.9	2.441	2.507	
65	05	30	1,205.11 tonnes			100	93	61.0	38	15	8	5.1	5.19	2.3	14.1	13,274	3.2	2.448	2.506	
105	06	04	1,639 tonnes			100	92	62.3	40	15	8	4.3	5.31	2.9	14.9	12,070	3.2	2.430	2.503	
131	06	06	2,111.33 tonnes										5.74							
132	06	06	2,256.33 tonnes			100	94	64.2	40	15	8	5.0	5.73	2.2	15.4	11,352	3.1	2.427	2.483	
133	06	06											5.80							
134	06	06				100	94	65.9	40	14	8	4.6	5.94	1.7	15.3	11,419	3.2	2.436	2.479	
135	06	06											4.89							
136	06	06				100	93	64.1	38	13	7	4.2	5.65	3.4	16.1	10,171	2.7	2.404	2.488	
137	06	06											5.55							
141	06	07	3,898 tonnes			100	95	64.2	39	14	8	4.5	5.65	2.8	15.5	11,755	3.4	2.421	2.490	
142	06	07	4,205 tonnes										5.35							
143	06	07	4,459 tonnes			100	93	61.5	38	14	8	4.4	5.56	2.6	15.2	12,248	3.2	2.427	2.493	
144	06	07	4,718 tonnes										5.60							
145	06	07	4,984 tonnes			100	96	65.5	39	13	7	4.4	5.63	2.8	15.4	12,165	3.5	2.424	2.494	
146	06	07	5,251 tonnes										5.72							
147	06	07	5,439 tonnes			100	95	64.5	39	14	8	4.5	5.65	2.6	15.3	11,835	3.3	2.426	2.490	
156	06	08	5,900 tonnes			100	94	64.5	39	14	8	4.4	5.59	3.9	16.4	9,556	2.7	2.394	2.491	
157	06	08	6,453 tonnes			100	94	63.5	41	17	9	4.8	5.48	2.6	15.0	11,779	3.4	2.431	2.496	
158	06	08	6,800 tonnes			100	95	64.6	43	17	9	5.2	5.47	2.9	15.3	10,915	3.4	2.422	2.496	

Non-compliant result

**TABLE 2: ASPHALT MIX, 1999 COMPILATION
120-150 ASPHALT SURFACE LAYER**

Type of Mix	: Surface	Formula No.	: 458-11b	Our File	: 70840-500
Type of Asphalt	: Petro-Canada 120-150	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases II and III		
Accuracy Factor	: 0.14	Particle Density	: 2.704		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS							
				Screen in mm						Screen in µm									
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density	
																		Gross	Maximum
159	06	08	7,212 tonnes										5.46						
160	06	08	5,695 tonnes										5.46						
161	06	08	6,148 tonnes										5.65						
162	06	08	6,582 tonnes										5.58						
163	06	09	7,450 tonnes			100	96	64.7	39	14	8	4.4	5.70	4.3	16.8	9,414	2.8	2.387	2.493
164	06	09	7,665 tonnes										5.60						
165	06	09	7,930 tonnes			100	94	62.9	41	16	9	4.9	5.61	1.8	14.8	13,142	3.3	2.440	2.485
166	06	09	8,182 tonnes										5.50						
167	06	09	8,372 tonnes			100	96	68.6	44	16	9	4.8	5.71	2.4	15.4	12,600	3.2	2.427	2.487
174	06	10	8,652 tonnes										5.64						
175	06	10	8,892 tonnes			100	96	68.7	44	16	8	4.4	5.56	3.6	16.0	11,436	2.8	2.406	2.495
176	06	10	9,354 tonnes			100	95	66.1	41	15	8	4.4	5.50	2.8	15.5	12,316	3.1	2.419	2.488
177	06	10	9,873 tonnes			100	97	69.0	43	16	9	4.8	5.75	2.6	15.4	12,265	3.2	2.426	2.491
178	06	10	10,476 tonnes			100	95	66.2	41	15	8	4.6	5.61	2.7	15.3	11,400	3.2	2.427	2.495
179	06	11				100	96	67.0	44	16	9	5.0	5.68	2.8	15.5	11,463	2.8	2.422	2.491
180	06	11				100	95	69.1	43	16	8	4.8	5.62	2.5	15.2	12,736	3.1	2.429	2.490
181	06	11	11,940 tonnes			100	94	64.6	40	15	8	4.7	5.33	3.2	15.3	11,983	2.8	2.420	2.499
182	06	11	12,341 tonnes			100	95	66.5	41	15	8	5.0	5.49	3.5	15.9	10,586	3.0	2.407	2.496
183	06	11	12,938 tonnes			100	95	64.0	40	15	8	4.6	5.48	3.5	15.7	11,362	2.8	2.412	2.500
184	06	12				100	95	68.3	45	17	9	5.1	5.67	2.4	15.3	11,235	3.3	2.429	2.490

Non-compliant result

**TABLE 2: ASPHALT MIX, 1999 COMPILATION
120-150 ASPHALT SURFACE LAYER**

Type of Mix	: Surface	Formula No.	: 458-11b	Our File	: 70840-500
Type of Asphalt	: Petro-Canada 120-150	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases II and III		
Accuracy Factor	: 0.14	Particle Density	: 2.704		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS							
				Screen in mm						Screen in µm									
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density	
																		Gross	Maximum
Phase 3																			
202	07	04	5+600 strip 1 left			100	95	66.3	42	15	8	4.4	5.89	2.1	15.3	11,797	3.2	2.429	2.482
203	07	04	5+590 strip 7 left			100	95	62.3	40	15	8	4.8	5.72	3.4	15.8	11,956	3.0	2.411	2.495
212	07	05	5+520 strip 6 right			100	96	65.6	42	15	8	4.5	5.68	2.8	15.6	10,783	3.3	2.419	2.489
229	07	11	5+330 strip 2 right			100	91	63.7	40	14	7	4.1	5.14	3.9	15.4	13,247	3.0	2.408	2.507
230	07	11	5+390 strip 3 right			100	92	59.0	39	15	8	4.4	5.35	2.5	14.5	13,200	3.5	2.440	2.502
246	07	13	5+230 centre (1)										5.54						
247	07	13	5+230 centre (1)										5.36						
248	07	13	5+320 centre (1)										5.26						
249	07	13	5+320 centre (1)										5.02						
253	07	14	5+400 centre (1)										5.25						
254	07	14	5+445 strip 2 right (1)										5.37						
255	07	14	5+300 strip 2 right (1)										5.20						
256	07	14	5+210 strip 2 g. (1)										5.45						
257	07	14	5+300 strip 2 g. (1)										5.05						
258	07	14	5+240 strip 3 g. (1)										5.29						
232	07	12	5+300 strip 5 left			100	94	65.6	44	16	9	5.2	5.52	2.7	15.1	13,036	3.2	2.430	2.499
233	07	12	5+390 strip 8 left			100	95	66.9	43	15	8	4.5	5.57	2.7	15.4	12,252	3.0	2.421	2.489
237	07	13	5+220 strip 5 right			100	91	62.3	43	15	8	4.4	5.47	2.4	15.1	12,612	3.0	2.428	2.488
238	07	13	5+360 strip 7 right			100	91	59.1	40	15	8	4.4	5.41	3.3	15.4	11,696	3.3	2.419	2.501

Non-compliant result

**TABLE 2: ASPHALT MIX, 1999 COMPILATION
120-150 ASPHALT SURFACE LAYER**

Type of Mix	: Surface	Formula No.	: 458-11b	Our File	: 70840-500
Type of Asphalt	: Petro-Canada 120-150	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases II and III		
Accuracy Factor	: 0.14	Particle Density	: 2.704		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS							
				Screen in mm						Screen in µm									
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density	
																		Gross	Maximum
252	07	14	18,924 tonnes			100	90	59.0	40	15	8	4.2	5.30	3.8	15.7	10,708	3.1	2.407	2.501
259	07	15	Holding area east			100	92	62.8	42	15	8	4.7	5.39	3.2	15.4	12,237	3.0	2.419	2.499
260	07	15	4+980 5 m right C.L.			100	92	63.4	42	15	8	4.2	5.47	2.6	15.0	13,134	3.0	2.432	2.496
262	07	16	307 tonnes day			100	90	57.0	34	14	8	4.3	5.28	2.7	14.8	13,589	3.3	2.432	2.499
Average						100	94	64.0	41	15	8	4.6	5.53	2.9	15.3	11,891	3.1	2.423	2.494
Formula						100		65.0	42	15	8	4.5	5.60	3.0	16.0	12,000	3.0	2.410	2.497
Measured deviation (Ef/m)						0		1.0	1	0	0	0.1	0.07	0.1	0.7	109	0.1	0.013	0.003
Allowable deviation								5	4	3	2	1	0.25						
REQUIREMENTS - surface -			Minimum			100		55	35	15	5	3	5.6	2	13	9.0	2		
			Maximum					75	55	30	20	8		4				4	

Comments:

Sample 135 – result is average of two tests (4.91 and 4.87%). Two samples comprising two cores were taken in the area where this material was laid and the asphalt content of the mix was determined (6+120 and 6+300 strip 3 right). The results are 5.48% and 5.32% respectively.

Samples 229 and 230 – asphalt content result is average of two tests (5.12 and 5.14 for 229; 5.27 and 5.43 for 230). Asphalt content was also determined for additional samples taken at 250 tonnes): the results were 5.16% and 5.47%.

(1) : Test conducted using a core sample.

Repeated asphalt content tests were not taken into account in calculating the average asphalt content of output.

Prepared by:	Marie Bellemare, ing.	Date:	99-07-27	Approved by:	Marie Bellemare, ing.	Date	99-07-27
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Non-compliant result

**TABLE 3: ASPHALT MIX, 1999 COMPILATION
PG 58-34 ASPHALT BASE LAYER**

Type of Mix	: Base	Formula No.	: 457-5	Our File	: 70840-500
Type of Asphalt	: PG 58-34	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases II and III		
Accuracy Factor	: 0.10 (estimated)	Particle Density	: 2.706		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS							
				Screen in mm							Screen in µm								
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density	
																		Gross	Maximum
218	07	07	5+175 strip 1 right	100	99	89	86	73.2	48	17	9	5.3	4.93	3.7	14.6	12,967	2.9	2.430	2,522
219	07	07	5+080 strip 4 right	100	97	86	83	71.5	45	17	9	5.4	4.84	3.7	14.6	13,267	2.9	2.428	2,521
220	07	07	5+160 strip 6 right	100	94	82	80	67.1	44	17	10	5.3	4.83	3.5	14.3	13,404	3.1	2.437	2,525
221	07	08	5+145 strip 3 left	100	94	77	74	62.1	41	16	10	5.6	4.63	3.1	13.2	14,729	3.1	2.463	2,542
Average				100	96	84	81	68.5	44	17	10	5.4	4.81	3.5	14.2	13,592	3.0	2.440	2,528
Formula				100		82		65.0	42	15	9	5.3	4.80	4.0	14.0	13,000	3.0	2.440	2,529
Measured deviation (Ef/m)				0		2		3.5	2	2	1	0.1	0.01	0.5	0.2	592	0	0	0.001
Allowable deviation						5		5	4	3	2	1	0.25						
REQUIREMENTS			Minimum	100		70		40	30	15	5	3	4.8	2	13	9.0	2		
- BASE -			Maximum			85		65	50	30	20	8		4			4		

Comments:

Prepared by: Marie Bellemare, ing.	Date: 99-08-23	Approved by: Marie Bellemare, ing.	Date: 99-08-23
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**TABLE 4: ASPHALT MIX, 1999 COMPILATION
PG 58-34 ASPHALT SURFACE LAYER**

Type of Mix	: Surface	Formula No.	: 458-11b	Our File	: 70840-500
Type of Asphalt	: PG 58-34	Plant No.	: 116	Your File	: ADM-D736
Supplier	: DJL (mobile plant)	Project	: Rehabilitation of runway 06L-24R		
Contractor	: Construction DJL inc.	Location	: Dorval Airport, phases II and III		
Accuracy Factor	: 0.10 (estimated)	Particle Density	: 2.704		

SAMPLE				PARTICLE SIZE DISTRIBUTION								CHARACTERISTICS							
				Screen in mm						Screen in µm									
Lab No.	M	D	Location	25	19	12.5	9.5	4.75	2.00	0.425	0.180	0.075	Asphalt %	Voids %	VAM %	Stability N	Flow mm	Density	
																		Gross	Maximum
222	07	08	5+185 strip 2 right			100	93	62.5	41	16	9	4.9	5.32	2.1	14.3	11,530	3.4	2,447	2,500
223	07	09	5+190 strip 7 right			100	96	67.4	44	17	9	4.9	5.86	1.6	14.9	9,778	4.3	2,444	2,484
224	07	09	5+210 L.C. (2)			100	90	58.8	38	14	8	4.1	5.20	4.0	15.6	11,423	3.0	2,408	2,508
236	07	12	5+180 strip 2 left (1)										5.41						
239	07	12	5+150 strip 3 left (1)										5.38						
240	07	12	5+120 strip 2 left (1)										5.47						
241	07	12	5+060 strip 3 left (1)										5.45						
250	07	14	5+000 strip 2 right			100	92	60.0	41	16	9	4.7	5.32	2.7	15.0	11,711	3.3	2,429	2,497
Average						100	93	62.2	41	16	9	4.6	5.43	2.6	15.0	11,111	3.5	2,432	2,497
Formula						100		65.0	42	15	8	4.5	5.60	3.0	16.0	12,000	3.0	2,410	2,497
Measured deviation (Ef/m)						0		2.8	1	1	1	0.1	0.23	0.4	1.0	889	0.5	0.022	0
Allowable deviation								5	4	3	2	1	0.25						
REQUIREMENTS			Minimum			100		55	35	15	5	3	5.6	2	13	9.0	2		
- surface -			Maximum					75	55	30	20	8		4			4		

Comments:

(1) : Test conducted using a core sample.
(2) : Mix laid as base layer

Prepared by: Marie Bellemare, ing.	Date: 99-08-23	Approved by: Marie Bellemare, ing.	Date: 99-08-23
---	-----------------------	---	-----------------------

Non-compliant result

**TABLE 5: ASPHALT MIXES – 1999 COMPILATION
COMPACTNESS – BASE LAYER**

PLANT: DJL (116)

FORMULA: 457-5

Laboratory No.	Date laid	Core density	Gross Marshall density	Thickness (mm)	Compactness (%)
PG 58-34 ASPHALT					
44	99-07-07	2.444	2.432	84.5	100.5
45	99-07-07	2.451	2.432	80.0	100.8
46	99-07-07	2.457	2.432	80.2	101.0
47	99-07-07	2.449	2.432	80.5	100.7
57	99-07-08	2.462	2.463	80.0	99.9
58	99-07-08	2.421	2.463	80.7	98.3
59	99-07-08	2.457	2.463	89.5	99.8
60	99-07-08	2.398	2.463	81.8	97.4
120-150 ASPHALT					
6	99-05-27	2.425	2.444	80.0	99.2
17	99-05-27	2.464	2.444	81.5	100.8
18	99-05-27	2.381	2.444	88.0	97.4
19	99-05-28	2.433	2.440	90.0	99.7
20	99-05-28	2.414	2.440	80.0	98.9
21	99-05-28	2.399	2.440	92.0	98.3
22	99-05-28	2.404	2.440	95.0	98.5
23	99-05-28	2.438	2.440	75.0	99.9
24	99-05-30	2.431	2.464	75.0	98.7
25	99-05-31	2.426	2.458	75.0	98.7
26	99-05-31	2.409	2.458	70.0	98.0
27	99-05-31	2.461	2.458	65.0	100.1
28	99-05-31	2.461	2.458	75.0	100.1
29	99-05-31	2.448	2.458	80.0	99.6
30	99-05-31	2.452	2.446	75.0	100.3
31	99-05-31	2.477	2.446	85.0	101.3
32	99-05-31	2.451	2.446	85.0	100.2
33	99-06-01	2.428	2.419	80.0	100.4
34	99-06-01	2.408	2.419	67.0	99.5
77	99-06-05	2.465	2.446	89.7	100.8
78	99-06-05	2.459	2.446	80.0	100.5
79	99-06-05	2.458	2.446	85.0	100.5
80	99-06-05	2.406	2.446	89.3	98.4
81	99-07-03	2.442	2.439	89.7	100.1
82	99-07-03	2.447	2.439	90.2	100.3
83	99-07-03	2.418	2.439	85.0	99.2

**TABLE 6: ASPHALT MIXES – 1999 COMPILATION
COMPACTNESS – SURFACE LAYER**

PLANT: DJL (116)

FORMULA : 458-11b

Laboratory No.	Date laid	Core density	Gross Marshall density	Thickness (mm)	Compactness (%)
PG 58-34 ASPHALT					
40	99-07-08	2.378	2.447	60.3	97.2
41	99-07-08	2.382	2.447	60.0	97.3
42	99-07-08	2.362	2.447	53.0	96.5
43	99-07-08	2.390	2.447	55.0	97.7
53	99-07-09	2.409	2.408	55.3	100.1
54	99-07-09	2.402	2.408	60.0	99.8
55	99-07-09	2.312	2.408	54.3	96.0
56	99-07-09	2.389	2.408	55.7	99.2
120-150 ASPHALT					
48	99-05-30	2.362	2.440	43.0	96.8
49	99-05-30	2.432	2.440	50.7	99.7
50	99-05-30	2.405	2.440	54.3	98.6
51	99-05-30	2.380	2.440	52.8	97.6
52	99-05-30	2.354	2.440	50.0	96.5
70	99-06-06	2.383	2.404	46.8	99.1
71	99-06-06	2.374	2.404	55.5	98.8
72	99-06-07	2.371	2.426	50.5	97.8
73	99-06-07	2.391	2.426	51.5	98.6
74	99-07-04	2.395	2.420	60.0	99.0
75	99-07-04	2.406	2.420	56.5	99.4
76	99-07-04	2.374	2.420	59.5	98.1
62	99-07-11	2.391	2.424	59.5	98.6
63	99-07-11	2.410	2.424	55.2	99.4
64	99-07-11	2.381	2.424	52.5	98.2
65	99-07-11	2.360	2.424	52.0	97.4

TABLE 7
CONVENTIONAL ASPHALT TESTS

TESTS \ ASPHALT	Original 120-150 A	Recycled 120-150 A	Original PG 58-34	Recycled PG 58-34
Penetration at 25°C (X0.1 mm) (ASTM D 5)	122 * 138 **	67	156	108
Kinematic viscosity at 135°C (mm ² /s) (ASTM D 2170)	295.5 * 270.7 **	467.8	370.1	612.5
Brookfield viscosity at 135°C (Pa.s) (AASHTO TP 48)	0.28 * 0.25 **	0.42	0.32	0.54
Brookfield viscosity at 165°C (Pa.s) (AASHTO TP 48)	0.08 * 0.08 **	0.11	0.10	0.15
Absolute viscosity at 60°C	51.2	117.6	373.6	359.3
Flash point (°C) (ASTM D 92)	306 * 278 **	292	270	278
Solubility in trichlorethylene (%) (ASTM D 2042)	100.0 * 100.0 **	100.0	99.91	99.6
Storage stability (°C) (LC 25-003)	2.0 * 1.0 **	0.2	0.3	0.8
Elastic recovery at 10°C (%) (LC 25-005)	--- * 10 **	0	53	0
Penetration at 25°C of residue after RTFOT (X0.1 mm) (ASTM 05)	--- * 75 **	--	87	---

* 1999 work

** 1998 work

TABLE 8
SUPERPAVE ASPHALT TESTS

Asphalt	Original asphalt					Tests after RTFOT (or recycled asphalt)			PAV curing		
	DSR G*/Sin (δ) (kPa)	Temp. (°C)	BBR (Sc) (MPa)	Temp. (°C)	Slope (mc)	DSR G*/Sin (δ) (kPa)	Temp. (°C)	Change in mass (%)	BBR (S) (MPa)	Temp. (°C)	Slope (m)
120-150 A	1.2	58	72.2	-18	0.444				160.0	-18	0.296
*	0.6	64							316.5	-24	0.272
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
**	1.2	58	212.6	-24	0.375	2.7	58	-0.20	120.0	-18	0.329
	0.5	64							305.4	-24	0.282
Recycled 120- 150 A	---	---	---	---	---	3.5 (δ = 79.7)	58	---	134.0	-18	0.309
						1.6 (δ = 82.4)	64	---	337.0	-24	0.264
Original PG 58-34	1.2	58	147.5	-24	0.396	2.7	58	-0.17	245.5	-24	0.296
	0.6	64							502.0	-30	0.248
Recycled PG 58-34	---	---	---	---	---	3.0 (δ = 75.0)	58	---	242.5	-24	0.305
						1.5 (δ = 77.3)	64	---	505.5	-30	0.248
Requirements (original asphalt)	≥ 1.0	---	---	---	≥ 0.350	≥ 2.2	---	---	≤ 300	---	≥ 0.300

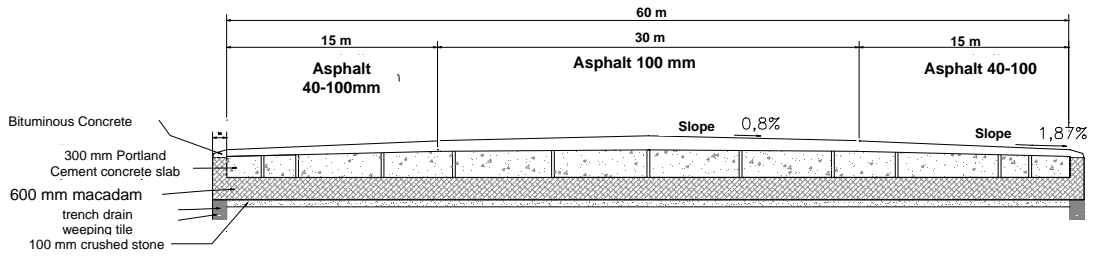
* 1999 work

** 1998 work

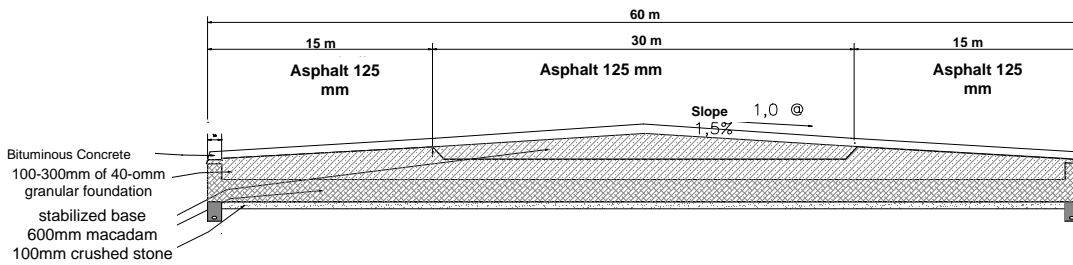
Appendix II

Figures

**Figure 1a: Typical Cross Section - Runway 06L-24R
(1200 m from approach end 24R)**



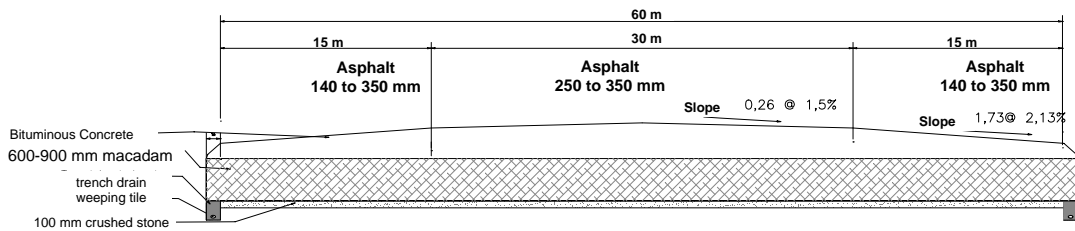
Existing



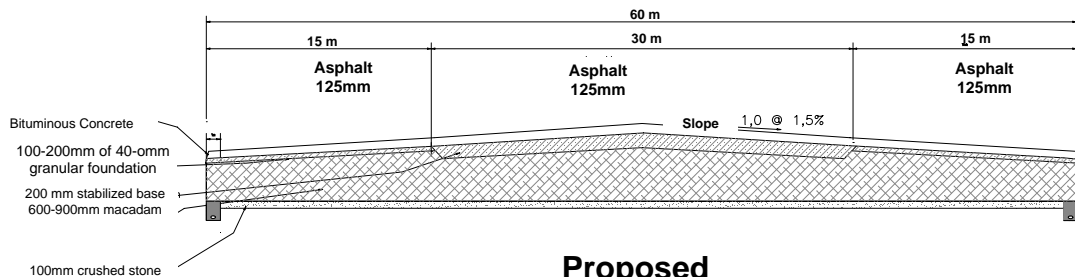
Proposed

New flexible surface with stabilized base

**Figure 1b: Typical Cross Section - Runway 06L-24R
(2153 m from approach end 06L)**



Existing



Proposed

New flexible surface with stabilized base

FIGURE 2: Kinematic viscosity as a function of penetration

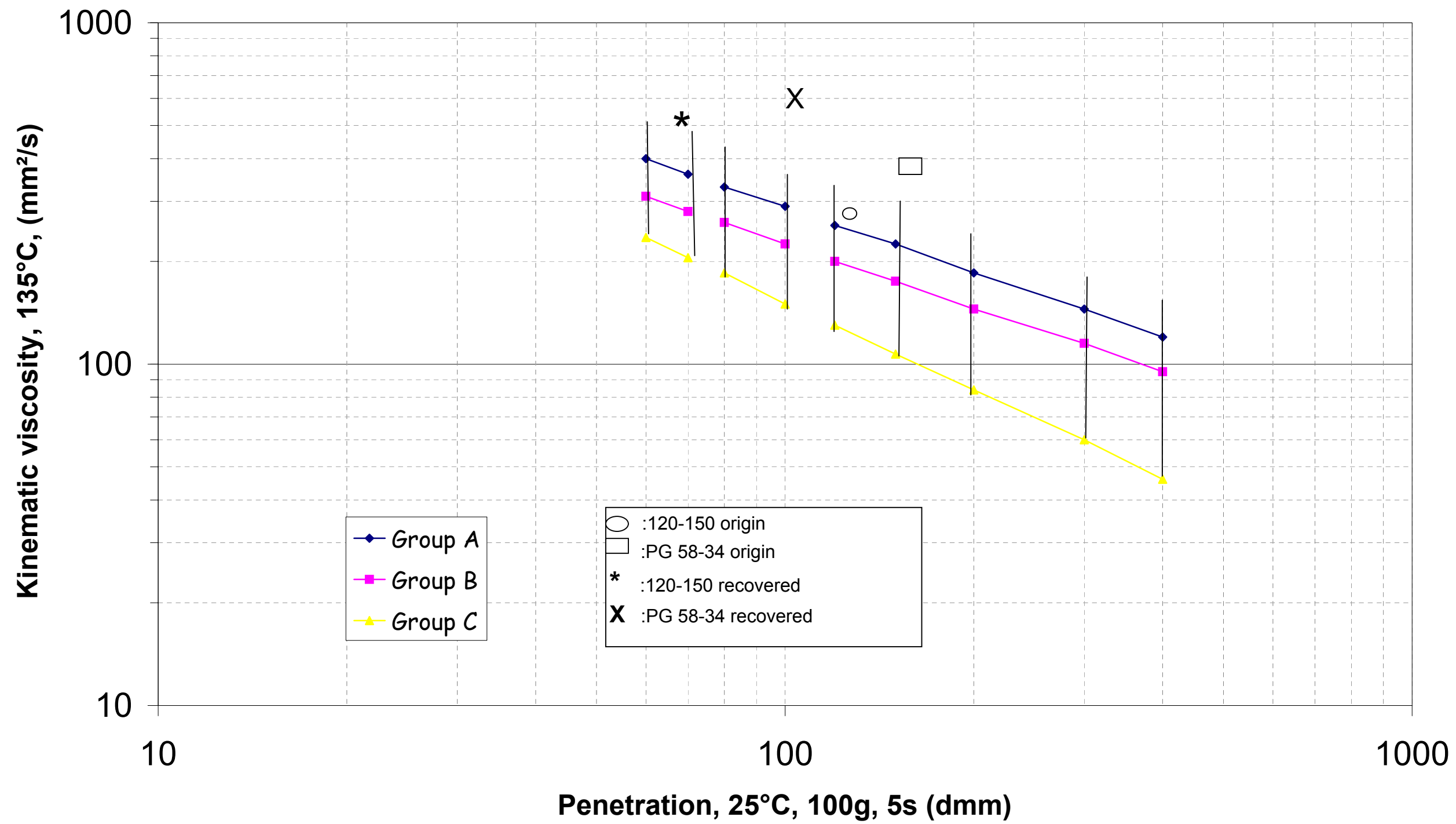
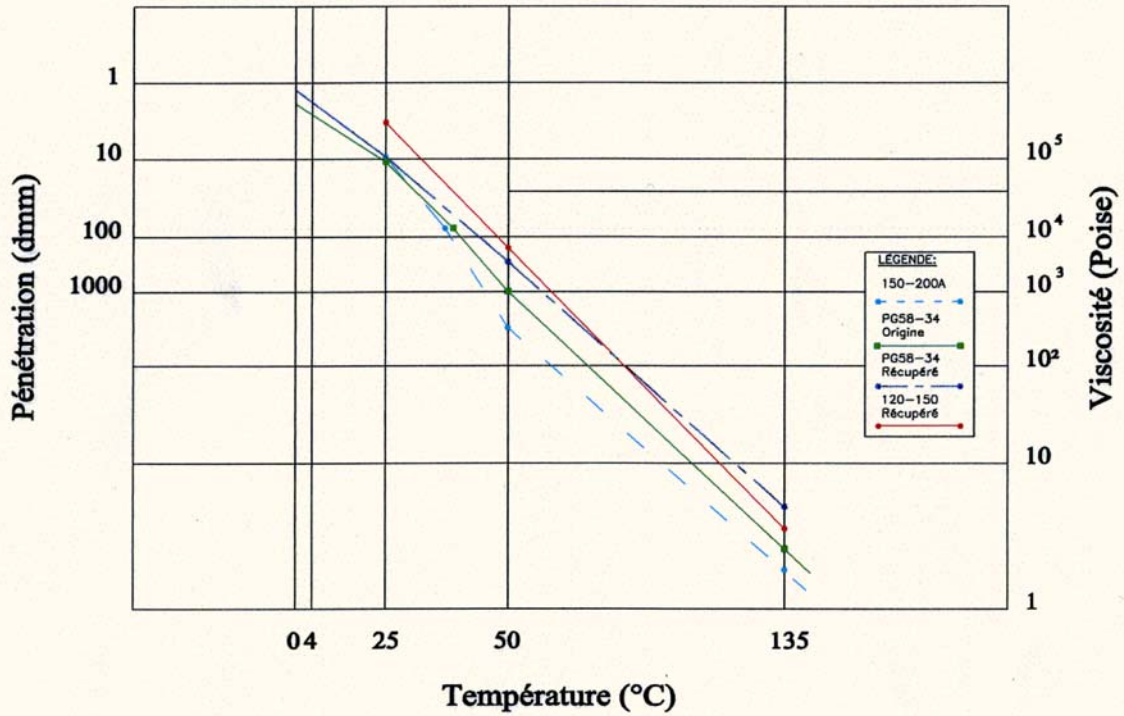


Figure 3: Chart depicting the behaviour of asphalt binders with respect to temperature, as per Heukelom



Projet

Asphalt Binder Behaviour

Titre

ABAQUE



**DESSAU
SOPRIN**

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Dessiné J. Juteau	Échelle Aucune	Extrait de: Rév.:	
Vérifié M. Bellemare	Date 2006-11-06		

Projet	Lot	Disc.	No. Dessin
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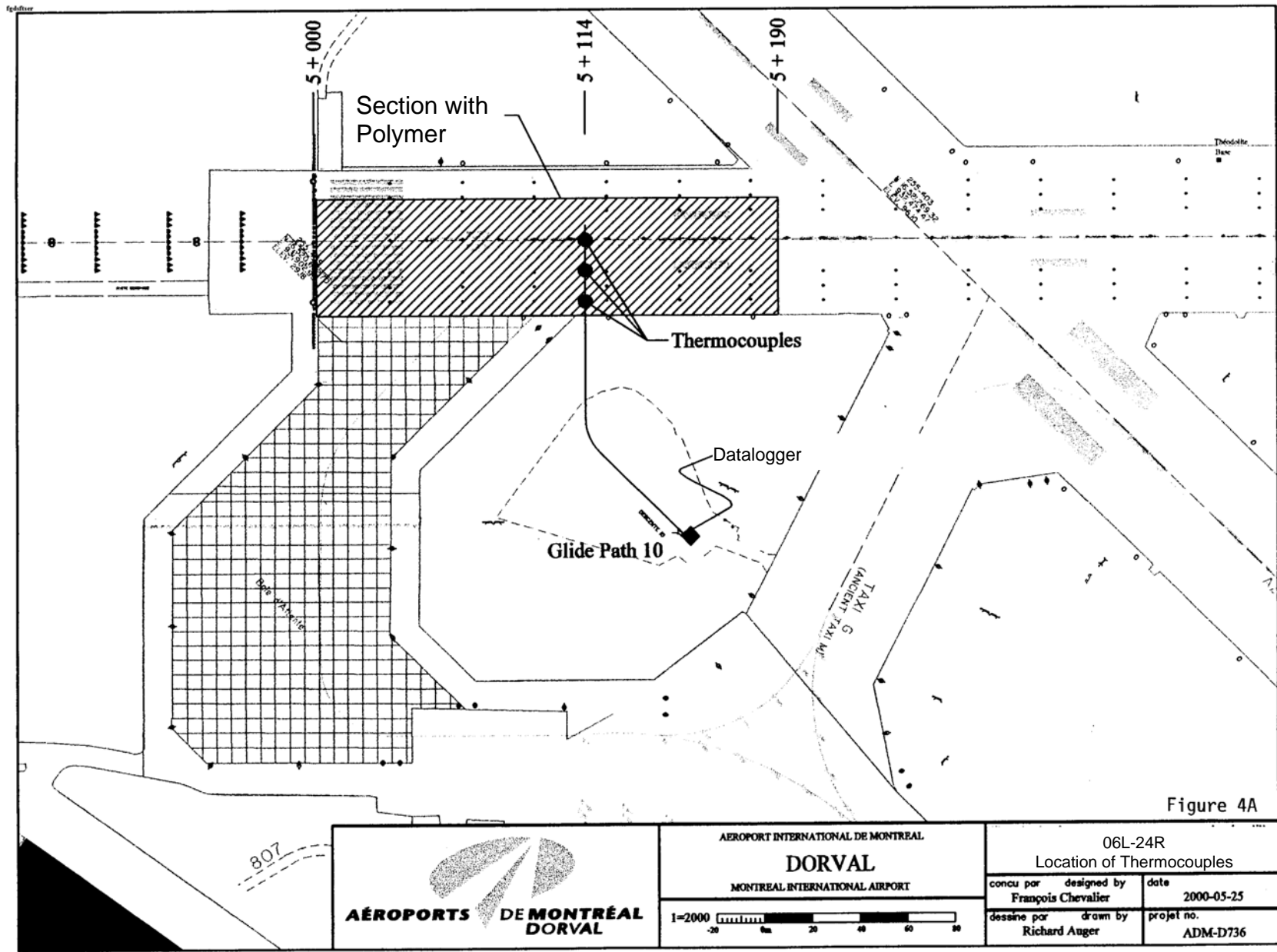
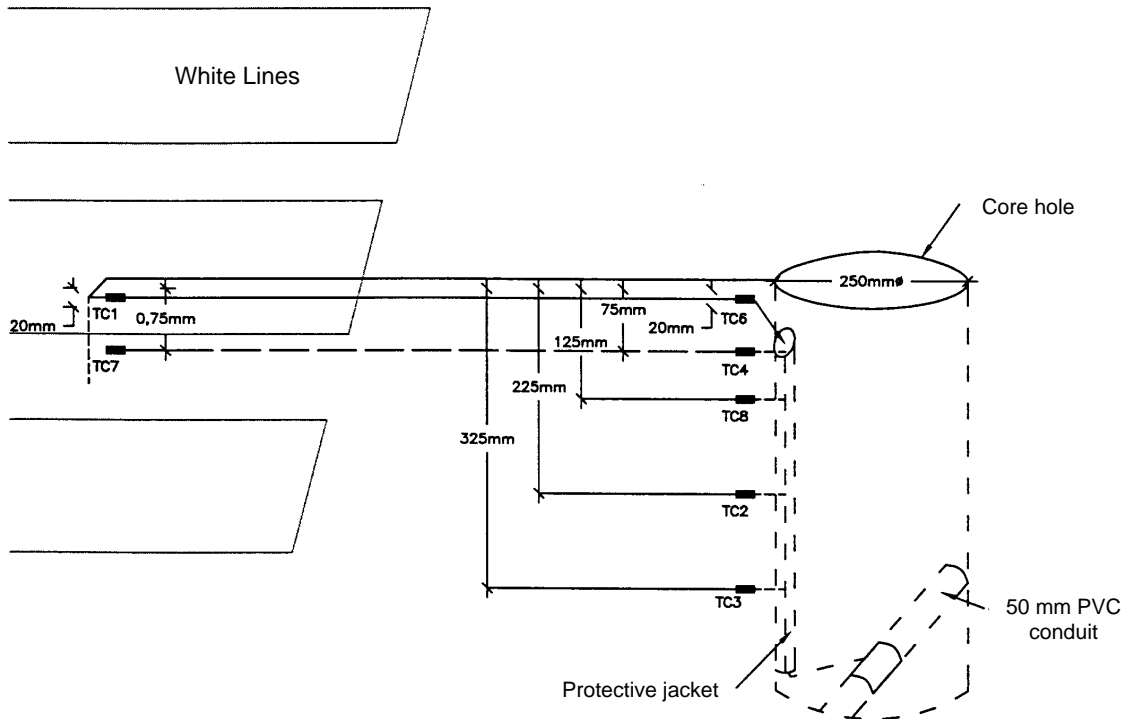


Figure 4B Cross Section - Thermocouples Runway Centre Lines



Projet

Sketch

Titre

Figure 4B Cross Section - Thermocouples Runway Centre Lines

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Vérifié M. Bellemare	Date 2000-11-06	

Projet	Lot	Diac.	No. Dessin	Rév.
0070840505	IM	0001	10	A

IDENTIFICATION OF THERMOCOUPLES

Depth in millimetres	20 mm	75 mm	125 mm	225 mm	325 mm
Position					
Centre line	TC 6	TC 4	TC 8	TC 2	TC 3
10 metres right	TC 11	TC 12	TC 10	TC 13	TC 9
20 metres right	TC 5	TC 14	TC 16	TC 15	TC 17

NOTES:

TC 1: 20 millimetres under paint

TC 2: 75 millimetres under paint

See figures 4A and 4B for location.

Appendix III

Photographs

Dorval Airport PG Binder Test Section - Construction Report

THERMOCOUPLE INSTALLATION



Photo n° 1

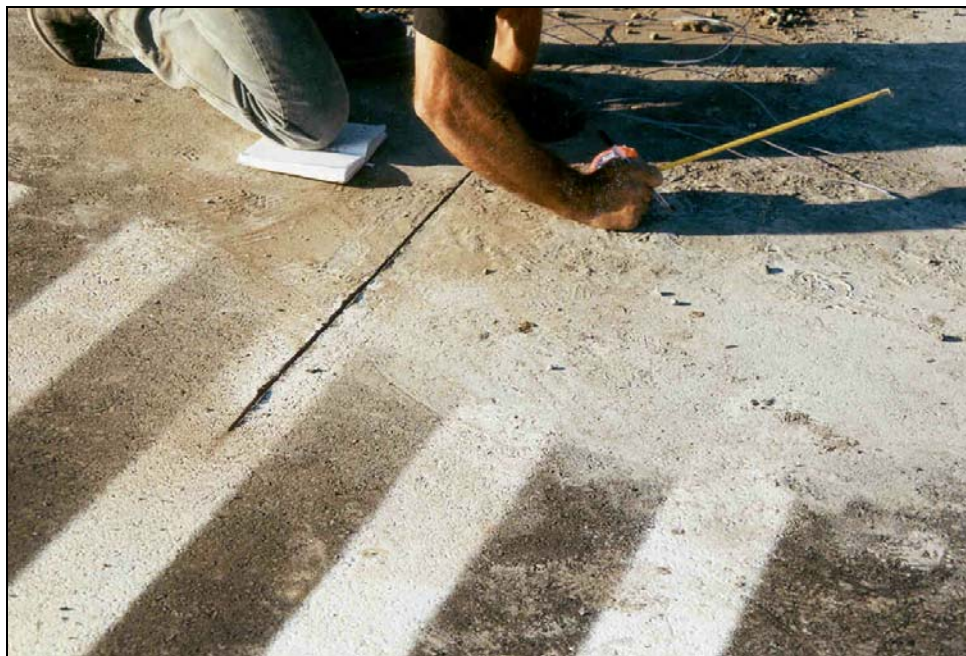


Photo n° 2

Dorval Airport PG Binder Test Section - Construction Report

THERMOCOUPLE INSTALLATION



Photo n° 3

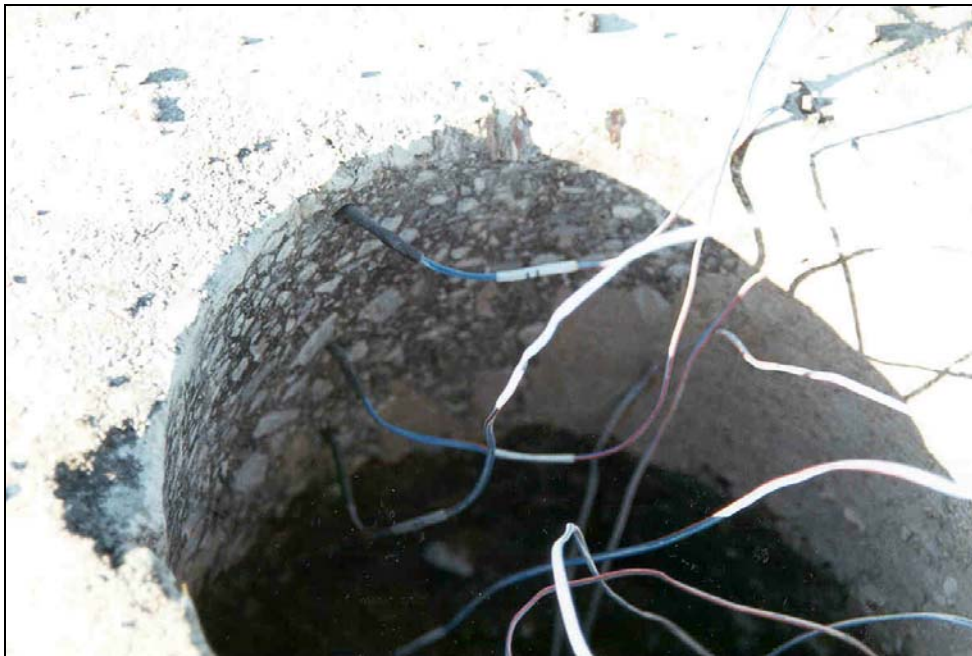


Photo n° 4

THERMOCOUPLE INSTALLATION

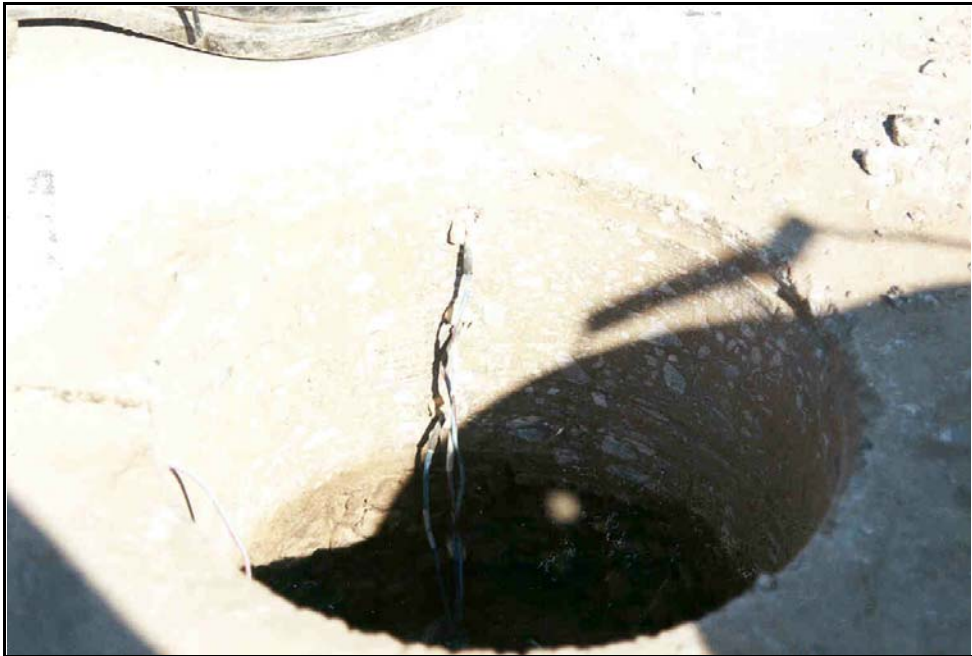


Photo n° 5



Photo n° 6

THERMOCOUPLE INSTALLATION



Photo n° 7



Photo n° 8

Dorval Airport PG Binder Test Section - Construction Report

THERMOCOUPLE INSTALLATION



Photo n° 9

Dorval Airport PG Binder Test Section - Construction Report

DATALOGGER UNIT



Photo n° 9

Dorval Airport PG Binder Test Section - Construction Report

DATALOGGER UNIT

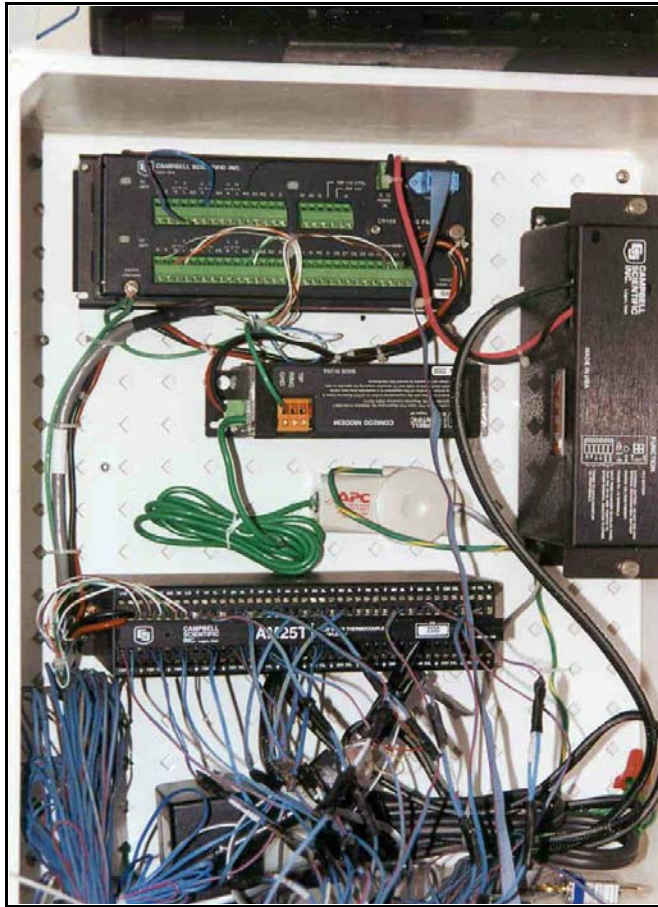


Photo n° 2

Dorval Airport PG Binder Test Section - Construction Report

SAND PATCH TEST



Photo n° 1



Photo n° 2

Dorval Airport PG Binder Test Section - Construction Report

SAND PATCH TEST



Photo n° 3



Photo n° 4

Dorval Airport PG Binder Test Section - Construction Report

SAND PATCH TEST

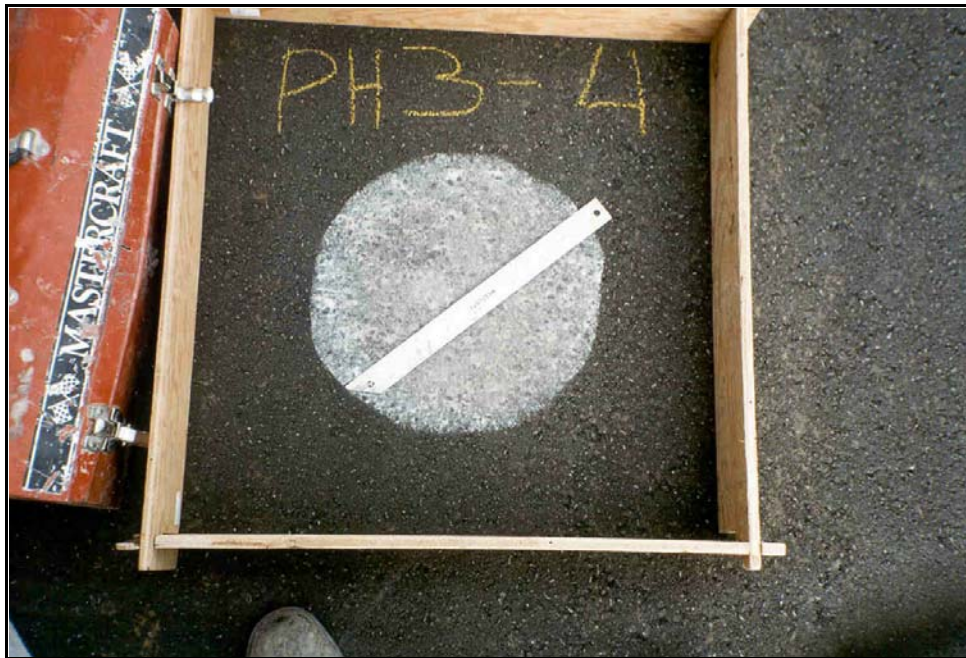


Photo n° 5

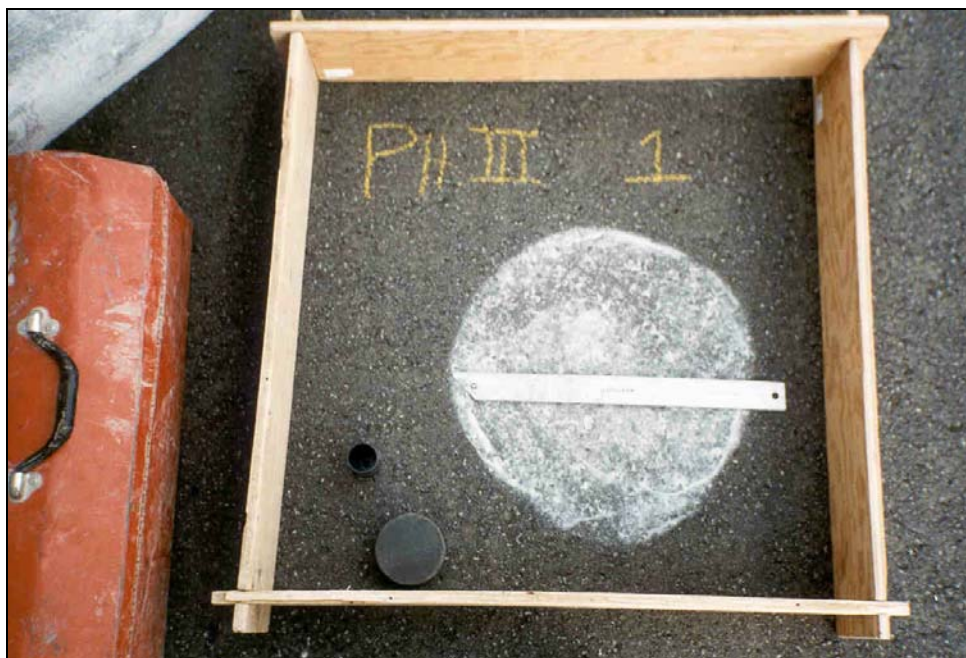


Photo n° 6