

# Comparison of Airport Paving Specification Requirements in Canada & USA

Ludomir Uzarowski, Ph.D., P.Eng.  
Rabiah Rizvi, P.Eng.  
Golder Associates Ltd., Ontario, Canada

Susan Tighe, Ph.D., P.Eng., University of  
Waterloo, Ontario, Canada



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# PRESENTATION OUTLINE

- **Introduction**
- **Airport paving specifications in Canada and US**
- **Pavement layers and materials**
- **Quality Assurance and acceptance**
- **Issues with specifications in Canada**
- **Conclusions and initial suggestions**



# INTRODUCTION

## ■ US

- FAA provides guidance in AC documents; if funding is from FAA AC documents are mandatory

## ■ Canada

- Lack of clear guidance
- Canadian Airfield Pavement Engineering Reference
- Individual airport specifications



# AIRPORT PAVING SPECIFICATIONS

- **Federal Aviation Administration (FAA)**
  - **Advisory Circular AC 150/3570-10G “Standards for Specifying Construction of Airports”, 2014**
  - **AC 150/5320-6E “Airport Pavement Design and Evaluation”, 2009**



# AIRPORT PAVING SPECIFICATIONS

## Canada

- **Edmonton International Airport (EIA) – 2016**
- **Thunder Bay International Airport – 2016**
- **Waterloo International Airport (2014)**
- **Greater Toronto Airport Authority (GTAA) - 2016**
- **Department of National Defence (DND) - 2016**



## VARIOUS PAVING SPECIFICATIONS

- **Few older specifications  
(Vancouver, Saskatoon, Calgary)  
- 2008**
- **Canadian Airfield Pavement  
Engineering Reference (CAP)  
2008**
- **Public Works and Government  
Services Canada (PWGSC)**

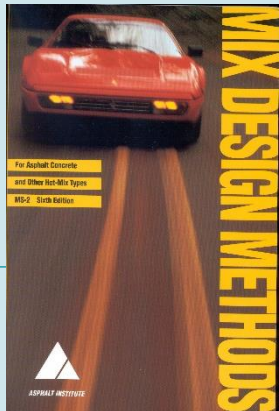


# COMPARISON OF PAVING SPECIFICATIONS

- Initial comparison included
  - Granular subbase
  - Granular base
  - Hot-mix asphalt paving
  - Portland cement concrete paving



# COMPARISON OF PAVING SPECIFICATIONS



- Aspects considered
  - Materials
    - Types
    - Properties
    - Testing
    - Gradations
    - Mix designs
  - Construction
  - Quality Control/Quality Assurance testing
  - Acceptance



# GRANULAR SUBBASE



# GRANULAR SUBBASE

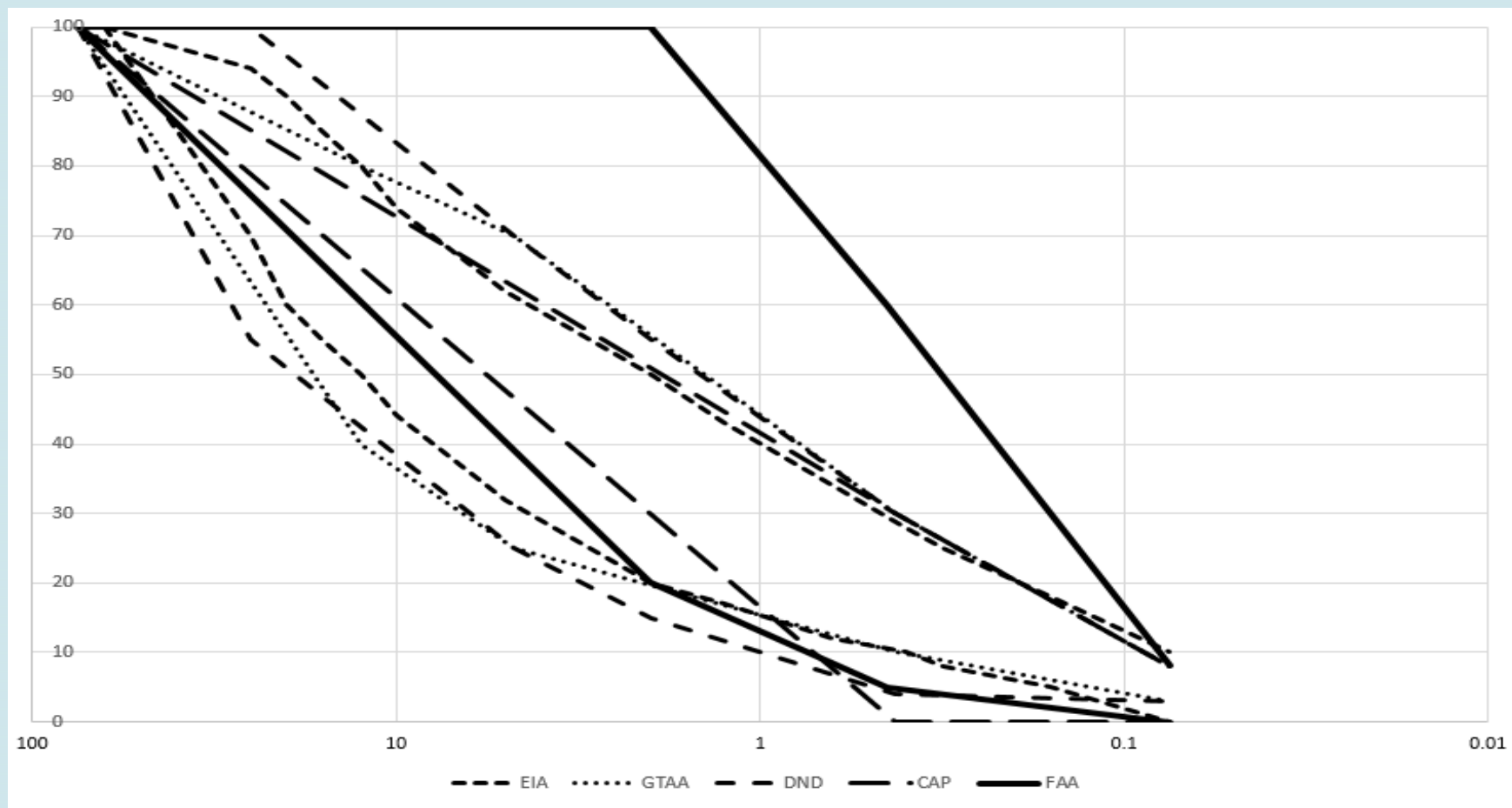
## ■ Gradation requirements

Sieve Size (mm)	GTAA		DND		CAP		FAA	
75	100	100	100	100	100	100	100	100
25	-	-	55	100	-	-	-	-
12.5	40	80	-	-	-	-	-	-
4.75	25	70	25	70	-	-	-	-
2.0	-	-	15	55	-	-	20	100
0.425	10	30	4	30	0	30	5	60
0.075	3	8	3	8	0	8	0	8



# GRANULAR SUBBASE

## ■ Gradation requirements





# GRANULAR SUBBASE

## ■ Requirements

Aggregate Type	Prpoerties/Construction Requirements	Specification Limits	Specifications Compared			Remarks
			Item included		Total	
			Yes	No		
Crushed stone			5	-	5	GTAA
Crushed gravel			4	1	5	
Recycled concrete			1	4	5	
	Lilquid limit, max	25	5	-	5	
	Plasticity Index, max	6	5	-	5	
	Los Angeles degradation, max	45 to 50	5	-	5	
	Particles smaller than 0.02 mm, %, max	3.0	1	4	5	
	Fractured paritcles, %, min	60 - 100	1	4	5	
	CBR, min	40%	1	4	5	DND; FAA - 30%
	Gradation limits		5	-	5	
	Gradation tolerances		1	4	5	
	Maximum lift thickness	150 mm	4	1	5	
		200 mm	1	4	5	
	Proof rolling		4	1	5	
	Filed compaction, min	98%	4	1	5	
		100%	1	4	5	
	Finish tolerance	15 mm to 25 mm	5	-	5	

FAA: LA abrasion?; lift thickness 200 mm; field compaction 100%; thickness and grade tolerance 12 mm



# GRANULAR BASE



# GRANULAR BASE

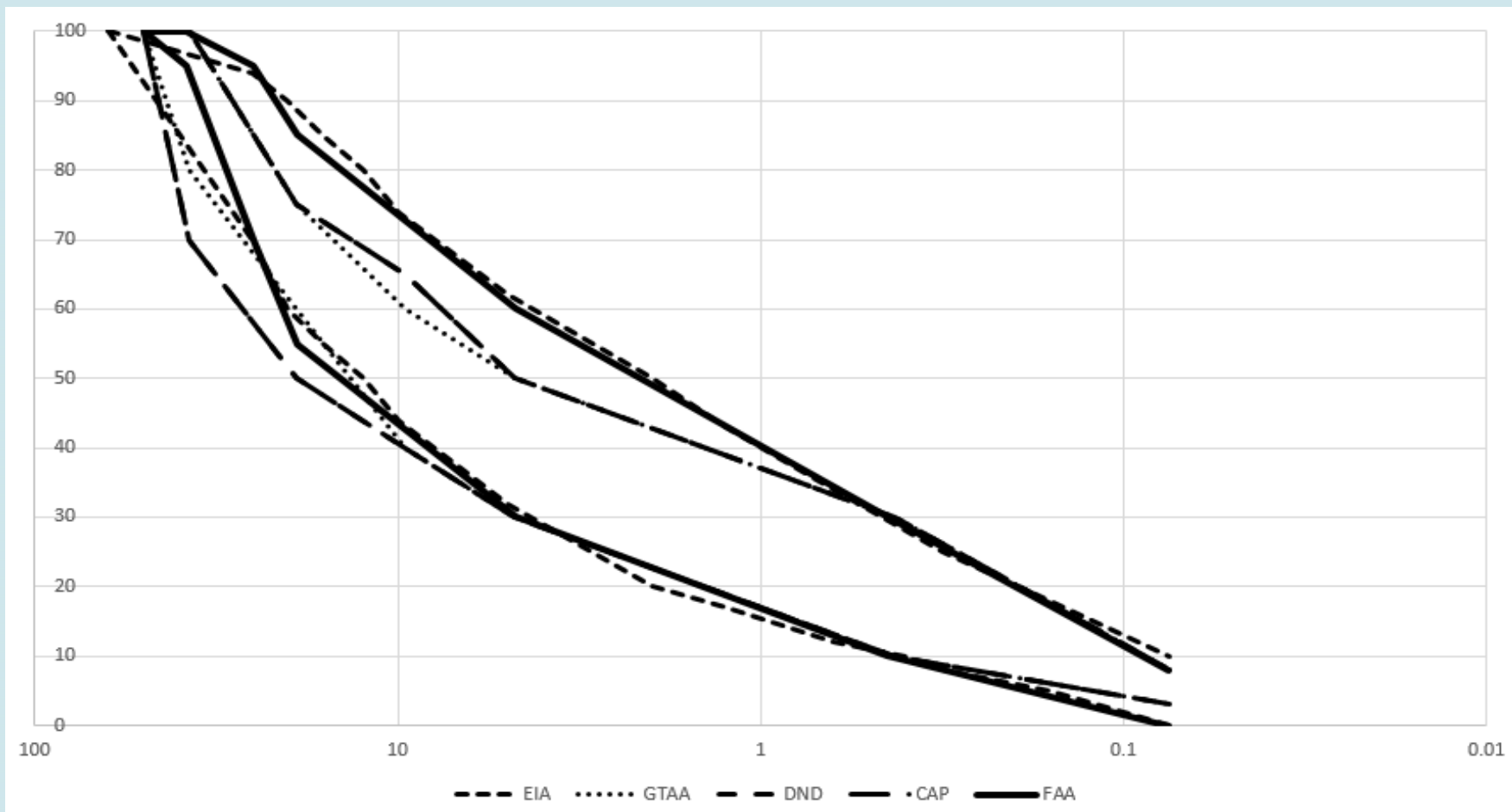
## ■ Gradation requirements

Sieve Size (mm)	EIA		GTAA		DND		CAP		FAA	
63	100	100	-	-	-	-	-	-	-	-
50	-	-	100	100	100	100	100	100	100	100
37.5	70	94	80	100	70	100	70	100	95	100
25	60	90	-	-	-	-	-	-	70	95
19	55	85	60	75	-	-	50	75	55	85
12.5	50	80	-	-	50	75	-	-	-	-
9.5	44	74	40	60	40	65	40	65	-	-
4.75	32	62	30	50	30	50	30	50	30	60
2.0	20	50	-	-	-	-	-	-	-	-
1.25	17	43	-	-	-	-	-	-	-	-
0.63	12	34	-	-	-	-	-	-	-	-
0.425	10	28	10	30	10	30	10	30	10	30
0.315	8	25	-	-	-	-	-	-	-	-
0.16	5	18	-	-	-	-	-	-	-	-
0.075	0	10	3	8	3	8	3	8	0	8



# GRANULAR BASE

## ■ Gradation requirements





# GRANULAR BASE

## ■ Requirements

Aggregate Type	Prpoerties/Construction Requirements	Specification Limits	Specifications Compared			Remarks
			Item included		Total	
			Yes	No		
Crushed stone			6	-	6	
Crushed gravel			5	1	6	
	Lilquid limit, max	25	6		6	GTAA
	Plasticity Index, max	4	1	5	6	
		6	5	1	6	
	Los Angeles degradation, max	40, 45	5	1	6	
		25	1	5	6	
	Shape and texture index, min	16	1	5	6	
	Fractured paritcles, %, min	60 - 100	6	-	6	
	CBR, min	100%	1	5	6	DND; FAA - 100%
	Gradation limits		6	-	6	
	Gradation tolerances		1	5	6	
	Maximum lift thickness	150 mm	4	2	6	
		200 mm	2	4	6	
	Proof rolling		2	4	6	
	Filed compaction, min	98%	5	1	6	
		100%	1	5	6	
	Finish tolerance	10 mm	6	-	6	

FAA: allows crushed slag; fractured particles 90%; layer 150 mm; compaction 100%;  
grade tolerance 12 mm; smoothness requirement 12' straight edge 9 mm



# HOT-MIX ASPHALT PAVING



# HOT-MIX ASPHALT BINDER COURSE

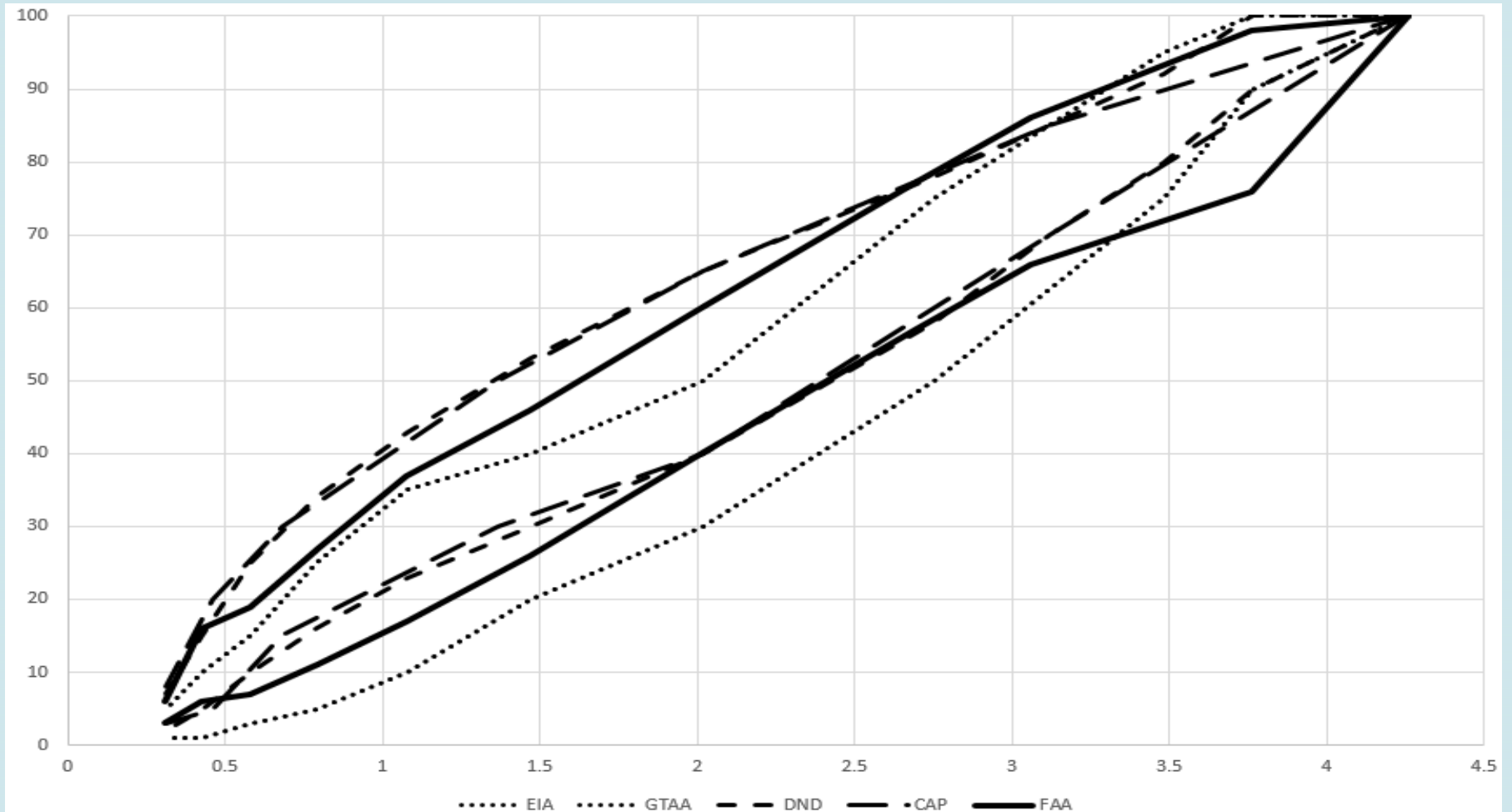
- Gradation
- Asphalt cement content and grade

Sieve Size (mm)	EIA		GTAA		DND		CAP		FAA	
25	100	100	100	100	100	100	100	100	100	100
19	90	100	90	100	90	100	-	-	76	98
16	75	95	75	95	80	92	-	-	-	-
12.5	-	-	-	-	70	85	70	85	66	86
9.5	50	75	50	75	58	78	-	-	-	-
9.0	-	-	-	-	-	-	-	-	57	77
4.75	30	50	30	50	40	65	40	65	40	60
2.36	20	40	20	40	30	53	-	-	26	46
2.0	-	-	-	-	-	-	30	50	-	-
1.18	10	35	10	35	23	43	-	-	17	37
0.6	5	25	5	25	16	34	-	-	11	27
0.425	-	-	-	-	-	-	15	30	-	-
0.3	3	15	3	15	10	25	-	-	7	19
0.18	-	-	-	-	-	-	5	20	-	-
0.15	1	10	1	10	5	15	-	-	6	16
0.075	1	5	1	5	2	7	3	8	3	6
AC content (%)	5.0		5.0	5.4	4.7		-	-	4.5	7.0
AC grade	PG 64-34		PG 64-28		PG 64-28 PM		Site specific (pen)		PG site specific	



# HOT-MIX ASPHALT BINDER COURSE

## ■ Gradation





# HOT-MIX ASPHALT SURFACE COURSE

- Gradation
- Asphalt cement content and grade

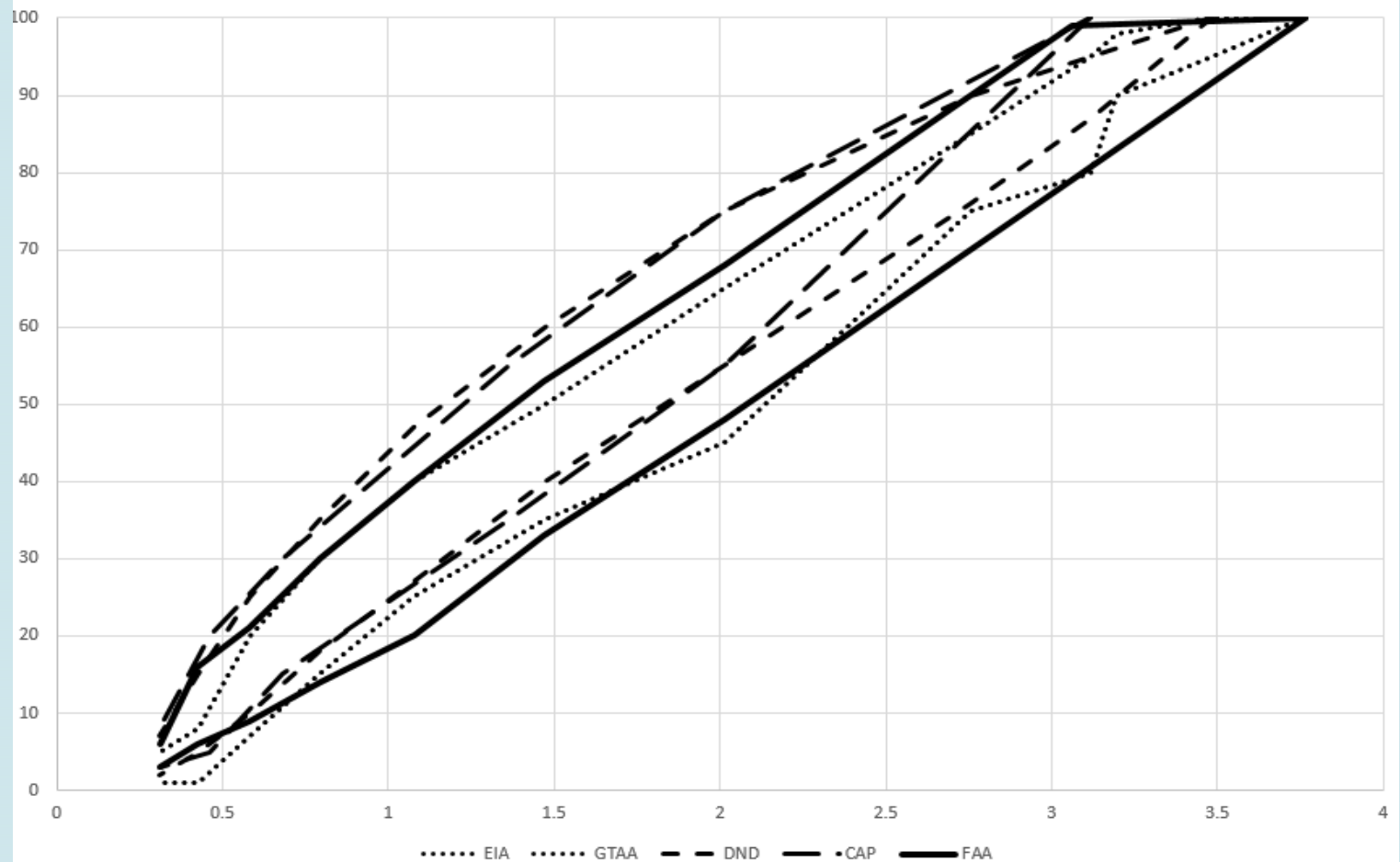
Sieve Size (mm)	EIA		GTAA		DND		CAP		FAA	
19	100	100	100	100	-	-	-	-	100	100
16	95	100	95	100	100	100	-	-	-	-
13.2	90	98	90	98	-	-	-	-	-	-
12.5	80	95	80	95	87	95	100	100	-	-
12	-	-	-	-	-	-	-	-	79	99
9.5	75	85	75	85	76	90	-	-	-	-
9.0	-	-	-	-	-	-	-	-	68	88
4.75	45	65	45	65	55	75	55	75	48	68
2.36	35	50	35	50	40	60	-	-	33	53
2.0	-	-	-	-	-	-	35	55	-	-
1.18	25	40	25	40	27	47	-	-	20	40
0.6	15	30	15	30	18	35	-	-	14	30
0.425	-	-	-	-	-	-	15	30	-	-
0.3	7	20	7	20	10	25	-	-	9	21
0.18	-	-	-	-	-	-	-	-	-	-
0.15	1	8	1	8	5	15	5	20	6	16
0.075	1	5	1	5	2	7	3	8	3	6
AC content (%)	5.3		5.0	5.4	5.0		-	-	5.0	7.5
AC grade	PG 64-34		PG 70-28 PM or E		PG 64-28 PM		Site specific (pen)		PG site specific	



# HOT-MIX ASPHALT SURFACE COURSE

## ■ Gradation requirements

SURFACE	Scale of Texture	
	Macro (Large)	Micro (Fine)
A		Rough Harsh
B		Rough Polished
C		Smooth Harsh
D		Smooth Polished



# HOT-MIX ASPHALT

## ■ Materials



Material Type	Specification Limits	Specifications Compared			Remarks
		Item included		Total	
		Yes	No		
Asphalt cement:  PG grade				8	
Aggregate: Dolomitic rock or trap rock Crushed stone Crushed gravel Natural sand, max	    10%	1 8 7 2	7 - 1 6	8 8 8 8	GTAA

**FAA: PGAC grade site specific – grade as for interstate as required by State DOT bumped ; 1 grade for < 100,000 lbs or 2 grades for > 100,000 lbs; up to 15% natural sand; low temperature not higher than -22**



# HOT-MIX ASPHALT

## ■ Material properties

Prpoerties/Construction Requirements	Specification Limits	Specifications Compared			Remarks
		Item included		Total	
		Yes	No		
Los Angeles degradation, max	25% - 35%	7	1	8	DND
Micro Deval, max	15% - 25%	1	7	8	
Absorption, coarse aggregate, max	1.75% - 2.2%	8	-	8	
Fractured paritcles, min	100%	1	7	8	GTAA
	60% - 90%	7	1	8	
Sand equivalent, min	40% - 50%	8	-	8	
Soundness loss, max	12% - 16%	8	-	8	SIA - ratio 3
Loss by washing, max	1.0% - 2.0%	8	-	8	
Lighweight particles, max	1.5% - 3.0%	8	-	8	
Flat and elengated particles, ratio 5, max	8.0% - 15.0%	8	-	8	
Liquid limit, max	25	2	6	8	
Plasticity Index, max	6	2	6	8	DND GTAA
Petrographic Number, max	135 - 160%	1	7	8	
Polished Stone Value, min	60	1	7	8	
Polishing characterisitcs		5	3	8	

FAA: fractured particles 70 & 85%; sand equivalent 45%; F&A 8% 5:1 or 20% 3;1;  
 LL 25; PI 6; 15% magnesium soundness and 10% sodium soundness



# HOT-MIX ASPHALT

## ■ Mix design

Prpoerties/Construction Requirements	Layer	Specification Limits	Specifications Compared			Remarks	
			Item included		Total		
			Yes	No			
Compactive effort, blows per face		75	4	4	8		
		50	4	4	8		
Marshall stability, kN, min	75 blows	binder	10 - 14	4	4	8	
		surface	12 - 14	4	4	8	
	50 blows	binder	9.0	4	4	8	
		surface	9.0 - 10.0	4	4	8	
Flow, mm	binder	2 - 4	8	-	8		
	surface	2 - 4	8	-	8		
Air voids, %	binder	3 - 5	8	-	8		
	surface	2.5 - 5	8	-	8		
VMA, %, min	binder	13 - 14.5	8	-	8		
	surface	13 - 15	8	-	8		
Marshall retained stability, %,min	binder	75	5	3	8		
	surface	75	5	3	8		
	surface	85	1	7	8		
Minimum film thicnkness			2	6	8		
TSR, %, min	surface	75 - 80	2	6	8	YVR	
RAP	binder	15%	1	7	8	YVR	
	surface		-	8	8		

FAA: 75 and 50 blows; 9560 N and 6000 N; flow 10 – 16 and 10-18; target air voids 3.5%;

VMA 16% and 15%; up to 20% RAP (?); TSR minimum 75%; Superpave included



# HOT-MIX ASPHALT

## ■ Construction

Construction Requirements	Location	Specification Limits	Specifications Compared		
			Item included		Total
			Yes	No	
Echelon paving			7	1	8
MTV or Shuttle Buggy			3	5	8
Test strip			8	-	8
Compaction, Marhsall density	mat	100%	1	7	8
		98%	6	2	8
		96%	1	7	8
	joint	97%	1	7	8
Maximum lift thickness, mm	surface	50	2	6	8
	binder	65 - 100	2	6	8
Minimum air temperature		5°C - 7°C	8	-	8
Minimum compaction temerature		100°	7	1	8
Joint offset	transverse	600 mm	8	-	8
	longitudinal	150 mm	8	-	8

FAA: MTV for > 100,000lbs; mix moisture max 0.5%; cold joint cut back 75 mm to 150 mm; trial batch and test strip required



# HOT-MIX ASPHALT

## ■ Surface requirements



Construction Requirements	Location	Specification Limits	Specifications Compared		
			Item included		Total
			Yes	No	
<b>Smoothness:</b>					8
California Profilograph, mm/km, max	runway	80 mm/km	1	7	8
	taxiway, apron	110 - 120	2	6	8
Finish tolerances, mm	surface	3.0 - 5.0	8	-	8
	binder	6.0	1	7	8
Coefficient of friction, min		0.75	1	7	8
Segregation			1	7	8

FAA: smoothness using 12' straightedge – if more than 6 mm grinding required;  
 profilograph Profile Index < 15; California Profilograph – max 10 mm; Boeing Bump Index



# HOT-MIX ASPHALT

## ■ Acceptance

Construction Requirements	Specifications Compared			Remarks
	Item included		Total	
	Yes	No		
Acceptance:			8	
asphalt cement content	8	-	8	
gradation	8	-	8	
air voids	8	-	8	
stability	8	-	8	
field compaction	8	-	8	
joint compaction	4	4	8	
smoothness	8	-	8	
grade	4	4	8	
Payment adjustment	4		8	

FAA: air voids; mat density; joint density; thickness; smoothness; grade; stability and flow; gradation and AC content; control charts; action limits; suspension limits: PWL



# **PORTLAND CEMENT CONCRETE PAVING**



# PORTLAND CEMENT CONCRETE

## ■ Mix design

Prpoerties/Construction Requirements	Specification Limits	Specifications Compared		
		Item included		Total
		Yes	No	
Compressive strength, MPa, min	35	2	4	6
Flexural strength, MPa, min	4.0 - 4.5	6	-	6
Splitting tensile strenght, MPa, min	2.8 - 3.5	3	3	6
Cement content, kg/m <sup>3</sup>	290 - 335	6	-	6
Water-cememt ratio	0.43 - 0.45	6	-	6
Slump, mm			-	6
slip form	10 - 40	6	-	6
fixed form	25 - 60	4	2	6
tolerance	5 - 20	6	-	6
Air content, %	6.0	5	-	6
	5.0 - 8.0	1	4	6
tolerance	1.0	6	-	6

FAA: flexural strength 600 psi to 700 psi (4,136 kPa to 4,826 kPa); for lighter aircraft 28-day compressive strength > 4,400 psi (30 MPa); emphasis on alkali silica reactivity



# PORTLAND CEMENT CONCRETE

- Construction
- Acceptance

Construction Requirements	Specification Limits	Specifications Compared			Remarks
		Item included		Total	
		Yes	No		
Test strip	required	1		6	
Minimum air temperature	30 - 35 4 to 7 days 4.0 - 5.0 70	2	4	6	
Maximum air temperature, °C		4	2	6	
Curing, min time		6	-	6	
Finish tolerances, 4.5 m straight edge, mm		6	-	6	
Testing 7-day strength, %, min		3	3	6	
Acceptance:	97%		-		
flexural strength		6	-	6	
thickness		3	3	6	
smoothness		6	-	6	
Dowels	required	4	2	6	
Tie bars	required	4	2	6	
QC plan required		1	5	6	DND
Payment adjustment		1	5	6	DND

FAA: flexural strength (compressive strength); pavement thickness; smoothness; grade; edge slump; control charts; action limits; suspension limits; PWL



# ISSUES WITH AIRFIELD PAVING

- Inconsistent airfield paving specifications in Canada
- Large differences between road and airfield paving
- High costs of asphalt and Portland cement concrete paving
- Recent serious issues with the quality of asphalt cement



# CONCLUSIONS

- **FAA**
  - **Clear guidance**
  - **Consistency**
  - **Emphasis on quality**
  - **Mix designs, inspection of materials, plants and equipment**
  - **Trial batches and test strip**
  - **Paving quality inspection**
  - **Requirements for laboratory**
  - **Clear testing and acceptance rules**



# INITIAL SUGGESTIONS

## Airport pavement quality

- Is not achieved by accident
- Steps
  - Preengineering
  - Designs
  - Specifications
  - Materials
  - Mix designs
  - Construction
  - QC/QA and acceptance



# INITIAL SUGGESTIONS

## Airport pavement quality

- Team work – Owner, Engineer, Contractor, Laboratories
- Communication
- Specifications must be
  - Clear
  - Understood
  - Enforced



**THANK YOU !**

**QUESTIONS ?**

**[luzarowski@golder.com](mailto:luzarowski@golder.com)**

