JUNE 13 2023

Centre for Excellence in Transportation Infrastructure (CETI)
95 Arrow Road, North York ON M9M 2L4

2023 OAPC ASPHALT TECHNICAL SYMPOSIUM (ATS)

asphalt ontario rides on us

PRESENTED BY Engtec Consulting Inc.

ORBA

oapc A council of ORBA

2023 OAPC ASPHALT TECHNICAL SYMPOSIUM (ATS)

Developing High RAP Mixtures Using International Experiences: Literature Review

Mike Aurilio

Terminal Manager, Yellowline Asphalt Products Ltd.

asphalt ontario rides on us

PRESENTED BY Engtec Consulting Inc.

ORBA

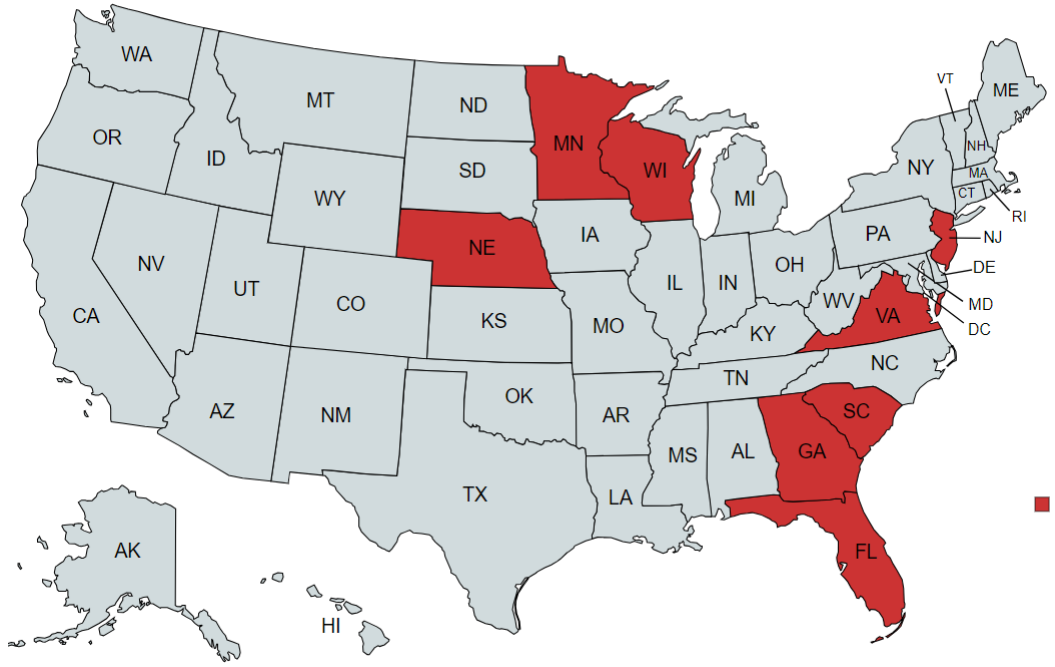
oapc A council of ORBA

Table of Contents

Co-Authors:
Yashar Alamdary
Doubra Ambaiowei
Pejoohan Tavassoti
Amma Wakefield

oapc
ontario asphalt pavement council
A council of ORBA

Table of Contents

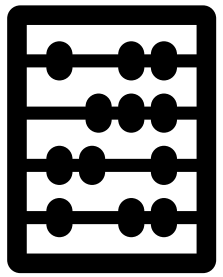


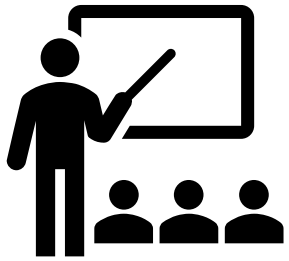
Japan Sweden Switzerland

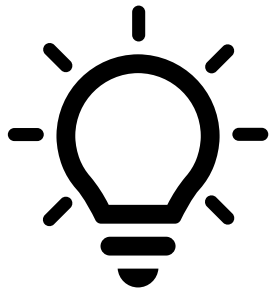
oapc ontario asphalt pavement council
A council of ORBA

Key to Success

Proper Data Collection → Education → Fundamental Understanding



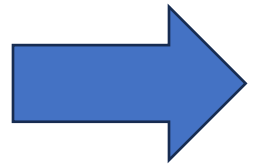




oapc
ontario asphalt pavement council
A council of ORBA

Major Findings

1. RAP Handling Characterization
    - AC Content and Gradation
    - Fractionation and Stockpile Management
2. Performance Testing
    - Verifying Design Changes
3. Mix Design Changes
    - Increasing AC content



RECOMMENDATIONS

oapc
ontario asphalt pavement council
A council of ORBA

State DOT RAP use Requirements

DOT RAP Use Requirements	FDOT	NDOT	NJDOT	SCDOT	WisDOT	WSDOT
% RAP Criteria	X	X	X			X[7]
RBR Criteria	X[1]			X	X	X
% RAS Criteria			X	X	X	X
Specifications Used by Others	X	X		X	X	X
Lift Location Criteria	X	X	X	X	X	
Traffic Criteria	X			X	X	X
Specialty Mixture Criteria	X		X	X	X	X
Binder Type Criteria	X	X		X		X
Softer Binder by Grade Bump	X	X	X[5]			
Softer Binder by Blending Chart			X[5]		X	X
Softer Binder by PG of Blend			X[5]		X	X
Recycling Agent Additive		X	X[5]			X
WMA Additive	X	X	X[5]	X	X	X
Additional Asphalt at Design		X	X	X	X	
Additional Asphalt at Acceptance			X	X	X	
Gsb for RAP Aggregates					X	X
Mixture Performance Test(s)			X	X[4]		X
Pay for Binder Separately		X		X		
RAP Fractionation	X[2]			X[2]	X[2]	
RAP QC Plan	X		X	X		
Dedicated RAP Stockpiles	X[3]			X[6]		

[1]Contractor option for RAP over 20 percent, but RBR may not exceed 0.20;
[2]Contractor option, use may be greater for FRAP than RAP;
[3]Contractor option;
[4]APA rutting test only;
[5]Contractor option to meet performance test criteria;
[6]If not fractionated;
[7]RAS percent specified but overruled by RBR.

RAP Characterization

- Focus on gradation and binder content and regular testing of RAP stockpile
- Some jurisdictions use binder penetration/PG grade
  - Japan tests compacted samples using Indirect Tensile Strength because of increase in use of PMA
- Georgia:

If ranges in asphalt content and gradation are equal to or less than:						
% asphalt cement	≤ 0.65	0.66 - 0.90	0.91 - 1.00	1.01 - 1.20	1.21 - 1.30	> 1.30
% passing No 200 Sieve	≤ 5.0	5.1 - 7.0	7.1 - 7.75	7.76 - 8.0	8.1 - 8.8	> 8.8
% passing control sieves	≤ 8.0	8.1 - 13	13.1 - 18	13.1 - 18	18.1 - 20.0	> 20.0
			the maximum % RAP allowed is:			
	Max	35%	30%	25%	20%	15%

RAP Processing

South Carolina SC-M-407:

Type of Mix	Maximum % Aged Binder from RAP and RAS	
	Non Fractionated RAP	Fractionated RAP
Surface A	-	15
Surface B	15	25
Surface C**	20	30
Surface D**	20	30
Surface E	-	30*
PMTLSC	15	30*
Intermediate A	-	15
Intermediate B	20	30
Intermediate C**	25	35
Base A**	30	35
Base B**	30	35
Base C	-	35*
Base D	-	35*
Shoulder Widening**	30	45

*Fractionated Fine Rap only
** RAS permitted

oapc ontario asphalt pavement council
A council of ORBA

Mix Design Changes

- Anything that increases AC content
- May require multiple changes to make sufficient changes to performance

- List from report summary:
  - Decreasing design gyrations
  - Using finer gradations
  - Decreasing the nominal maximum aggregate size
  - Increasing the minimum VMA
  - Decreasing the design target air voids
  - Corrective Optimum Asphalt Content (COAC)
  - Changing the RAP binder replacement ratio

Performance Testing

- Allows for fundamental evaluation of mix ideas if done properly
- Lessons learned can be adopted into specification
- Potential for performance testing criteria

- Allows for transparent sharing of information to rebuild trust between owners and contractors

oapc
ontario asphalt pavement council
A council of ORBA

Major Recommendations

- Pooled fund, multi-year studies
- Begin with following mix design changes:
  - Lowering Gyrations
  - Increase minimum VMA
  - Finer Gradations
  - Corrective Optimum Asphalt Cement Content
- Incorporating RAP QC plan into second phase of third-party certification process (Trillium Award)

oapc
ontario asphalt pavement council
A council of ORBA

Applying the Recommendations

Step 1: Develop High RAP Mix Concepts

Step 2: Verify changes using laboratory performance testing

Step 3: Develop plan for field trials

End Goal:

- Develop template for High RAP Mix Specification
- Choose tentative QC plan protocols

oapc
ontario asphalt pavement council
A council of ORBA

Applying the Recommendations

Step 4: Begin pavement trials using developed mixture specification

Step 5: Evaluate RAP processing protocols, impact of mix changes on plant production

End Goal:

- Pavement trials with control sections
- Develop tentative QC requirements

oapc ontario asphalt pavement council
A council of ORBA

Applying the Recommendations

Step 6: Collect data on field performance

Step 7: Use field performance to update template specifications

End Goal:

- Implementation of High RAP Mixture specification
- Implementation of QC protocols into third party certification

oapc
ontario asphalt pavement council
A council of ORBA

Big Picture Planning

- Multi-year approach taking laboratory work and field trial evaluation into consideration
- Field trials can begin with conservative RAP contents relative to laboratory work
- Review cycle/process should be part of long-term plan for high RAP Mixtures

Possible Mix Changes?

		Maximum RAP	Maximum FRAP		Performance Testing Criteria			
		By Weight		Corrective Optimum Asphalt Content	Based on Minimum Traffic Level: ***	Design Gyrations	Minimum VMA	Gradation
Zone 1	Surface	25	30	60:40	Yes	Lower	+1.0%	SP9.5
	Base	30	35					SP12.5
Zone 2	Surface	30	35	60:40	Yes	Lower	+1.0%	SP9.5
	Base	35	40					SP12.5
Zone 3	Surface	30	35	75:25	Yes	Lower	+0.5%	SP9.5
	Base	40	45					SP12.5

**Subject to laboratory and field evaluation

oapc ontario asphalt pavement council
A council of ORBA

Final Thoughts

- Much of the ideas we can use exist already, require Ontario specification adoption
- The process should be under discussion between all stakeholders
- There must be a commitment to collaborate
  - Report suggests pooled funding research projects
- RAP usage must continue to increase but implementation can be staged to reduce risk
  - Numerical targets should be set

ontario asphalt pavement council
A council of ORBA

asphalt ontario rides on us

ORBA

oapc
A council of ORBA