PAVEMENT REHABILITATION ON RUNWAY 13-31 AT WINNIPEG AIRPORT – EVALUATION, DESIGN, ADVANCED ASPHALT TECHNOLOGY

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GOLDER

PRESENTATION OUTLINE

- Introduction
  - Winnipeg International Airport
  - Runway 13-31
- Initial pavement evaluation
- Geotechnical investigation
- Pavement design
- Advanced asphalt technology
- Construction - ongoing
- Summary

INTRODUCTION

Winnipeg James Armstrong Richardson International Airport

- City of Winnipeg – 0.5 million inhabitants
- Winnipeg Airport – 4.3 million passengers annually
- Two runways
  - 13-31
  - 18-36
- Number of taxiways and aprons

INTRODUCTION

Runway 13-31

- Length 2,650 m
- Width 60 m
- Main intersection with Runway 18-36
- Seven intersections with taxiways
- Initially asphalt and concrete pavement surface
- Very complex pavement structure

INTRODUCTION

- **Owner – Winnipeg Airports Authority Inc.**
- **Civil Consultant – Avia NG Inc.**
- **Geotechnical Consultant – Golder Associates Ltd.**
- **Contractor – Maple Leaf Construction Ltd.**

INITIAL PAVEMENT EVALUATION

Review of existing documentation

Pavement visual condition inspection

Initial pavement rehabilitation design

INITIAL PAVEMENT EVALUATION

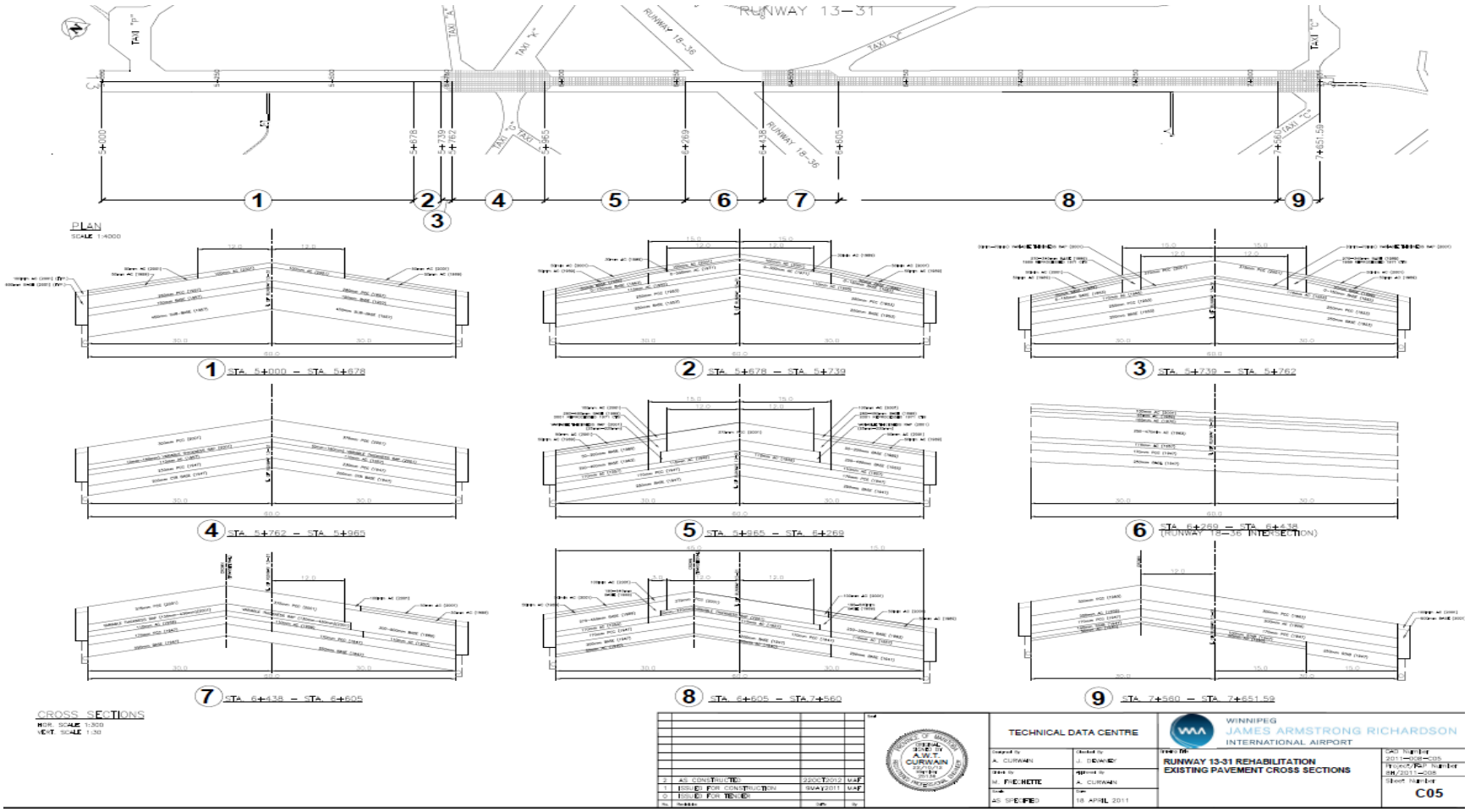
Review of existing documentation

- As constructed drawings 2012
- Bump repair report 2007
- Wheel path rutting report 1994
- Scope of work 2018
- Aircraft traffic data 2018
- Tender specifications
- Runway 13-31 roughness survey
- Friction testing report 2017

INITIAL PAVEMENT EVALUATION

- Runway condition inspection
- Inspection on October 16, 2018
- Golder – pavement visual condition
- Avia NG Inc. – drainage and electrical work

INITIAL PAVEMENT EVALUATION



INITIAL PAVEMENT EVALUATION

Pavement visual condition inspection

Section	Station		Pavement Surface	
	From	To	Keel zone	Non-keel zone
1	5+000	5+678	Asphalt	Asphalt
2	5+678	5+739	Asphalt	Asphalt
3	5+739	5+762	Concrete	Asphalt
4	5+762	5+965	Concrete	Concrete
5	5+965	6+269	Concrte	Asphalt
6	6+629	6+438	Asphalt	Asphalt
7	6+438	6+605	Concrete	Asphalt
8	6+605	7+560	Concrete	Asphalt
9	7+560	7+652	Concrete	Concrete

INITIAL PAVEMENT EVALUATION

Typical asphalt pavement distresses

- Longitudinal and transverse cracking
- Random cracking
- Frost heaving
- Raveling and few low severity potholes
- Polished surface
- Bumps and cracking at concrete/asphalt interface

INITIAL PAVEMENT EVALUATION

INITIAL PAVEMENT EVALUATION

INITIAL PAVEMENT EVALUATION

Typical concrete pavement distresses

- Spalled joints
- Localized slab cracking
- Corner breaks
- Scaling
- Polished surface
- Section 9 – concrete cracking and shattering

INITIAL PAVEMENT EVALUATION

INITIAL PAVEMENT EVALUATION

INITIAL PAVEMENT EVALUATION

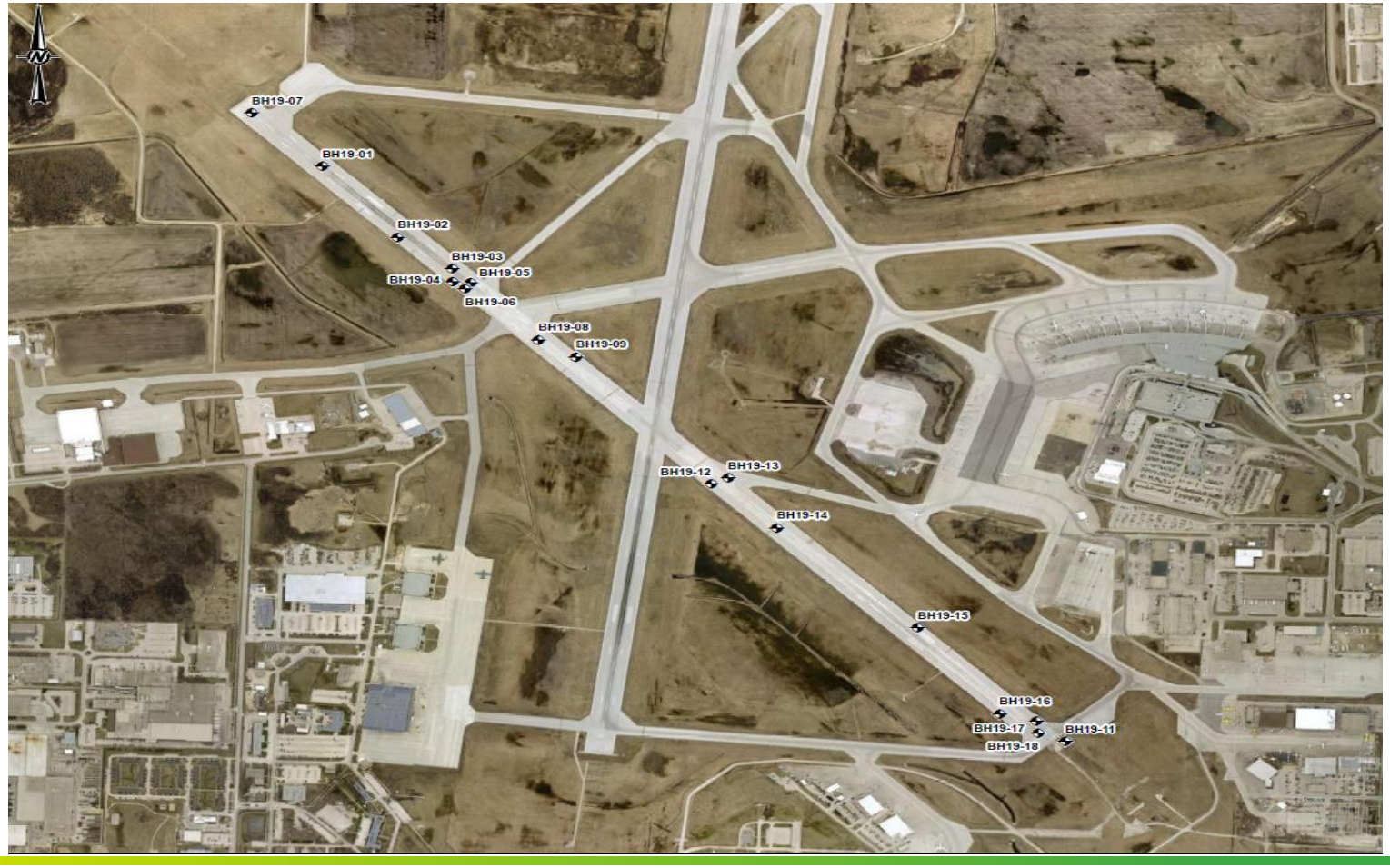
- Initial pavement design recommendations
- Asphalt surface over the entire runway
- Required PLR 12
  - Structural improvement needed
- High quality asphalt mixes required
- Generally asphalt - mill asphalt 0 to 50 mm and overlay with 100 mm new HMA
- Generally concrete
  - Replace cracked slabs
  - Slightly scarify and overlay with 100 mm new HMA
- Repair severe cracks at the interface PCC/HMA

GEOTECHNICAL INVESTIGATION

- Advancing 17 boreholes 2.0 m deep
- Identifying type and condition of pavement layers and subgrade soils
- Obtaining cores for visual inspection
- Obtaining samples for laboratory testing

GEOTECHNICAL INVESTIGATION

Borehole Location Plan



GEOTECHNICAL INVESTIGATION

- **Soils – generally silty clay**
  - **Low to medium and localized high frost susceptibility**
  - **Variable moisture content**
- **Generally good quality granular materials – base and subbase**
  - **Some had high moisture content**

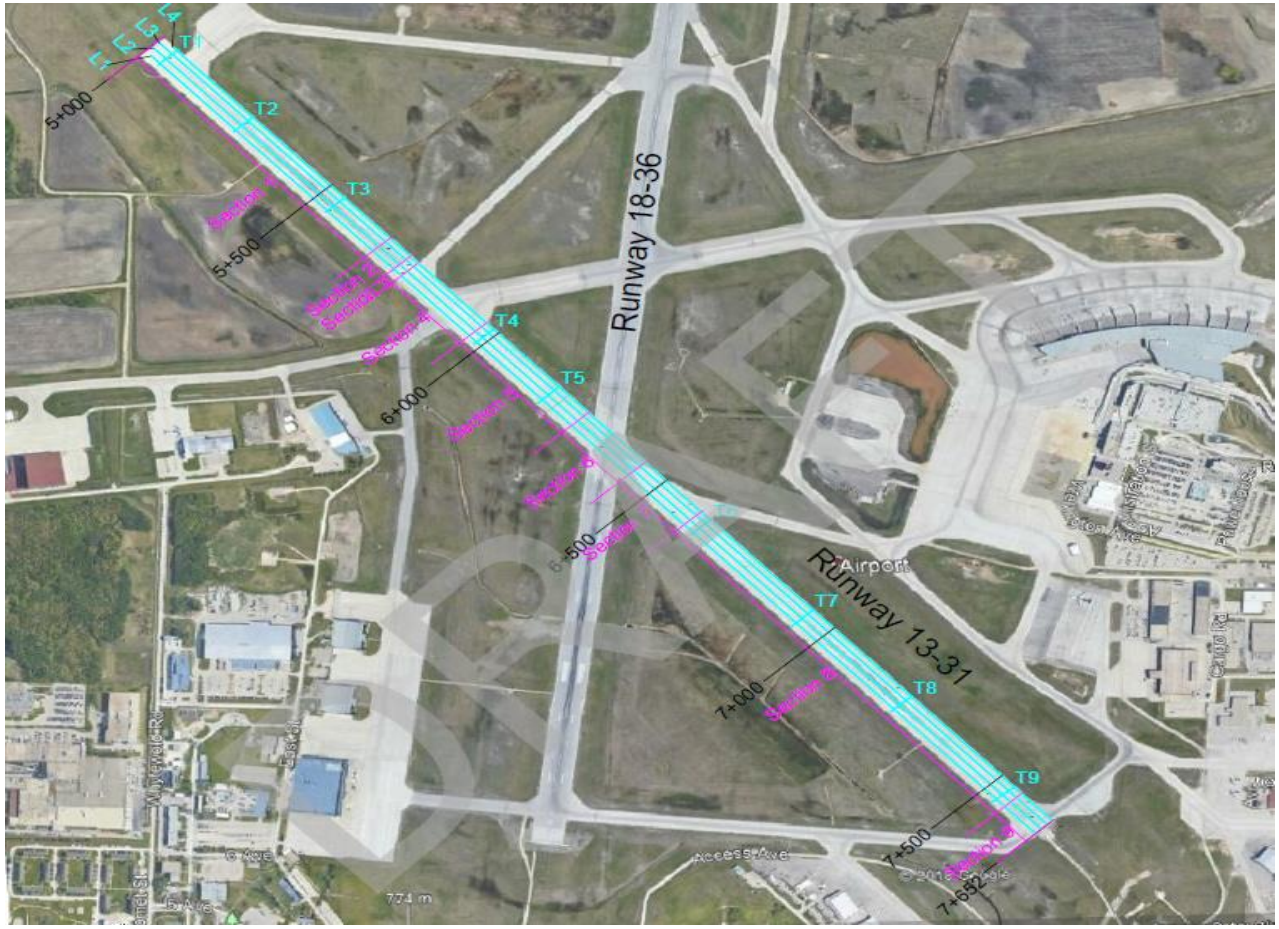
GEOTECHNICAL INVESTIGATION

Ground Penetrating Radar (GPR) survey

- January 2019
- Four lines along the runway length and 9 transverse lines across the runway
- Determine thicknesses and types of pavement layers
- Continuous layer profiles
- Calibrated against borehole results

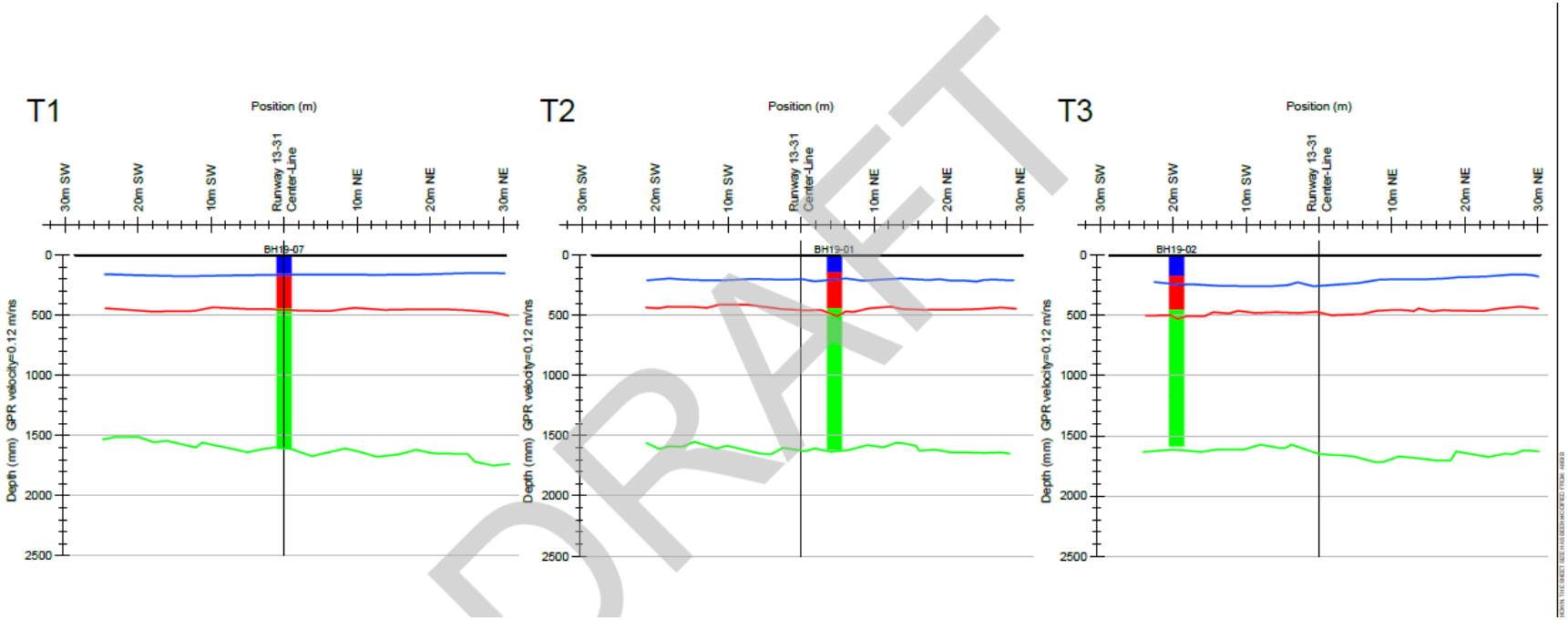
GEOTECHNICAL INVESTIGATION

Ground Penetrating Radar (GPR) Survey



GEOTECHNICAL INVESTIGATION

Ground Penetrating Radar (GPR) Survey



PAVEMENT DESIGN

Section	Pavement Design	
	Keel zone	Non-keel zone
1	Mill 0 to 50 mm, overlay with 100 mm HMA	
2	2A- Mill 0 to 50 mm, overlay with 100 mm HMA	2B- Mill 0 to 50 mm, overlay with 100 mm HMA
3	3A - Scarify, overlay with 100 mm HMA	3B- Mill 0 to 50 mm, overlay with 100 mm HMA
4	4A - Scarify, overlay with 100 mm HMA	
5	5A - Scarify, overlay with 100 mm HMA	5B- Mill 0 to 50 mm, overlay with 100 mm HMA
6	6A- Mill 0 to 50 mm, overlay with 100 mm HMA	
7	7A - Scarify, overlay with 100 mm HMA	7B- Mill 0 to 50 mm, overlay with 100 mm HMA
8	8A - Scarify, overlay with 100 mm HMA	8B- Mill 0 to 50 mm, overlay with 100 mm HMA
9	9A and 9B - Reconstruct - 500 mm subbase, 200 mm base, 380 mm PCC, 100 mm HMA	

ADVANCED ASPHALT TECHNOLOGY

Paving specifications

- Asphalt paving
- Tack coat
- Concrete paving
- Granular base
- Subbase
- Subgrade preparation

ADVANCED ASPHALT TECHNOLOGY

Asphalt paving

- **Performance graded asphalt cement PG 64-37 Polymer Modified**
  - **Testing to meet AASHTO M320 requirements**
  - **Sampling and storage for potential further testing**
- **Aggregates properties**
- **PSV testing**

ADVANCED ASPHALT TECHNOLOGY

Mix Design - Gradation

Table 1

Sieve Designation	Percent Passing (%)		
	Surface Course	Lower Course	Levelling Course
25.0 mm	-	100	-
19.0 mm	100	90-100	-
16.0 mm	95-100	75-95	-
12.5 mm	82-96	-	100
10.0 mm	76-87	52-77	82-99
5.0 mm	47-66	31-51	59-79
2.5 mm	36-51	21-41	40-60
1.25 mm	25-41	11-36	26-46
0.630 mm	16-31	5-25	19-35
0.315 mm	7-20	3-15	12-24
0.160 mm	1-8	1-10	7-17
0.080 mm	1-5	1-5	3-6

ADVANCED ASPHALT TECHNOLOGY

Mix Design - Aggregates

Table 2

Physical Property	Test Method	Surface Course Limits		Lower and Levelling Course Limits	
		Coarse Aggregate	Fine Aggregate	Coarse Aggregate	Fine Aggregate
Sand Equivalent - Minimum	ASTM D2419	50			
Magnesium Sulphate Soundness - Maximum[1]	ASTM C88	12%	12%	12%	16%
Los Angeles Abrasion - Maximum	ASTM C131	25%	-	35%	-
Absorption - Maximum	ASTM C127	2.0%	-	2.2%	-
Loss by Washing – Maximum[2]	ASTM C117	1.5%	-	2.0%	-
Lightweight Particles – Maximum[3]	ASTM C123	1.5%		3.0%	
Flat and Elongated Particles at 5:1 ratio – Maximum[4]	ASTM D4791	8%	-	10%	-
Polished Stone Value – Minimum	BS 812 Part 114	55*		-	
Petrographic Number (Fine and Coarse), Maximum	ASTM 295	120		135	

*If PSV is between 50 and 55, the aggregate has to be reviewed by the Consultant. If PSV is less than 50, the aggregate is not acceptable.

ADVANCED ASPHALT TECHNOLOGY

Mix Design – Mix Characteristics

Table 4

Marshall Method Mix Criteria	Surface Course	Lower Course	Levelling Course
Compaction Blows on each face of test specimen	75	75	75
Stability ASTM D1559 (kN @ 60°C) Minimum	Min 13	12	10
Target Stability	14	12	10
Flow ASTM D1559 (mm)	2 - 4	2 - 4	2 - 4
Air Voids ASTM D3203 (% of Total Mix)	2.5 – 4.5	3 - 5	3 - 5
Target Air Voids (% of Total Mix)	3.5	4.0	4.0
Asphalt Cement Content (% of Total Mix) range	5.3 – 6.0	5.0 – 5.7	5.0 – 5.7
Tensile Strength Ratio (% minimum)	80	80	80

ADVANCED ASPHALT TECHNOLOGY

Mix Design - VMA

Table 5

Percent Passing 5.00mm by Mass	Minimum Voids in Mineral Aggregate (VMA)	
	Surface Course	Lower Course
40	13.0	12.0
45	13.5	12.5
50	14.0	13.0
55	14.5	13.5
60	15.0	14.0
Over 60	15.5	14.5

ADVANCED ASPHALT TECHNOLOGY

Construction

- Paving in echelon required
- Use of Material Transfer Vehicle (MTV) ShuttleBuggy®
- Tightened construction tolerances
- Compaction tightened
  - 98 % of laboratory Marshall density for the mat
  - 97 % for the joints

ADVANCED TECHNOLOGY

Paving specifications

- **Concrete pavement**
  - **Compressive strength 35 MPa**
  - **Dowel bars and tie bars in the joints**
- **Granular base and subbase**
  - **Updated gradations**
  - **Tightened compaction**

CONSTRUCTION

Concrete Surface Preparation

CONSTRUCTION

GlasGrid® Installation

CONSTRUCTION

GlasGrid® Installation

CONSTRUCTION

Joint Construction

CONSTRUCTION

Joint Construction

CONSTRUCTION

Material Transfer Vehicle

CONSTRUCTION

Material Transfer Vehicle

CONSTRUCTION

Material Transfer Vehicle

CONSTRUCTION

Echelon Paving

CONSTRUCTION

Compaction

CONSTRUCTION

High quality mat produced with v. tight joints

CONSTRUCTION

Concrete Paving

CONSTRUCTION

Concrete Paving

CONSTRUCTION

Granular Subbase

SUMMARY

Pavement Rehabilitation on Runway 13-31

- Very complex existing pavement structure
- Initial pavement evaluation
- Geotechnical investigation and GPR survey
- Pavement design
  - PLR 12
  - Uniform asphalt surface
- Paving specification improvements
- Construction

SUMMARY

Advanced Asphalt Technology

- PG 64-37 Polymer Modified asphalt cement
- Better quality aggregates
- Improved mix design
- Construction
  - MTV's
  - Echelon paving
  - Tighter compaction including joints
  - Tight smoothness requirements
- Good quality asphalt mat
- Better performance anticipated

THANK YOU !

QUESTIONS ?

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