Quick Response: Quality Assurance (QA) Processes for Asphalt Pavement Construction in the Northeast

Jo Sias Daniel, Principal Investigator
University of New Hampshire (UNH)

Eshan V. Dave, Co-Principal Investigator
University of New Hampshire (UNH)

Chibuike Ogbo, Research Assistant (UNH)

Alan Perkins
Consultant

Prepared for
The New England Transportation Consortium
December 2018

NETCR112 Project No. 15-4

ACKNOWLEDGEMENTS

The following are the members of the Technical Committee that developed the scope of work for the project and provided technical oversight throughout the course of the research:

- Denis Boisvert, New Hampshire Department of Transportation
- Mark Brum, Massachusetts Department of Transportation
- Michael Byrne, Rhode Island Department of Transportation
- Kevin Cummings, Maine Department of Transportation
- Robert Lauzon, Connecticut Department of Transportation
- Aaron Schwartz, Vermont Agency of Transportation

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NETCR112	N/A	N/A

4. Title and Subtitle	5. Report Date
Quality Assurance (QA) Processes for Asphalt Pavement Construction in the Northeast	December 2018
	6. Performing Organization Code N/A
7. Author(s) Jo Sias Daniel, Eshan Dave, Alan Perkins, Chibuike Ogbo	8. Performing Organization Report No. NETCR112
9. Performing Organization Name and Address University of New Hampshire 105 Main Street Durham, NH, 03824	10. Work Unit No. (TRAIS) N/A
	11. Contract or Grant No. N/A
12. Sponsoring Agency Name and Address New England Transportation Consortium C/O Transportation Research Center University of Vermont, Farrell Hall 210 Colchester Avenue Burlington, VT 05405	13. Type of Report and Period Covered Final Report
	14. Sponsoring Agency Code NETC 15-4. A study conducted in cooperation with the U.S. DOT

15. Supplementary Notes
N/A

16. Abstract
The use of quality assurance (QA) systems in highway infrastructure is critical to ensure durable, safe, and economical transportation operations. These processes ensure that the desired level of quality is maintained throughout the manufacturing and construction processes. For regions such as New England, a significant cost savings can be realized if uniform QA processes are acceptable to all states, as this enables sharing of QA resources and streamlines producer and construction contractor operations. The primary objective of this study was to provide a framework to ascertain that the delivered products meet the required standards while all the New England State Transportation Agencies follow a uniform procedure in evaluating the quality of the delivered products. Through literature review and survey of agency and contractor personnel, various discrepancies in the QA specifications that are currently in use by the six New England Transportation agencies were identified and an initial roadmap was developed that leads towards the establishment of uniform QA processes for asphalt pavement construction in the region.

17. Key Words	18. Distribution Statement
Asphalt, Acceptance, Quality Assurance, Quality Control, Construction, Specification.	No restriction. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	131	N/A

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

Table of Contents

List of Figures

List of Tables

List of Acronyms

- AASHTO – American Association of State Highway and Transportation Officials
- AMRL – AASHTO Materials Reference Laboratory
- CFR – Code of Federal Regulations
- DOT – Department of Transportation
- FHWA – Federal Highway Administration
- HMA – Hot Mix Asphalt
- IA – Independent Assurance
- MSCR – Multiple-Stress Creep Recovery
- NETTCP – Northeast Transportation Technician Certification Program
- PCT – Process Control Technician
- PG – Performance Grade
- PMA – Polymer Modified Asphalt
- PWL – Percent Within Limits
- QA – Quality Assurance
- QAP – Quality Assurance Program
- QAT – Quality Assurance Technologist
- QC – Quality Control
- QCP – Quality Control Plan
- QCPA – Quality Control Plan Administrator
- QCT – Quality Control Technician
- VFA – Voids Filled with Asphalt
- VMA – Voids in Mineral Aggregate

Chapter One

Introduction

This report presents an initial roadmap towards the establishment of uniform QA processes for asphalt pavement construction in the New England region. The activities of the QA process include the quality control program, independent assurance program and acceptance program. The main aim of this study is to provide a framework to ascertain that the delivered products meet the required standards while all the New England State Transportation Agencies follow a uniform procedure in evaluating the quality of the delivered products. A significant cost savings can be realized if uniform QA processes are acceptable to all member states, as this enables sharing of QA resources and streamlines producer and construction contractor operations. The New England region already has a nationally recognized example of successful collaboration in the form of the Northeast Transportation Technician Certification Program (NETTCP). Through uniform QA processes and procedures, the training program can further be simplified.

The detailed objectives of this research study are to:

1. Review current asphalt pavement QA processes used by each state through interviews and literature review.
2. Identify best practices by working with agencies and contractors.
3. Identify cross-border issues that may impact the implementation of a uniform QA process and determine actions to alleviate these issues.
4. Develop recommendations for use of the research products in the NETTCP QA technology program.
5. Develop a white paper that provides guidance and an initial roadmap for uniform QA processes regarding HMA Acceptance and Quality Control testing in New England.

This report consists of four primary chapters:

Chapter One includes the purpose of the whole report along with the standard definitions that are applicable to asphalt pavement QA processes.

A review of the current asphalt pavement QA requirements in all the New England states have been summarized in Chapter Two. This includes information from specification review, the agency survey and discussion from the kickoff meeting. Additionally, information from the survey of contractors is included.

The cross-border challenges that could hinder the unification of the QA process are discussed in Chapter Three. In addition to identifying the challenges, possible actions that could help resolve these challenges were proposed by the agency personnel.

Chapter Four summarizes the major findings, recommendations and future extension topics on the basis of this study.

1.1 Definition of QA Terms

The following terms are listed and defined to aid in the understanding of the language used throughout this report.

Acceptance Program

A thorough and consistent evaluation of all factors that are to be used by the Owner to determine the quality and acceptability of the product or work as specified in the contract requirements. These factors include, but are not necessarily limited to, material certifications, acceptance sampling and testing, and inspection.

Acceptance Sampling and Testing

Sampling, testing, and the assessment of test results to determine the quality of produced material or construction is acceptable, in terms of the specifications.

Agency Laboratory

An Agency owned laboratory other than the central laboratory where acceptance samples are processed by Agency personnel or representatives.

Accredited Laboratory

It is a laboratory that is accredited by the AASHTO Material Reference Laboratory (AASHTO re:source).

Central Laboratory

The Agency's primary laboratory.

Certified Personnel

Any person determined qualified by an appropriate certification program, as determined by the Owner.

Clarification and Resolution of Material Test Results (Dispute Resolution)

The procedure used to resolve disputes between the Owner and its Contractor regarding material quality and material test results.

Confirmation

The act of determining whether the product supplied matches the product identified in the material certification submitted.

Contractor

The individual, partnership, firm, corporation, any acceptable combination thereof, or a joint venture which is a party to the Contract with the Owner which is undertaking the performance of the work under the terms of the Contract and acting directly or through its agent(s) or employee(s). The term "Contractor" means the prime Contractor as differentiated from a Subcontractor.

Contractor Laboratory

A laboratory which may be owned and/or operated by a Producer or Contractor. This laboratory may be located on a construction site for the purpose of processing Acceptance or quality control samples.

Fabricator or Producer

A company that produces or fabricates materials for use on a specific project (i.e. Aggregate, Hot Mix Asphalt (HMA), Portland Cement Concrete (PCC), Precast/Prestressed Concrete) by either the Contractor or Subcontractor.

Independent Assurance (IA) Sampling and Testing

Sampling and testing that is conducted by the Certifications and Independent Assurance (C&IA) Unit of the Materials & Research Section to provide an unbiased and independent evaluation of the Acceptance Program.

Independent Assurance (IA) Program

Unbiased activities that are performed by certified personnel that are not directly responsible for quality control or acceptance. These activities provide for an independent assessment of equipment, and evaluation of the sampling and testing methods employed during the Acceptance Program to ensure conformance with established procedures. Test procedures used in the Acceptance Program performed at the central laboratory are exempt from this program. Test results of IA tests are not to be used as basis of material acceptance.

Lot

A defined quantity of material from a single source assumed to be produced and/or placed essentially by the same controlled process.

Manufacturer

A company that manufactures and supplies standard manufactured materials or fabricated materials for use on a project.

Material Certifications

Documents submitted by the *Manufacturer* or *Producer* of a product that assures (or certifies) that the product used in the work conforms to all applicable requirements of the Owner's standard specifications, drawings, and contract provisions for the intended project.

Qualified Personnel

Personnel that have successfully completed the Agency's Qualified Technician Program or an Owner approved qualified technician program.

Quality Assurance Program

Documented, predicted, and systematic actions conducted to provide sufficient confidence that a product or service will satisfy given or specified requirements.

For example, it identifies the various elements of the Owner's sampling, testing and inspection programs that are in place to assure that the materials and workmanship incorporated into the Owner's construction projects are in conformity with the requirements of the approved plans and specifications including approved changes.

Quality Characteristics

The specific material properties evaluated by quality control and acceptance sampling and testing.

Quality Control

All activities performed by the Contractor, Producer, and Manufacturer in the manufacturing, production, transport and placement to ensure the materials incorporated and work performed on a project meet or exceed contract specification requirements. These activities include material handling, construction/manufacturing procedures, calibration and maintenance of equipment, production process control, sampling and testing, and inspection that are accomplished to complete the work involved in an Owner project.

Quality Control Plan

A detailed document prepared by the Contractor or Producer identifying the processes to ensure the quality of material.

Referee Sample

A split or replicate sample that is taken, prepared and stored in an agreed upon manner for the purpose of settling a dispute.

Replicate Samples

Two or more material samples taken at the same location and time. These samples are taken to estimate sampling and testing variability.

Split Sample

A split sample is a single material sample that has been divided into two or more portions. These samples are taken to estimate testing variability.

Standard Manufactured Materials

These are items produced routinely (i.e. not for a specific project) by a Manufacturer.

Sublot

A defined portion of the production lot typically represented by a single sample.

Validation

The process of comparing two independently obtained sets of test results to determine whether they came from the same population.

Verification

Sampling and testing conducted by the agency, or its designated agent, to evaluate acceptability of the final product.

Chapter Two

Review of Current Asphalt Pavement Quality Assurance Processes Used by New England States

The federal code of regulation (23 CFR 637) requires all state DOTs to adhere to the QA procedures set forth by FHWA for all construction activities conducted through the federal aid. Furthermore, FHWA recommends that the DOTs use the same QA procedures for all other non-federal aid work. Under the federal requirements, each DOT is required to develop and implement a QA program to ensure that the materials and workmanship in highway construction projects conform to the approved plans and specifications. Such a QA program requires the DOTs to maintain qualified staff and a central testing laboratory to administer the program. The QA program consists of three major components: (1) Acceptance Program; (2) Independent Assurance; and, (3) Preparation of Materials Certification. Quality assurance (QA) specifications can be used to meet the requirements of 23 CFR 637. These specifications require the contractor to be fully responsible for controlling the quality of the work, and the agency to be responsible to ensure that the quality achieved is adequate to meet the specification bid (Benson, 1999). This safeguards the State DOTs against inferior products and lowers the risk on the part of agencies. The AASHTO R 38 specifications provide the minimum criteria and guidelines for establishing and implementing QA procedures for standard manufactured materials used in highway construction (AASHTO, 2012).

2.1 Review of Current Specifications

The research team conducted an in-depth review of the current QA processes for each of the six New England DOTs. The review was conducted using the latest versions of standard specifications, supplemental specifications, and quality assurance program descriptions on each agency's website. Interviews and survey of agency personnel were further employed to obtain further clarifications of specific elements of the specifications. Details of this review including highlights of similarities and differences between QA processes for asphalt mixture production and paving are discussed next.

2.1.1 Sampling Location and Frequency

The QA specifications of the state agencies require the sampling and testing of: asphalt binder before mixing, loose mixture, and cores after compaction. Based on this, this section is divided into the three categories:

Binder

Common to most of the agencies' specification requirements for QC and acceptance testing, the PG binder is sampled in-line at the HMA production facility. However, the sampling frequencies differ. Table 2-1 shows the summary of the PG binder sampling frequencies in the six states.

Table 2-1. Summary of Binder Sampling Frequency

State	***PG Binder Sampling Frequency for Process Control and Acceptance Testing***
CT	Once per month for each source and grade
ME	Once per 10,000 tons for non-PMA, per 6000 tons for PMA
MA	Once per 12,000 tons per project.
NH	Every day during production
RI	Every day during production
VT	Once per 1000 tons or per project

Loose Mixtures

The requirements for sampling loose mixtures vary between the six states. There is also a difference in sampling as regards to the purpose, whether it is for either contractor QC or agency verification or acceptance testing. However, common in the six states is that contractors sample loose mixtures from hauling vehicles at the plant as requirements for QC. Table 2-2 provides a summary of sampling frequency for contractor QC and sampling location & frequency for agency testing.

Table 2-2. Summary of Loose Mixtures Sampling Location and Frequency for QC and Acceptance

State	***QC Sampling Frequency***	***Sampling Location for Acceptance Testing***	***Agency Sampling Frequency***
CT	Minimum of one to two times a day for their own use. Once per 500 tons when used for acceptance.	From hauling vehicles at plant	Once per 500 tons sublot
ME	Minimum of once per 500 ton sub-lots	From paver hopper	Once per sublot. (Sublot size depends on Method A, B, C or D). For Method A and C: 750 ton for mix properties. Minimum of 4 sublots. For Method B: minimum of 3 sublots. For Method D: Once per 250 ton.
MA	Minimum of once per 600 tons sublot	From hauling vehicles at plant	Once per 600 tons sublot.
NH	Minimum of once per 750 tons is recommended.	Behind paver	Once per 750 tons sublot.
RI*	Varies by contractor. Roughly about once per 500 tons.	From hauling vehicles at plant	Once per 600 tons sublot.
VT	Once per 250 ton when sampling for Mix Temperature; Once per 500 ton for other mix properties	From hauling vehicles at plant	Once per 500 tons sublot.

*RI granted autonomy to the contractors to be responsible for sampling and conducting QC tests at a frequency of their choice.

Field Cores

The cores are typically taken from the mainline of compacted HMA course. NH takes cores from the shoulder for informational purposes only for overlays and full box designs. The requirements for sampling frequency of cores vary between the six states. However, the same frequency of sampling is maintained for both the contractor QC and agency verification/acceptance testing in each of the states. The details for sampling frequency of the cores are summarized in Table 2-3. The sizes of cores taken are also specified. Some states sample cores from joint while others do not, as indicated in Table 2-3.

Table 2-3. Summary of Cores Sampling Frequency for QC and Acceptance

State	***Sampling Frequency***
CT	3 tiered approach: Less than 2000 tons project → 1 mat and joint core/500 ton 2000 – 3500 ton projects → 4 mat and 4 joint cores >3500 ton → PWL, up to 7 mat cores(1/500 ton) and 7 joint cores(1/2000ft) *All cores 6 inches in diameter*
ME	Once per 500 tons for non-surface mix, 250 tons for surface mix and joint core once per 2000 ft. *All cores 6 inches in diameter*
MA	Once per 600 tons sublot. No joint cores taken. *All cores 6 inches in diameter*
NH	Once per 750 tons sublot. No joint cores taken. *All cores 6 inches in diameter*
RI	Once per 300 tons sublot. One joint core per 3000 ft. *All cores 4 inches in diameter*
VT	Once per 500 tons sublot or 6 cores per day and 2 joint cores per mile per lot (lot size for joint cores = project length). *All cores 6 inches*

2.1.2 Quality Control Testing

The contractors are required by all the states to ensure that the asphalt binder passes the AASHTO M320 PG requirements. In addition to the binder quality control, QC tests are conducted on the loose mixtures and cores. Each state's test requirement is summarized in Table 2-4. Rhode Island is excluded from the table as they grant contractors autonomy on QC tests.

Table 2-4. Summary of QC Testing Requirements

Parameters	***CT***	***MA***	***ME***	***NH***	***VT***
Aggregate Gradation	✓	✓	✓	✓	✓
Air Voids	✓	✓	✓	✓	✓
Binder Content	✓	✓	✓	✓	✓
Mix Temperature	✓	✓	✓	✓	✓
Aggregate Angularity	✓	✓	✓		✓
In-place Density for Mat	✓	✓	✓	✓	
Maximum Theoretical Specific Gravity	✓	✓	✓	✓	
Voids in Mineral Aggregates (VMA)	✓	✓	✓		✓
Cross Slope		✓	✓	✓	
In-place Density at Joint	✓	✓	✓		
Pavement Thickness		✓	✓	✓	
Voids Filled with Asphalt (VFA)	✓	✓	✓		
Ride Smoothness		✓	✓		
Surface Temperature		✓	✓		
Effectiveness of Anti-stripping Additive in PG Binder (boiling method)					✓

2.1.3 Independent Assurance Testing

At times, states employ IA program to evaluate mix quality. The testing requirements by each state are summarized in Table 2-5.

Table 2-5. Summary of IA Testing Requirements

Parameter	***CT***	***MA***	***ME***	***NH***	***RI***	***VT***
Binder Content	✓	✓	✓	✓	✓	✓
Aggregate Gradation		✓	✓	✓	✓	✓
Air Voids	✓	✓	✓		✓	✓
Maximum Theoretical Specific Gravity	✓	✓	✓		✓	✓
Mix Temperature	✓	✓			✓	✓
Voids in Mineral Aggregates (VMA)	✓		✓			✓
In-place Density for Mat		✓			✓	
In-place Density at Joint					✓	
Pavement Thickness		✓				
Voids Filled with Asphalt (VFA)			✓			

2.1.4 Agency Validation/Acceptance Testing

In four (CT, MA, ME, VT) out of the states, the DOT personnel periodically oversee QC testing and/or validate results. VT specifically staffs an Agency Plant Inspector. The test results validated by the agencies are summarized in Table 2-6 (details of CT not represented). On the other hand, no validation of the QC test is done by DOT personnel in the other two states (NH & RI); QC results are purely for contractor's use.

Table 2-6. Summary of Agency Validation Testing Requirements

Parameters	***MA***	***ME***	***VT***
Binder Content	✓	✓	✓
Air Voids	✓	✓	✓
In-place Density for Mat	✓	✓	✓
Ride Smoothness*	✓	✓	✓
Maximum Theoretical Specific Gravity (Gmm)	✓	✓	✓
Aggregate Gradation	✓	✓	
In-place Density at Joint*		✓	✓
Pavement Thickness	✓	✓	
Voids in Mineral Aggregates (VMA)	✓	✓	
Mix Temperature	✓	✓	✓
Cross Slope		✓	✓
Voids Filled with Asphalt (VFA)	✓	✓	
Aggregate Angularity	✓	✓	
Surface Temperature	✓	✓	

For Agency acceptance, the sampled materials are tested by the states for different parameters as summarized in Table 2-7. The tests are conducted by the states in different lab locations as follows:

- Central Lab (CT (cores), ME, RI and VT (cores))
- District Lab (ME)
- Plant Lab (CT (loose mixtures), MA, NH and VT (loose mixtures))

Table 2-7. Summary of Agency Acceptance Testing Requirements

Parameters	***CT***	***MA***	***ME***	***NH***	***RI***	***VT***
Binder Content	✓	✓	✓	✓	✓	✓
Air Voids	✓	✓	✓	✓	✓	✓
In-place Density for Mat	✓	✓	✓	✓	✓	✓
Ride Smoothness*	✓	✓	✓	✓	✓	✓
Maximum Theoretical Specific Gravity (Gmm)	✓	✓	✓	✓	✓	✓
Aggregate Gradation			✓	✓	✓	✓
In-place Density at Joint*	✓		✓		✓	✓
Pavement Thickness	✓	✓		✓	✓	
Voids in Mineral Aggregates (VMA)	✓		✓			✓
Mix Temperature	✓				✓	✓
Cross Slope	✓			✓		✓
Voids Filled with Asphalt (VFA)	✓		✓			
Aggregate Angularity					✓	
Surface Temperature					✓	

*sometimes tested by ME

2.1.5 Chain of Custody

The philosophy behind the chain of custody in the states vary depending on whether it is loose mixture or core. There are three approaches which are utilized which are summarized in Table 2-8:

Table 2-8. Summary of Chain of Custody Approaches

Approach	***CT***	***MA***	***ME***	***NH***	***RI***	***VT***
Loose Mixtures: DOT personnel take immediate possession	✓	✓		✓		✓
Loose Mixtures: Contractor delivers sample to agency			✓		✓	
Cores: DOT personnel take immediate possession		✓				
Cores: Contractor delivers sample to agency	✓		✓	✓	✓	
Cores: Courier services are utilized						✓

2.1.6 Dispute Resolution

In an event of a dispute between the contractor and agency results, there are different approaches towards its resolution:

- In CT, MA & ME, already sampled splits are taken and tested. Additionally, in MA, the central lab serves as an arbitrator. ME on the other hand does not allow dispute on core results but on the location of the sampling.
- In NH & VT, new samples are taken and tested. However, in NH, this is only allowed for core samples. VT on the other hand allows dispute on the location of core sampling and not the test results.
- RI does not allow any form dispute resolution. The agency results are only validated.

2.1.7 Paperwork/Report Requirements

Along with testing requirements associated with QA process, it is important to be able to relate the feedback to the contractors. The agencies have different mediums of disseminating feedback, not all come in the form of a standardized paperwork/report:

- CT: The loose mixture results are readily available to the contractors as the testing is done at the plant lab. However, the results of the core testing is referred back using specific agency forms through project personnel.
- MA: Spreadsheet containing the quality level analysis is made available. However, this varies by district, as some districts do not share the information. A database system is currently under development to better reform the process.
- ME: The forms/reports associated with agency test results are automatically generated from a database system and sent to a contractor representative.
- NH: The testing results are readily available to the Resident Engineer as testing is done at the plant lab. It is then up to the Engineer as to whether to give the feedback to the contractor or not. A database system is also under development to reform the process.
- RI: A copy of the testing result is readily available to the contractors when they deliver samples to the central lab.
- VT: Just started using software systems to organize and share results as opposed to sending out through email as was done in previous years. Still send emails to Resident Engineers and contractors per request.

2.1.8 Pay Factor

Following the acceptance, each state has different aspects of the QA specification on which payments is based. CT, ME and NH use a composite calculation and MA, RI and VT calculate it separately. The parameters used are summarized in Table 2-9:

Table 2-9. Summary of Pay Factor Parameters

Parameters	***CT***[1]	***MA***	***ME***[2]	***NH***	***RI***	***VT***
Binder Content	✓	✓	✓	✓	✓	✓
Air Voids	✓	✓	✓	✓	✓	✓
In-place Density for Mat	✓	✓	✓			✓
Aggregate Gradation			✓	✓	✓	
In-place Density at Joint			✓		✓	✓
Pavement Thickness	✓	✓		✓	✓	
Ride Smoothness		✓	✓		✓	✓
VMA	✓		✓			
Cross Slope				✓		

[1] adjusts for thickness only when off.

[2] aggregate gradation is included only in some jobs

2.1.9 Certification Requirements

To effectively administer the QA program, all states except RI require some form of NETTCP certified positions. The positions obtainable in each state are summarized in Table 2-8.

Table 2-10. Summary of Positions/Certification Requirements

Contractor Certified Positions	***CT***	***MA***	***ME[1]***	***NH***	***VT[2]***
HMA Plant Technician	✓	✓	✓		✓
HMA Paving Technician	✓	✓	✓		✓
Quality Control Plan Administrator (QCPA)		✓	✓	✓	✓
Quality Assurance Technologist (QAT)		✓	✓		✓
Quality Control Technician (QCT)			✓	✓	
Process Control Technician (PCT)			✓		✓
Agency Certified Positions	***CT***	***MA***	***ME[1]***	***NH***	***VT[2]***
HMA Plant Inspector			✓		✓
HMA Paving Inspector			✓		

[1]QCPAs must be QAT certified. PCTs and HMA Plant Inspectors (for QA) require the HMA Plant Technician certification. QCT and Paving Inspectors (for QA) require the HMA Paving Technician Certification.

[2]QCPAs must be QAT certified. PCTs and HMA Plant Inspectors (for QA) require the HMA Plant Technician certification.

2.2 Contractor Recommendations

In the course of this project, a survey was sent to 17 QC personnel from companies working in the New England region. Seven responded, weighing in on their thoughts on the cross-border issues and how it affects their productivity. Table 3-1 gives a summary of the respondents, the companies they represent and states their company works in.

Table 2-11. Contractor Survey Respondents

Contractors (No. of Personnel)	**States**
Lane Construction Corporation (1)	CT, MA, NH, VT
Brox Industries (1)	ME, MA, NH
Pike Industries (3)	ME, NH, VT
P.J. Keating (1)	MA, RI
J. Hutchins, Inc.(1)	NH, VT

2.2.1 Sampling Location and Frequency

There were minimal issues with the sampling frequency of the materials. However, few differences that may pose as a challenge were pointed out:

- VT tends to take more cores than other states.
- Maine always has contractors take extra boxes of QC sample.

For sampling location, the contractors recommended the following:

- There was a consensus that in-line binder sampling is the most suitable.
- There were concerns that Maine sampling out of paver hopper tends to result in a halt in paving operations which leads to issues with heat loss, density loss and ride quality.
- All the contractors prefer sampling loose mix in plant for real time adjustments or behind paver as the next best option. Cores should be taken from mat for evaluation.

2.2.2 Testing Requirements

There were also minimal issues with QC testing requirements in all the states as the contractors considered the differences to be minor. However, the following recommendations were given by some of the contractors:

- It was suggested that RI should allow contractor's test results to be used in pay factor calculations as it allows the product quality to be measured/assessed more accurately with a larger pool of data.
- It was recommended that the contractor be in control of frequency and tests that need to be run to control the process so that the focus will be more on the entire production process and not just the testing aspect of QC.

Furthermore, the contractors suggested optimal QA tests which they believe should be adequate for evaluation of quality of the products delivered. These tests are summarized in Figure 2-1 and are ordered from most recommended to least recommended.

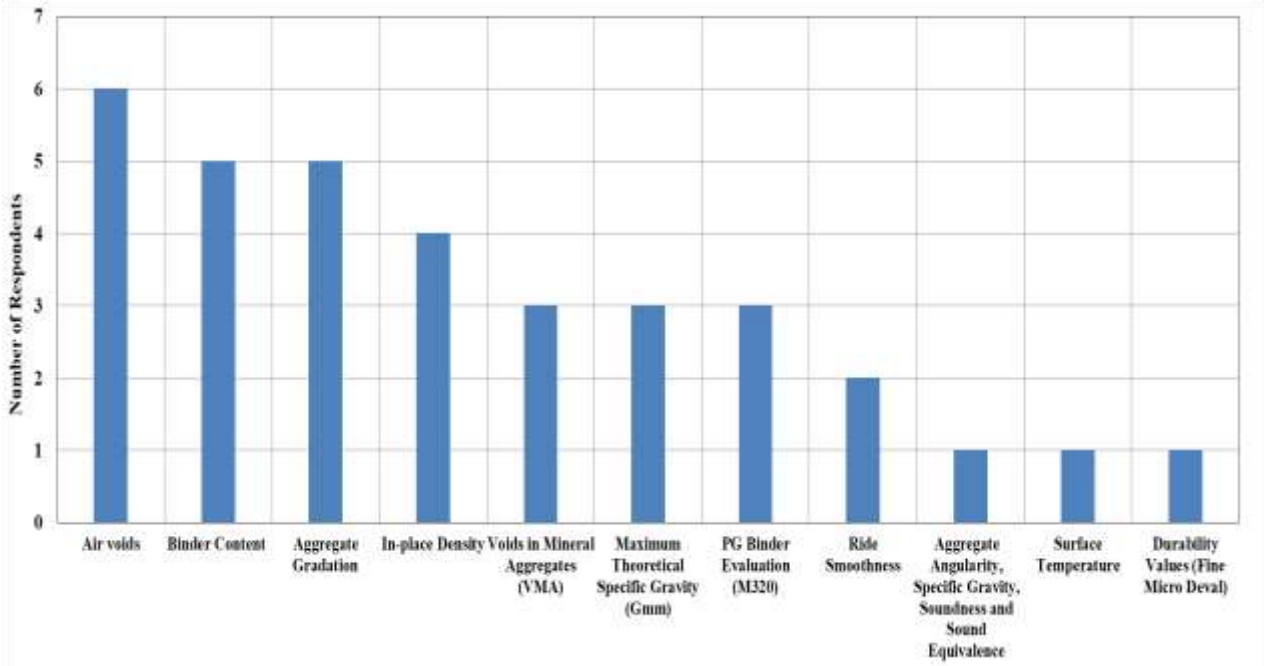


Figure 2-1. Suggested Optimal QA Tests

2.2.3 Paperwork/Report Requirements

In terms of paperwork/report requirements, most contractors did not have any issues. However, it was highlighted that CT requires a gradation report using individual percent passing each sieve instead of cumulative percent passing used by other states. Contractors expressed concerns on timing for retrieval of results, particularly in VT.

2.2.4 Chain of Custody

Contractors were all fine with current chain of custody in the six states even though it is slightly different. This is because they already are used to the process. However, it was recommended that special transport boxes should be used in MA for cores to eliminate any chance the samples could be damaged in transit.

2.2.5 Additional Recommendations

There were additional recommendations on some other specific parameters or tests they believe there should be a consensus on. These include the following:

- All states should consider settling on a particular VMA target.
- Aggregate specific gravity should be allowed to move with the material instead of the states having hard limits.
- Hamburg Wheel Tracker test parameters should be consistent between Maine and Vermont

Chapter Three

Cross-Border Issues: Challenges and Opportunities

Stemming from the review of the QA specifications of the agencies, it is apparent that there are aspects where the states' philosophies are similar, whereas in other cases they are totally different. This section summarizes some of the identified opportunities as well as cross-border challenges that could hinder the unification of the QA specification in the New England region. Included in this chapter are details from the workshop which was organized to help discuss these issues and some possible actions were proposed by agency and contractor personnel that could help resolve the challenges.

3.1 Cross-border Issues

3.1.1 Sampling Location and Frequency

Binder

All states sample PG binder at the same location: in-line at the plant. However, the frequency of sampling differs. Each agency further highlighted that their current sampling frequency is unsatisfactory. A more practical system for sampling PG binder therefore needs to be identified. Suggestions from the workshop include that daily sampling should be considered but testing may not be daily. These samples can be referred to in the event of a failure.

Loose Mixtures

For QC purposes in all the states, contractors commonly sample loose mix from the truck at a similar frequency (at least once per 500 tons). This poses as an opportunity where a single minimum test frequency can be adopted to better streamline the process and still be satisfactory to states sampling at a lower frequency. On the other hand, agencies sample either from the truck, from the paver hopper, or behind the paver. Concerns therefore arise as to location that best represents the property of the materials. The frequency of agency sampling also differs considerably with some of the states employing a tiered approach while the others do not. It will therefore be challenging to have a consensus on a frequency that can be adopted.

Field Cores

In sampling field cores, one significant difference is that some states require coring at the longitudinal joint while other states do not. This is directly related to the difference in the technology for testing mat & joint densities. The question is then whether every state can afford similar technology or a consensus on sampling of joint cores can be reached. Most states are however in favor of adopting joint core sampling. Additionally, there is a dilemma on the part of the joint that should sampled (directly in the middle or at an offset), if joint cores are to be sampled. Considering the sizes of cores sampled, all but one of the states already sample 6-inch cores. It is apparent that this could present itself as an opportunity where this single size can be adopted by the remaining state without having any negative impact. In terms of sampling frequency, the approach in all the states vary significantly. This also might be challenging to reach a consensus.

3.1.2 Testing Requirements

The previous chapter summarized the various tests currently used to evaluate the quality of products. However, there is need to itemize the optimal tests that can be used to assess quality. These tests can apply to QC, IA and acceptance purposes.

The agencies concurred that the most critical tests associated with evaluating PG binder include:

- PG grading (AASHTO M320)
- Extended aging evaluation (with which an agreement is needed on definition of extended aging)
- MSCR for polymer modified binders

The agencies also concurred that the optimal tests for evaluating loose mixtures include:

- Binder content
- Aggregate gradation
- Air Voids
- VMA
- Some form of performance testing in future

For evaluating quality of cores, the following parameters were suggested by the agencies in consensus as optimal:

- In-place air voids
- Thickness

3.1.3 Chain of Custody

The chain of custody practiced by the six member states do not differ significantly. Most of the states already take possession of loose mixtures as soon as it is sampled and have contractors deliver the cores after being safe-guarded. The challenge that may arise from attempting to get all the states to adhere to one method or the other is associated with testing location (whether plant or state lab). It is easier for states that test in the plant lab to immediately take possession of samples. On the other hand, states that test in state lab would rather have contractors deliver samples. One thing that can however be easily adopted by all states is a method of securing the loose mixtures and/or cores when sampled.

3.1.4 Dispute Resolution

The state agencies employ varying approaches towards dispute resolution that may pose a challenge in reaching a consensus. However, in an attempt to unify the QA specification, it is imperative to identify best approach to resolving dispute between agencies and contractors. One recommendation by the agencies is that it will be best to base the dispute resolution only on pay factor results (and tests that relate to those).

3.1.5 Paperwork/Report

Feedback/results from the agency QA testing needs to be related back to the contractors as quickly as possible. This could result in a better control in production process and necessary adjustments can be made to further minimize risks. The state agencies currently employ different methods of sharing this information. Whereas some are more effective, others take longer times. In an aim to unify the QA specification, the best way of getting the detailed results sooner to the contractors needs to be identified. There are also concerns as to what information could be included. Some states are either currently using or developing a database which generates and sends reports automatically to the contractor. Initial discussions from the workshop point towards having a detailed report that looks at all quality level analysis results instead of just a final summary.

3.1.6 Pay Factor

State agencies currently use different aspects of the QA specifications to calculate pay factor as summarized in the previous chapter. Where some of the states calculate it separately for the various parameters, others calculate compositely using an equation. This poses a challenge to the unification process and therefore the first step to resolving this will be in identifying the most important aspects of the QA specifications that should affect the pay factor. These aspects should be most critical with respect to longevity. Once identified, a fair strategy (separate or composite) could be adopted by all the state agencies to calculate pay factor.

3.1.7 Certification Requirements

The certification and training requirements for contractor process/quality control personnel and agency QA personnel vary between the five agencies to which it is applicable. However, the certification requirements all use the NETTCP training program. RI is the only state that does not require any form of certification. Ultimately, the aim of the certification is to ensure that each personnel in charge has a good understanding and training in the QA process. Although this may not pose a significant challenge, it may be helpful to determine which requirement are considered adequate for the positions for the unification of the QA specifications.

3.1.8 Agency Presence in Plant Facility

Ideally, agencies are required to periodically inspect the contractor plant facilities in order to ensure they meet required standards. This plays a role in the success of the QA program. One thing that is a concern is how often this inspection is needed. Although this might not be a problem for agencies that already carry out tests in the plant lab, it is a concern for other agencies that do not. Currently, the inspection is done at least once annually by almost all agencies. The question is then whether that will be adequate to be adopted in a common specification or more presence is needed.

3.1.9 Political or Fiscal Barriers

Stemming from the discussion during the workshop, some additional political and/or fiscal barriers were identified that may hinder the adoption of a unified QA specifications. These include:

- Location of personnel which is dictated by where testing is done – at plant lab or agency lab.
- The possibility of one agency's employee working for another agency's job.
- The feasibility of one agency's certification from plant inspections being acceptable to other agencies.
- Problem/issues arising from one plant producing mix for more than one state on the same day, depending on how often this may occur.
- The ease of passing through state borders and how this may affect the contractors delivering materials across borders.
- Possible need for hiring of additional plant/site staff associated with adopting a process that might be new to an agency.

Chapter Four

Conclusions and Recommendations

The overall goal of this study was to present an initial roadmap that leads towards the establishment of uniform QA processes for asphalt pavement construction in New England region. The research activities included an in-depth review of the current QA processes for each of the six New England DOTs. The review was conducted using the latest versions of standard specifications, supplemental specifications, and quality assurance program descriptions on each agency's website. Interviews and survey of agency personnel were further employed to obtain further clarifications of specific elements of the specifications. A highlight of the review findings is presented next.

4.1 Summary of Review Findings

Based on the reviews and surveys conducted, the major findings are summarized as follows:

- **Binder:**
  - Most of the agencies sample binder in-line at different frequencies ranging from every day to once per project.

- **Loose Mixtures:**
  - Contractor QC: loose mixtures are sampled from hauling vehicles at the plant at varying frequencies ranging from once per 500 to 750 tons with once per 500 tons being the most common.
  - Agency sampling: sampling of loose mixtures is either done from hauling vehicles at the plant, or the paver hopper or behind the paver. The most common location is from hauling vehicles at the plant. The frequency of sampling ranges from once per 500 to 750 tons

- **Field Cores:**
  - All agencies sample field cores of 6 inches except RI that samples 4-inch field cores.
  - Sampling is done from the mat and the frequency is unique to each state.
  - Some states sample field cores from joint while others do not.

- **QC Testing:**
  - Every state except RI specify the minimum number of test requirements for QC purposes. Whereas most of the tests are common, there are a few tests unique to some states.

- **IA Testing:**
  - All six of the states employ the IA program. However, the test requirements vary.

- **Agency Testing:**
  - Contractor results are validated in four out of the six states. Most of the test results validated are common to at least two states.
  - There are only a few tests that are not common among the states that are included as part of the acceptance requirements.

- **Chain of Custody:**
  - Loose mixtures: four states have the DOT personnel take immediate possession while the other two states have the contractor deliver them.
  - Cores: all except one state has the contractor deliver the samples.

- **Dispute Resolution:**
  - Apart from RI that does not allow any form of dispute resolution, three states test splits that are sampled while the remaining two states take new samples.

- **Paperwork/Report Requirements:**
  - The state agencies currently employ different methods of sharing feedback/results back to contractors. Whereas some are more effective, others take longer times.
  - Some states are either currently using or developing a database which generates and sends the report automatically to the contractor.

- **Pay Factor:**
  - Currently, state agencies use different aspects of the QA specifications to calculate pay factor. Where some of the states calculate it separately for the various parameters, others calculate compositely using an equation.

- **Certification Requirements:**
  - The certification and training requirements for contractor process/quality control personnel and agency QA personnel vary between the five agencies. However, the certification requirements are all a form of NETTCP training program. RI is the only state that does not require any form of certification.

- **Political/Fiscal Barriers:**
  - Some political and/or fiscal barriers were identified that may hinder the adoption of a unified QA specifications.

4.2 Summary of Recommendations

Based on the review findings, recommendations are made regarding possible steps towards the unification of QA processes between New England state transportation agencies. The recommendations cut across the aspects of the QA specification in which cross-border challenges were identified.

4.2.1 Sampling Location and Frequency

Binder

- Sampling Location:
  - Since asphalt binder may get contaminated in the tank, in-line is the proper location for sampling to evaluate quality of the binder directly going into the mixture. Therefore, no changes need to be made in any of the states as this is already applicable.
- Sampling Frequency:
  - Going from the discussion in the workshop, it is recommended that each type of binder used per project be sampled daily.
    - For QC purposes, it should be tested daily to ensure compliance.

- For acceptance/verification purposes, a frequency of randomly choosing one out of seven for testing can be adopted.

Loose Mixture

- Sampling Location:
  - For QC purposes, it is recommended that the practice of sampling from the truck at plant should be retained for real time adjustments and easier process control. It has however been repeatedly observed that properties of material at the field tend to differ from material sampled from truck at plant.
  - For acceptance, agencies are recommended to sample behind the paver to get a more representative sample of the final product in the field. This will further act as a check and encourage contractors to address issues that may be related to transport of materials.

Sampling Frequency:

  - For QC purposes, contractors in most states are already required to sample at least once every 500 tons. For uniform requirements, this frequency should be adopted as the minimum by all states. For states not already using this frequency, this will result in a more frequent evaluation of quality which is a positive step towards minimizing risk.
  - For acceptance/verification, a tiered approach based on the importance of the project, similar to what ME and VT (for cores) currently have in place will be the most feasible and should be adopted.

Field Cores

- Sampling Location:
  - It is recommended that mat cores be taken from the mainline for evaluation.
  - Due to difference in joint construction techniques, it is recommended that sampling of joint cores be made optional in the unified specifications.
    - The part of the joint that is cored should be dependent on the type of joint. For a traditional butted joint, the core should be cut directly on the joint. When a notch wedge is used the core should be centered above the wedge, offset from the visible joint, with the offset determined by the size of the wedge.

- Sampling Frequency:
  - A tiered approach based on the importance of the project will also be the most feasible and should be adopted.

4.2.2 Testing Requirements

  - All states should consider adopting QC testing requirements. This will ensure the QC results are evaluated in a standard manner and can therefore be used in the pool of data validated during acceptance.
  - It is recommended that the testing requirements be consolidated into the parameters that have already been identified by consensus by agencies and contractors as the optimum for evaluating quality. These same tests should be applicable to the contractor QC, agency verification/acceptance and IA programs where applicable. The minimum tests should include:
    - Binder: PG testing (AASHTO M320), Extended aging evaluation (40PAV), MSCR for polymer modified binder
    - Loose mixtures: Binder content, Aggregate gradation, Volumetrics (Air Voids, VMA and VFA)

        - Cores: In-place mat & joint density, thickness.
        - Post construction: Ride smoothness and cross slope
    - Additionally, for QC only: Aggregate angularity, mix temperature and surface temperature should be tested as they are secondary parameters that may affect the ease of construction in an attempt to meet the criteria of some of the primary parameters listed above.
    - Subsequently, a clause in the specification may be added where on occasions additives are used such as anti-stripping agent, the agency may be allowed to request performance testing. This in turn should be project specific.

4.2.3 Chain of Custody

- Loose mixtures:
    - Due to difference in testing location (plant lab or state agency lab), it is recommended that two alternatives be included in a unified specification as follows:
        - DOT personnel take immediate possession of sample in all the states that test at the plant.
        - Courier services can be employed in the states that test at the state lab.

- Field Cores:
    - For an efficient and timely delivery process, courier service is recommended to be used for field cores by all states. Additionally, the transport boxes and security measures currently employed by ME should be adopted.

4.2.4 Dispute Resolution

- It is only fair to the contractors to allow some form of dispute resolution process. This is therefore recommended for adoption by all states.
- Sampling splits from the onset for this purpose should be the most efficient method. On occasions where the dispute arises, the split samples can then be tested and used for validation.

4.2.5 Paperwork/Report

- All states should consider developing a database system/portal that generates and makes a report automatically available to the contractor. This will be the most efficient way that can be adopted to share information to contractors in a timely manner.
- It is recommended that this database system be similar or compatible across states for easy sharing of information.
- It is also recommended that the report generated should include the detailed quality level analysis.

4.2.6 Pay Factor

- Time wise, it is evident that some elements of the pay factor are evaluated at different stages of the project. Therefore, the best approach will be to calculate pay factor separately on each element and payment can be made as applicable.
- Pay factor parameters should include: gradation, binder content, volumetrics (air voids, VMA, VFA), in-place mat and joint density, thickness, ride quality, and cross slope. Each of these elements are critical and will directly play a role on performance.

4.2.7 Certification Requirements

- It is recommended that every state have NETTCP certification requirements for contractor personnel as well as agency personnel.

- The minimum contractor personnel NETTCP certification requirements should include: HMA Plant Technician, HMA Paving Inspector and Quality Assurance Technologist. These certifications should be adequate to ensure that all personnel are knowledgeable in the respective process.
- The minimum agency personnel NETTCP certification requirement should include: HMA Paving Inspector and HMA Plant Technician (for agencies with staff in the Plant).

4.2.8 Agency Presence in Plant Facility

- Ideally, more frequent plant inspection or staffing personnel at plant is required for better efficiency of the QA program. However, this may not be feasible for states with several plants at different locations. It is therefore recommended that Agencies consider casually inspecting plant facilities depending on availability.
- An official annual inspection should be scheduled. This should be adequate for evaluating the plant facilities.
- Additionally, each state's inspection certification should be generally accepted. As a result, where two or more states are serviced by one plant, it is recommended that they should consider alternating the inspection in such a way that it is done at different times of the year.

4.3 Conclusions

This report highlighted various similarities and discrepancies in the QA specifications for plant-produced asphalt mixtures that are currently in use by the six New England Transportation agencies. From findings through literature review and survey of agency and contractor personnel, an initial roadmap was developed that leads towards the establishment of uniform QA processes for asphalt pavement construction in New England region. Next steps towards implementing these recommendations include:

- Agencies are required to reach a consensus to adopt the outlined recommendations by going through an iterative process via additional workshops and pilot projects.
- A draft of common QA specs will be required for New England agencies (including optional/alternate processes as appropriate).
- Further education and training will be required for QA personnel (both contractor staff and agency inspectors).
- A cost sharing model needs to be developed to be able to appropriately allocate the cost of inspection.
- A pilot plan need to be implemented so as to document cost savings and efficiency gains for agencies and contractors as well as to refine the common QA specifications.
- Finally, pertinent approvals need to be obtained from FHWA.

References

AASHTO. (2012). Standard Practice for Quality Assurance of Standard Manufactured Materials. In AASHTO, *Designation: R38-10* (pp. 1-19). Washington DC: American Association of State Highway and Transportation Officials.

Federal Highway Administration. (2011). *Title 23 PART 637 - Construction Inspection and Approval, Subpart B - Quality Assurance Procedues for Constructon.* Washington DC: Department of Transportation.

Transportation Research Board. (2009). *Glossary of Highway Quality Assuance Terms.* Washington DC: The National Academies.

Appendix A: Agency Survey Results

This section contains the responses from the agency survey conducted in the course of this study.

Default Report

NETC_15-4_QR_As_administered_survey

December 5th 2018, 3:19 pm MST

8 - What elements or specifications of your current asphalt pavement QA practice do you feel strongly should NOT be changed?

What elements or specifications of your current asphalt pavement QA practice do you feel strongly should NOT be changed?
Cores for in-place density testing.
While a volumetric design process is used to determine the JMF, the use of gradation and AC content provides a stronger method of controlling production.
Out of our QA practices, most of our current acceptance specifications and practices work very well for us. Our dispute resolution process, IA Program, Random sampling and statistical acceptance, as well as our certification requirements for both acceptance and QC staff and our laboratory quality system with proper accreditation.
This is a difficult question to answer. Since we are just completing a rewrite we reevaluated all the requirements to make sure we have what we need. However, we're hoping that through this project we may be made aware of beneficial changes.
Unknown.
Minimum QC testing requirements (what the Contractor is required to test during production). QC Plan requirements.

8a - What is the logic behind the element(s) of your current practice that you wish to maintain?

What is the logic behind the element(s) of your current practice that you wish to maintain?
Consistent and accurate method to determine critical HMA property.
If gradation and AC content characteristics are met, volumetrics will follow.
A fair specification using measures that are known to have an impact on the life of our treatments so we can provide as much of an indication of how well they will preform. our intent is to have an overall QA program with core elements that function well together and integrate with each other.
All of the requirements in our specification come from documentation, such as AASHTO or FHWA, or from our experiences.
Unknown.
Establishes the minimum testing requirements for the production of asphalt materials at the plant. Defines the roles & responsibilities of Contractor personnel.

9 - What elements or specifications of your current QA practice would you want to change?

What elements or specifications of your current QA practice would you want to change?
Sampling from Haul unit at plant
None
We would like to have a greater presence in our contractor plant facilities as well as improved QC/production requirements.
The one thing that we have had trouble coming to a consensus in is how to handle the acceptance of PG binder. We currently sample once every 12,000 tons per project but this gets a little confusing.
Unknown.
Sampling location (behind the paver instead of at the plant to evaluate in-situ characteristics) Performance testing (i.e., Hamburg and SCB/IFIT testing) with pay factors

9a - How would you like to see your current practice improved?

How would you like to see your current practice improved?
Sampling at the paver
more frequent plant inspections, improved process control by our material producers.
Like to have a more straight forward way of accepting binder, especially how to handle things when there is a failure.
Unknown.
Same as above.

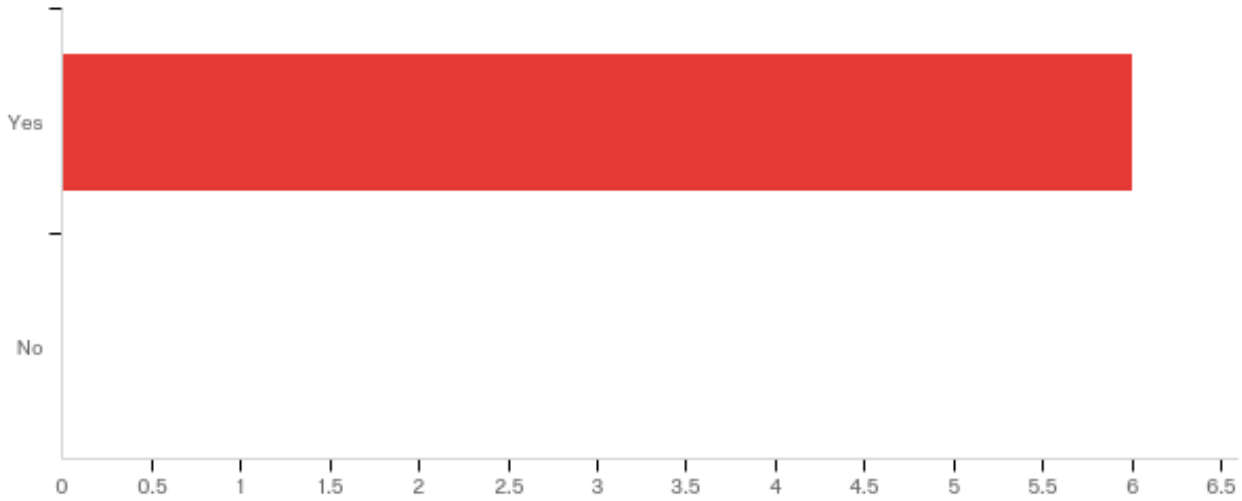
9b - What are the impediments to making the change(s) you've identified here?

What are the impediments to making the change(s) you've identified here?
Specification development, personnel reassignments, procedure development and documentation.
industries lack of understanding of process control as well as a lack of positions/qualified personnel to fill them.
We are concerned that to alleviate confusion we must sample more but more sampling could lead to more testing than we can currently perform.
Unknown.
Pushback from the Contractors Feasibility & development of pay factors

10 - What are the barriers specific to your state that would make it challenging to change your current QA practices or specifications?

What are the barriers specific to your state that would make it challenging to change your current QA practices or specifications?
Industry resistance. Lack of agency personnel and equipment resources.
Proof of a process that improves our product performance.
We have some geographical challenges given the size and remoteness of some parts of the state as well as differing materials due to the same. We also have constraints to the number and availability of staff to contend with as well.
We currently allow for Contractor testing to be used for payment. From our understanding the majority of states around us do not do this.
Contractor resistance.
Pushback from the Contractors. Giving up control of production at the plant. Internal stakeholders within the Agency (i.e., political and/or fiscal considerations).

2 - Do you work with or know of contractors who work across state borders, specifically in New England?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you work with or know of contractors who work across state borders, specifically in New England?	1.00	1.00	1.00	0.00	0.00	6

#	Answer	%	Count
1	Yes	100.00%	6
2	No	0.00%	0
	Total	100%	6

2a - If yes, list the contractors:

If yes, list the contractors:
Lane, Palmer, Galasso, American Industries (these are Contractors and Producers) Killingly Plant is owned by ALLSTATES.
Pike Industries, Inc. Brox Industries, Inc. Continental Paving, Inc. Lane/Cold River Materials Hutchins PJ Keating
For HMA contractors -Pike Industries, Continental Paving, Dayton Sand & Gravel, Brox Industries are all ones I know of that have operations either in Maine or New Hampshire that at times work in a different state than the one they're based in. Lane does have operations both in and out of Maine however their Maine based production/laydown operations generally don't cross state lines.
Brox Industries J.H. Lynch & Sons Lane Construction P.J. Keating Pawtucket Asphalt Ondrick Materials & Recycling Warner Bros. (All States Materials Group)
JH Lynch, Cardi Corp, PJ Keating, T. Miozzi?
Pike Industries Peckham Industries All States Asphalt Lane Construction Corporation

3 - From what specific locations do contractors draw samples for QC testing?

From what specific locations do contractors draw samples for QC testing?
Hauling Unit at the plant.
Brox: Dracut, MA; Amherst, Hooksett, Hudson, Keene and Rochester, NH Pike: Hooksett, Portsmouth, Northfield, Gorham, Columbia, Madison, Farmington and Lebanon NH; Waterford VT; Wells ME Continental: Londonderry, Litchfield and Pembroke NH Lane: Walpole, NH; Northfield, MA Hutchins: Irasburg VT (no plant yet; expected before end of 2018) PJ Keating: Lunenburg, MA
Generally most contractors sample from truck bodies for QC testing.
Binder - can vary; either the truck, the tank, or inline HMA - Primarily out of the truck
The truck beds
Truck at the plant Tank at plant Stockpile at plant

3a - How often do contractors sample for QC purposes?

How often do contractors sample for QC purposes?
One to two times a day for their own use. One per 500 tons when used for acceptance.
Don't know.
Contractors sample in maximum 500 ton sub-lots for QC but will at times sample more frequently.
Depends on the material and project requirements: For projects under Section 450 the sampling requirements, including frequency, are listed in Section 450. For those items not specifically listed in Section 450 it is up to the Contractor to sample and test at the frequency required to keep their operation in control. This should be listed in their QSMs and QC plans.
Varies by contractor, mix project, etc. Very roughly 500 tons?
Refer to frequencies provided in Table 406.03I of the 2018 Standard Specifications for Construction.

3b - Where are these samples tested?

Where are these samples tested?
At the Plant Laboratory
Plant laboratory.
At contractor labs generally located right at the plant location or close to it.
For the most part all materials are tested at the QC lab at the plant except for PG binder.
QC lab at plant
In QC lab at plant.

3c - What is the chain of custody to get the sample from source to testing location?

What is the chain of custody to get the sample from source to testing location?
ConnDOT staff witness sampling and testing.
Not necessary. NH does not use contractor test results for acceptance.
The contractor's QC personnel who sample are generally the ones who will run the testing as well.
QC technicians take their own samples for QC testing. MassDOT does not mandate any formal chain of custody for QC sampling and testing.
It's anywhere from 50 to 200 feet. And we don't monitor their testing.
QC technician at plant is responsible for handling their own samples.

3d - Who oversees or validates contractor-tested results?

Who oversees or validates contractor-tested results?
ConnDOT staff witness QC testing used for acceptance and ConnDOT staff validate those results.
Not applicable. See 3c.
We dont validate or oversee contractor test results as we dont use their results in acceptance, we do preform some testing of contractor splits to compair to thier results.
MassDOT has the ability to witness any QC testing performed for our projects. QC results are statistically validated with MassDOT's on larger HMA projects. QC must also have NETTCP qualified manager, technician, and laboratories as well as successfully completed independent assurance testing or round robin.
No one. We don't use them.
Agency plant inspector.

5 - How often does the agency conduct its own QA (acceptance) sampling during the project corresponding to the contractor's?

How often does the agency conduct its own QA (acceptance) sampling during the project corresponding to the contractor's?
ConnDOT performs verification sampling and testing. One per 1750 tons.
Once per 750 Tons. Does not correspond with contractor sampling.
our acceptance samples are generally taken at a maximum of 750 tons per sub-lot but are taken more frequently in lots with smaller quantities. we have different testing minimums per lot depending on the project either a minimum of 4 mix samples and 5 cores or 3 mix samples and 3 cores. Contractors take a split of the mix samples for dispute purposes.
Listed in 450. For - Category A - a minimum of 25% of the sublots - Category B - a minimum of 50% of the sublots - Category C - 100% of the sublots
Every 600 tons.
Air Voids Pay Adjustment: 1/500 ton sublot per mix design Mat Density Pay Adjustment: For projects less than or equal to 0.5 miles, 4 cores per day production; for projects greater than 0.5 miles, 1 core for every 0.6 miles with a minimum of 6 cores taken per day production Longitudinal Joint Compaction Pay Adjustment: Two cores per mile of joint per lot; lot size is the total project length and total project quantity per pavement course. Surface Tolerance Pay Adjustment: For projects less than or equal to 0.5 miles, straightedge used; for projects greater than 0.5 miles, Road Surface Profiler used once per project on wearing course (under jurisdiction of Pavement Design and Asset Management)

5a - Where are these samples tested?

Where are these samples tested?
ConnDOT central Laboratory
Plant laboratory, provided to DOT by contract.
Acceptance samples are all tested in department labs. the contractor tests their split in their labs.
Depends. Typically at the District lab. - Aggregate is typically tested at the district lab but the central lab might perform some testing that they are not qualified for. - Cores are typically tested at the District lab - HMA is usually tested in the lab at the HMA plant but one of our districts chooses to test at the district lab.
Acceptance lab at plant.
Air Voids: Laboratory at plant Mat Density: Agency Central Lab Longitudinal Joint: Agency Central Lab Surface Tolerance: Road Surface Profiler on completed surface

5b - What is the chain of custody to get the sample from source to testing location?

What is the chain of custody to get the sample from source to testing location?
ConnDOT staff (Present) Contractor personnel with secured container. (2019 season)
Mix is placed in a cardboard ice cream container. Cores are wrapped in a bag or other container. Each is wrapped in tamperproof security tape for transportation by a truck returning to the plant.
The departments samples after being taken, marked and secured with either tamper evident tape for mix samples or placed in a
Most samples are taken by MassDOT personnel. Cores are taken by QC in the presence of MassDOT and immediately taken possession of.
It never leaves our sight from the truck to the lab, 50-200 feet.
Air Voids: Agency plant inspector collects samples in buckets and maintains possession from sample rack to plant laboratory Mat Density & Longitudinal Joint: Contractor delivers cores to Agency Central Lab in color-coded containers Surface Tolerance: N/A

5c - What is the process of dispute resolution if the agency and contractor results do not match for a corresponding sample?

What is the process of dispute resolution if the agency and contractor results do not match for a corresponding sample?
Spilt samples will be tested by IA personnel.
N/A
the contractor has to submit their results prior to a deadline based on sample date, once the department issue the results of our testing the contractor is allowed to dispute within a time frame if the applicable results are not within a tolerance listed in our specification. the dispute is reviewed and a split of the sample is taken to a different department lab for testing than the original was tested in if the dispute is determined to be valid. once the dispute split is tested for the disputed property the results are reviewed and either confirm or overturn the original result. the departments dispute results replace the original if it's closer to the contractor's result than to the original with ties also using the dispute result.
There is a section of 450 specifically for dispute resolution.
They do QC, we do acceptance. They don't usually split with us. That probably wouldn't be optimal for effective QC.
Dispute resolutions only exist for selection of core sampling locations prior to extraction of cores; Contractor should provide just reasoning for recommending a reselection of core sample locations, and Agency will evaluate challenge within 1 working day of location(s) being selected. Accepted challenge results in new core sampling locations being randomly chosen by the Agency. Core result verification process for outlier test results is provided in Subsection 406.14(b)(4) of the 2018 Standard Specifications for Construction.

4 - Where do agencies take samples for acceptance/verification (CT)?

Where do agencies take samples for acceptance/verification (CT)?
Hauling unit at plant. (Presently) At the paver (2019 season)
Mix samples are taken from the mat, behind the paver prior to compaction. Density cores are taken from the mat.
Acceptance samples are taken from the paver hopper unless a paver is not being used (incidental/hand-placed mix) in that case a sample is taken from
Aggregate - directly from the plant's stockpiles HMA - from the back of the truck at the plant Binder - from the inline sample valve at the plant Cores - taken by QC and immediately taken possession of by the RE Rideability - MassDOT does its own testing
Truck at plant.
For air voids, VMA, AC content, and gradation: Truck at plant For mat density & longitudinal joint compaction: cores taken from roadway

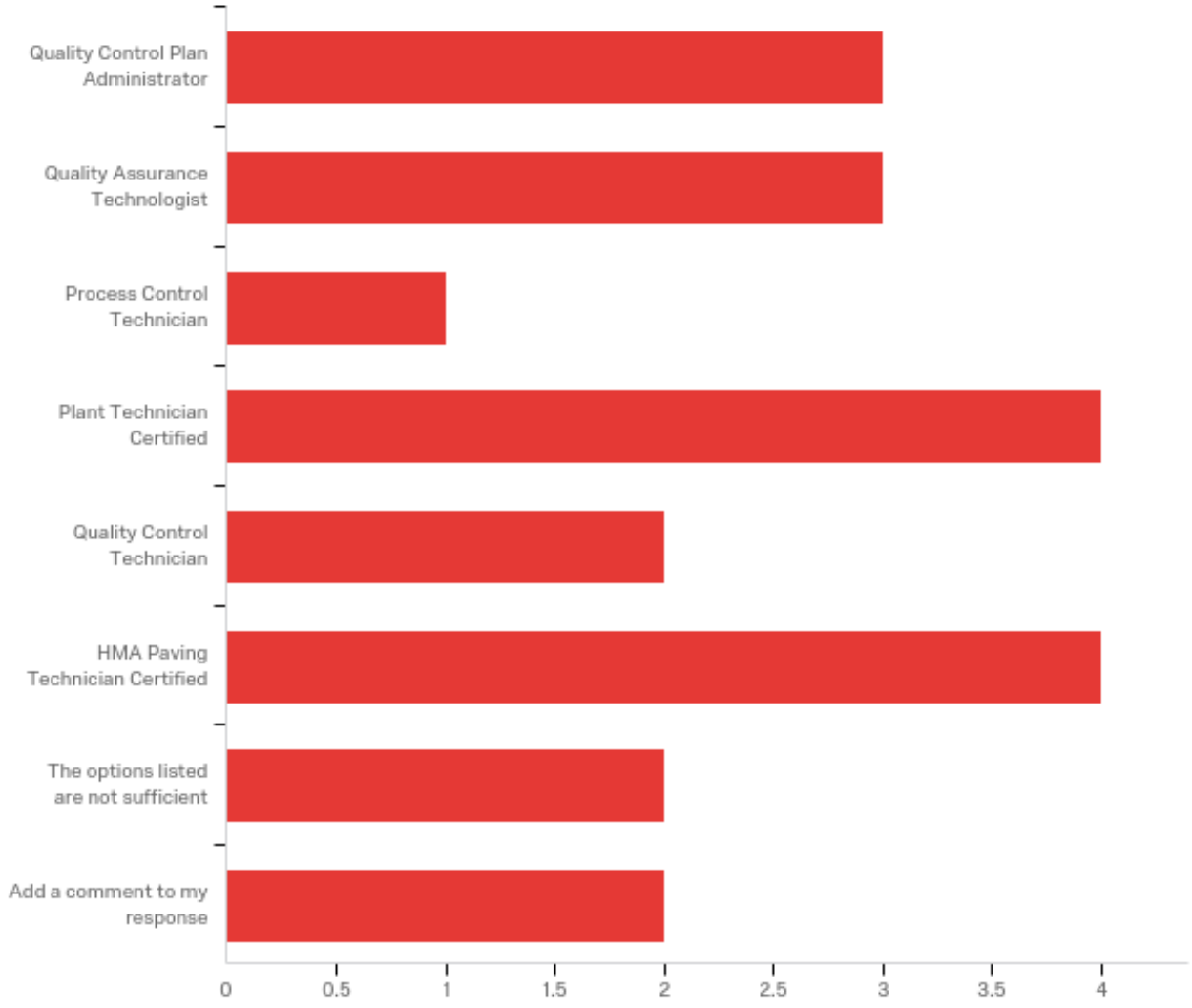
4a - Who is responsible for taking and testing the sample?

Who is responsible for taking and testing the sample?
Contractor witnessed by ConnDOT.
The contractor usually takes the sample in the presence of DOT staff.
Department Inspectors (state employed or consultants) are responsible for taking samples and they are tested in the Department's labs by state personel or consultants.
MassDOT personnel
RIDOT.
Agency plant inspector (air voids, VMA, AC content, gradation); Contractor takes roadway cores, Agency personnel at Central Lab test cores for density (mat and longitudinal joint)

4b - What are your current QA parameters for HMA projects?

What are your current QA parameters for HMA projects?
Mix- Air voids, binder content, Voids in mineral aggregate. In-place - density, visual
AC content and Gradation Cross Slope Density Ride Quality Thickness
Our QA mix testing includes Gradation, Asphalt content as well as volumetric parameters (Voids VMA,VFB, and Fbe ratio). We also do density testing by cores cut from the compacted mat if applicable. Our pay factors always use asphalt content as well as either gradation (4 sieves) or Voids and VMA depending on location/traffic/treatment. Density is included in pay factors if applicable.
Air voids Binder content Core density Core thickness Rideability
Random sampled every 600 tons.
Air Voids Pay Adjustment: 1/500 ton sublot per mix design Mat Density Pay Adjustment: For projects less than or equal to 0.5 miles, 4 cores per day production; for projects greater than 0.5 miles, 1 core for every 0.6 miles with a minimum of 6 cores taken per day production Longitudinal Joint Compaction Pay Adjustment: Two cores per mile of joint per lot; lot size is the total project length and total project quantity per pavement course. Surface Tolerance Pay Adjustment: For projects less than or equal to 0.5 miles, straightedge used; for projects greater than 0.5 miles, Road Surface Profiler used once per project on wearing course (under jurisdiction of Pavement Design and Asset Management)

7 - Which NETTCP certified positions do you require in your state? (Select all that apply.) *If your state uses alternate or additional titles, select "The options listed are not sufficient" in addition to your other responses. You can add them in #8a below. *If you would like to add a comment to your selection, select "Add a comment to my response" in addition to your other responses. You can add your comment(s) in #8b below.



#	Answer	%	Count
1	Quality Control Plan Administrator	14.29%	3
2	Quality Assurance Technologist	14.29%	3

3	Process Control Technician	4.76%	1
4	Plant Technician Certified	19.05%	4
5	Quality Control Technician	9.52%	2
6	HMA Paving Technician Certified	19.05%	4
7	The options listed are not sufficient	9.52%	2
8	Add a comment to my response	9.52%	2
	Total	100%	21

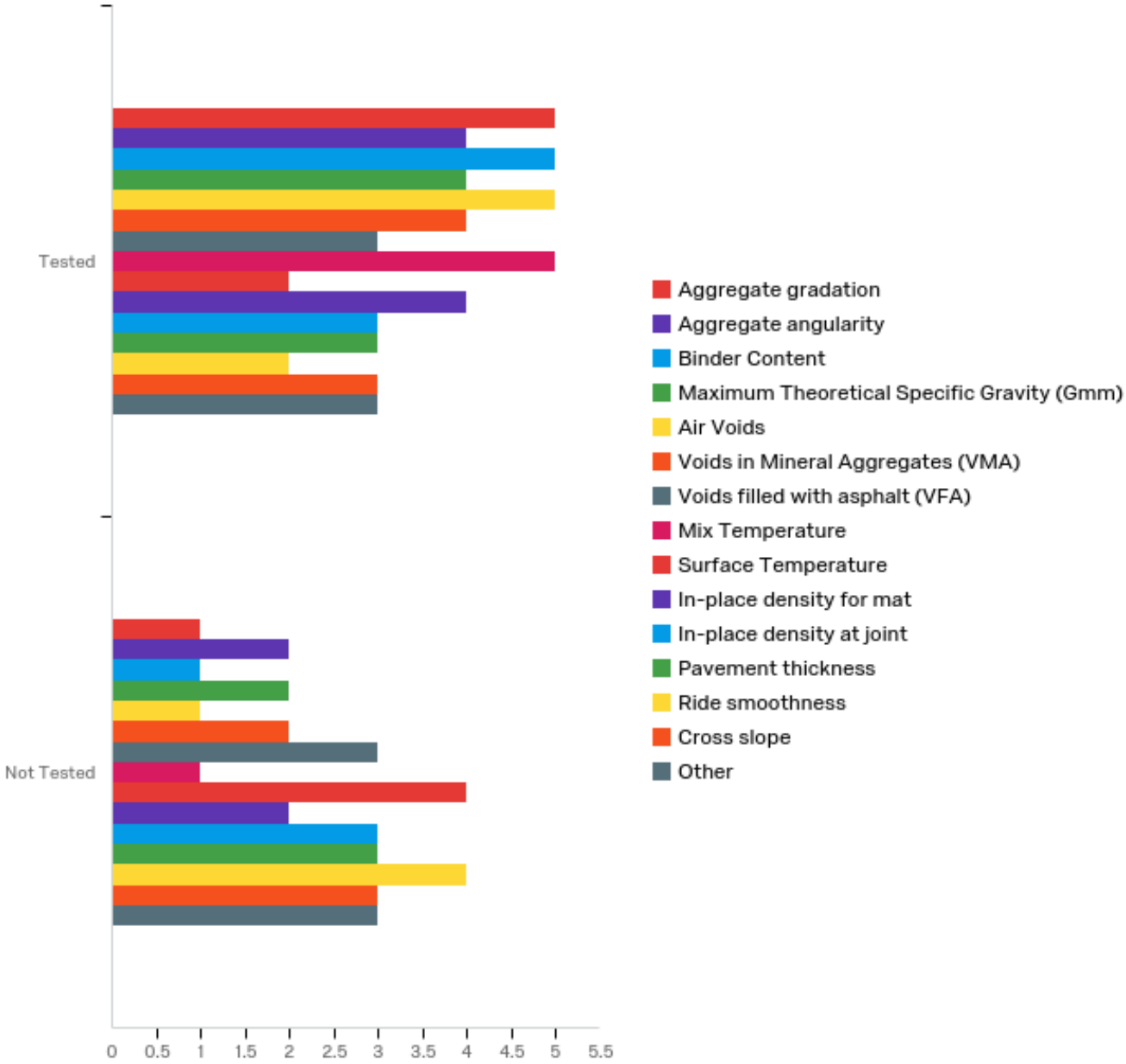
7a - If you selected "The options listed are not sufficient," list the additional or alternate certified position(s) required here:

If you selected "The options listed are not sufficient," list the additional or alternate certified position(s) required here:
HMA Plant Inspector, HMA Street Inspector are titles for the departments certified personnel.
We don't require certification.

7b - If you selected "Add a comment to my response," write your comment(s) here:

If you selected "Add a comment to my response," write your comment(s) here:
To clarify, our QCPAs need to have the QAT certification to qualify. PCTs and Plant Inspectors (for QA) require the HMA Plant Technician, while QCT and Paving Inspectors (for QA) require the HMA Paving Technician Certification.
QC Plan Administrator must be a NETTCP certified "Quality Assurance Technologist." Process Control Technician, as well as the Agency plant inspector, must be a NETTCP certified "HMA Plant Technician."

6#1 - Which Volumetric Mix Properties and Construction Quality properties are tested and for which purp... - Contractor QC



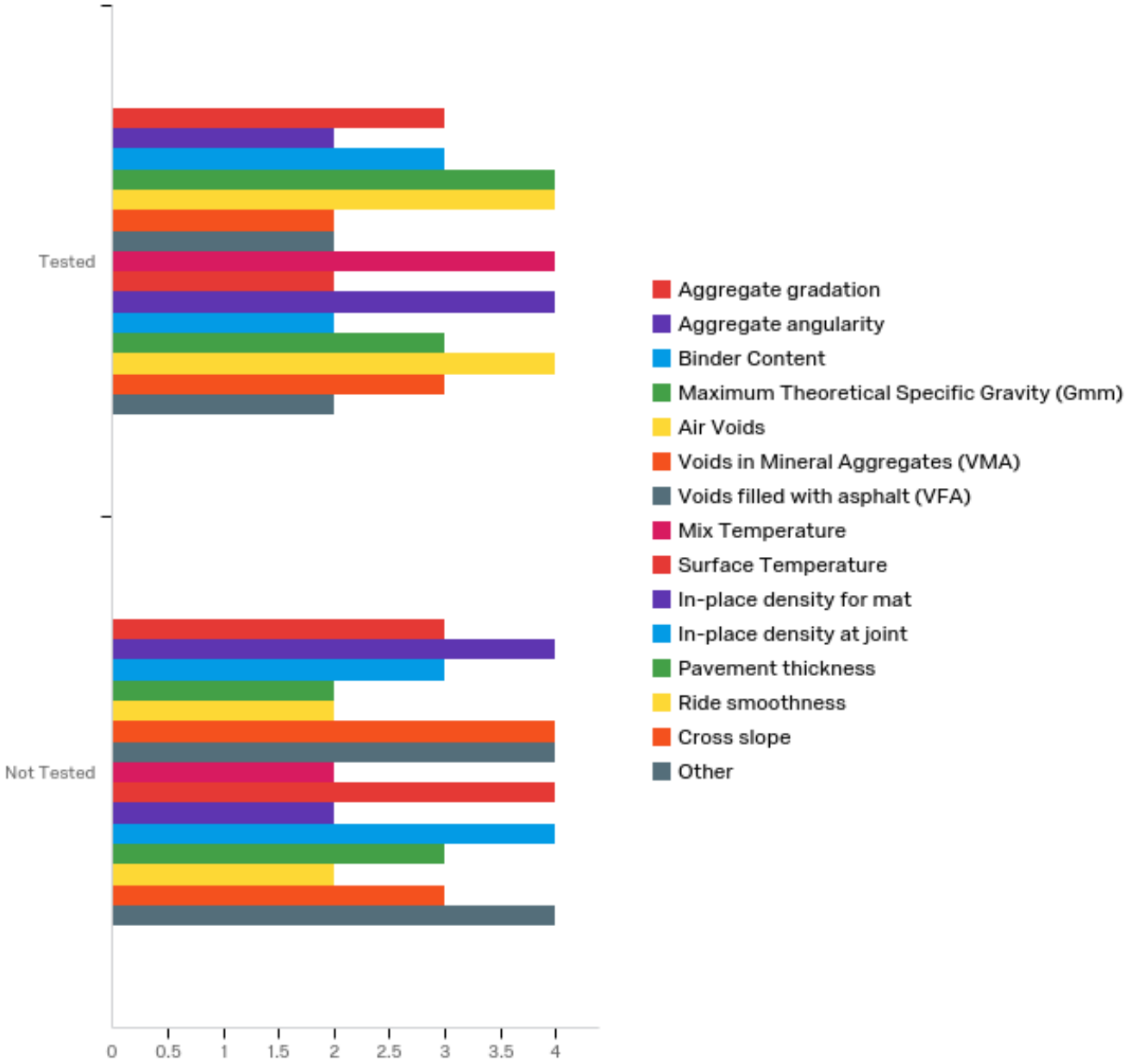
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Aggregate gradation	1.00	2.00	1.17	0.37	0.14	6
2	Aggregate angularity	1.00	2.00	1.33	0.47	0.22	6
3	Binder Content	1.00	2.00	1.17	0.37	0.14	6

4	Maximum Theoretical Specific Gravity (Gmm)	1.00	2.00	1.33	0.47	0.22	6
5	Air Voids	1.00	2.00	1.17	0.37	0.14	6
6	Voids in Mineral Aggregates (VMA)	1.00	2.00	1.33	0.47	0.22	6
7	Voids filled with asphalt (VFA)	1.00	2.00	1.50	0.50	0.25	6
8	Mix Temperature	1.00	2.00	1.17	0.37	0.14	6
9	Surface Temperature	1.00	2.00	1.67	0.47	0.22	6
10	In-place density for mat	1.00	2.00	1.33	0.47	0.22	6
11	In-place density at joint	1.00	2.00	1.50	0.50	0.25	6
12	Pavement thickness	1.00	2.00	1.50	0.50	0.25	6
13	Ride smoothness	1.00	2.00	1.67	0.47	0.22	6
14	Cross slope	1.00	2.00	1.50	0.50	0.25	6
15	Other	1.00	2.00	1.50	0.50	0.25	6

#	Question	Tested		Not Tested		Total
1	Aggregate gradation	83.33%	5	16.67%	1	6
2	Aggregate angularity	66.67%	4	33.33%	2	6
3	Binder Content	83.33%	5	16.67%	1	6
4	Maximum Theoretical Specific Gravity (Gmm)	66.67%	4	33.33%	2	6
5	Air Voids	83.33%	5	16.67%	1	6
6	Voids in Mineral Aggregates (VMA)	66.67%	4	33.33%	2	6
7	Voids filled with asphalt (VFA)	50.00%	3	50.00%	3	6
8	Mix Temperature	83.33%	5	16.67%	1	6
9	Surface Temperature	33.33%	2	66.67%	4	6
10	In-place density for mat	66.67%	4	33.33%	2	6
11	In-place density at joint	50.00%	3	50.00%	3	6
12	Pavement thickness	50.00%	3	50.00%	3	6

13	Ride smoothness	33.33%	2	66.67%	4	6
14	Cross slope	50.00%	3	50.00%	3	6
15	Other	50.00%	3	50.00%	3	6

6#2 - Which Volumetric Mix Properties and Construction Quality properties are tested and for which purp... - Agency QA



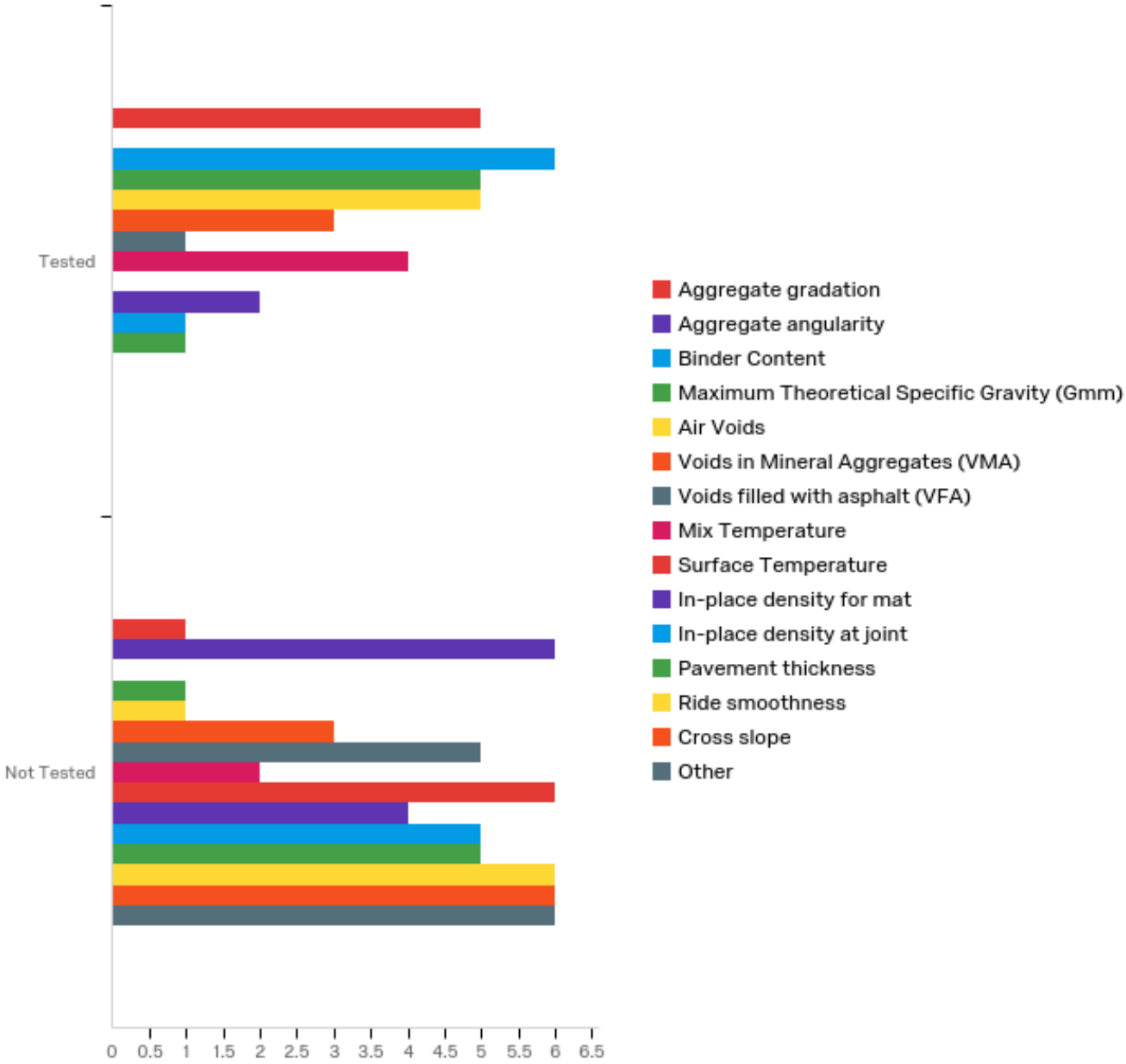
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Aggregate gradation	1.00	2.00	1.50	0.50	0.25	6
2	Aggregate angularity	1.00	2.00	1.67	0.47	0.22	6
3	Binder Content	1.00	2.00	1.50	0.50	0.25	6

4	Maximum Theoretical Specific Gravity (Gmm)	1.00	2.00	1.33	0.47	0.22	6
5	Air Voids	1.00	2.00	1.33	0.47	0.22	6
6	Voids in Mineral Aggregates (VMA)	1.00	2.00	1.67	0.47	0.22	6
7	Voids filled with asphalt (VFA)	1.00	2.00	1.67	0.47	0.22	6
8	Mix Temperature	1.00	2.00	1.33	0.47	0.22	6
9	Surface Temperature	1.00	2.00	1.67	0.47	0.22	6
10	In-place density for mat	1.00	2.00	1.33	0.47	0.22	6
11	In-place density at joint	1.00	2.00	1.67	0.47	0.22	6
12	Pavement thickness	1.00	2.00	1.50	0.50	0.25	6
13	Ride smoothness	1.00	2.00	1.33	0.47	0.22	6
14	Cross slope	1.00	2.00	1.50	0.50	0.25	6
15	Other	1.00	2.00	1.67	0.47	0.22	6

#	Question	Tested		Not Tested		Total
1	Aggregate gradation	50.00%	3	50.00%	3	6
2	Aggregate angularity	33.33%	2	66.67%	4	6
3	Binder Content	50.00%	3	50.00%	3	6
4	Maximum Theoretical Specific Gravity (Gmm)	66.67%	4	33.33%	2	6
5	Air Voids	66.67%	4	33.33%	2	6
6	Voids in Mineral Aggregates (VMA)	33.33%	2	66.67%	4	6
7	Voids filled with asphalt (VFA)	33.33%	2	66.67%	4	6
8	Mix Temperature	66.67%	4	33.33%	2	6
9	Surface Temperature	33.33%	2	66.67%	4	6
10	In-place density for mat	66.67%	4	33.33%	2	6
11	In-place density at joint	33.33%	2	66.67%	4	6
12	Pavement thickness	50.00%	3	50.00%	3	6

13	Ride smoothness	66.67%	4	33.33%	2	6
14	Cross slope	50.00%	3	50.00%	3	6
15	Other	33.33%	2	66.67%	4	6

6#3 - Which Volumetric Mix Properties and Construction Quality properties are tested and for which purp... - IA



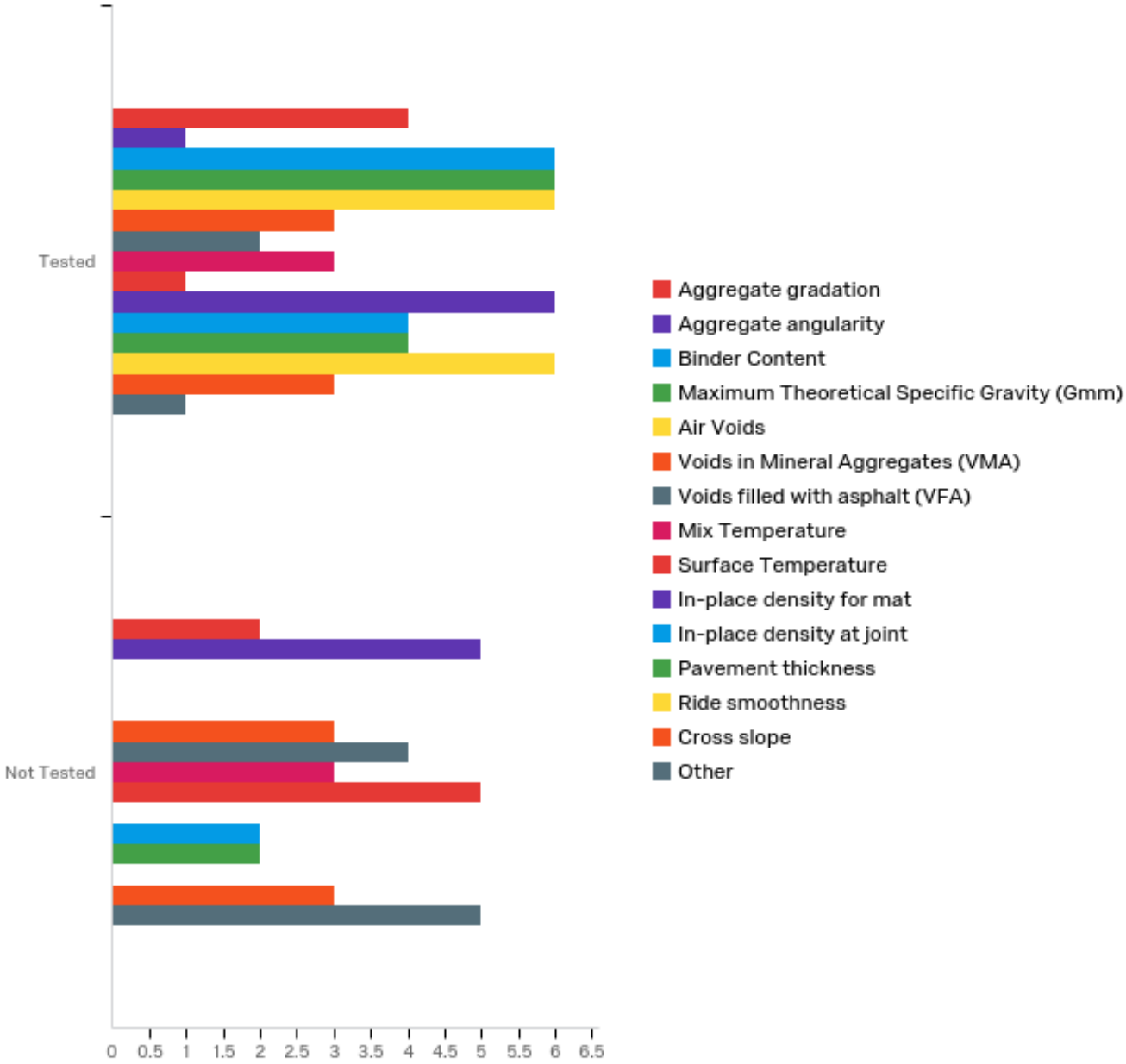
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Aggregate gradation	1.00	2.00	1.17	0.37	0.14	6
2	Aggregate angularity	2.00	2.00	2.00	0.00	0.00	6
3	Binder Content	1.00	1.00	1.00	0.00	0.00	6

4	Maximum Theoretical Specific Gravity (Gmm)	1.00	2.00	1.17	0.37	0.14	6
5	Air Voids	1.00	2.00	1.17	0.37	0.14	6
6	Voids in Mineral Aggregates (VMA)	1.00	2.00	1.50	0.50	0.25	6
7	Voids filled with asphalt (VFA)	1.00	2.00	1.83	0.37	0.14	6
8	Mix Temperature	1.00	2.00	1.33	0.47	0.22	6
9	Surface Temperature	2.00	2.00	2.00	0.00	0.00	6
10	In-place density for mat	1.00	2.00	1.67	0.47	0.22	6
11	In-place density at joint	1.00	2.00	1.83	0.37	0.14	6
12	Pavement thickness	1.00	2.00	1.83	0.37	0.14	6
13	Ride smoothness	2.00	2.00	2.00	0.00	0.00	6
14	Cross slope	2.00	2.00	2.00	0.00	0.00	6
15	Other	2.00	2.00	2.00	0.00	0.00	6

#	Question	Tested		Not Tested		Total
1	Aggregate gradation	83.33%	5	16.67%	1	6
2	Aggregate angularity	0.00%	0	100.00%	6	6
3	Binder Content	100.00%	6	0.00%	0	6
4	Maximum Theoretical Specific Gravity (Gmm)	83.33%	5	16.67%	1	6
5	Air Voids	83.33%	5	16.67%	1	6
6	Voids in Mineral Aggregates (VMA)	50.00%	3	50.00%	3	6
7	Voids filled with asphalt (VFA)	16.67%	1	83.33%	5	6
8	Mix Temperature	66.67%	4	33.33%	2	6
9	Surface Temperature	0.00%	0	100.00%	6	6
10	In-place density for mat	33.33%	2	66.67%	4	6
11	In-place density at joint	16.67%	1	83.33%	5	6
12	Pavement thickness	16.67%	1	83.33%	5	6

13	Ride smoothness	0.00%	0	100.00%	6	6
14	Cross slope	0.00%	0	100.00%	6	6
15	Other	0.00%	0	100.00%	6	6

6#4 - Which Volumetric Mix Properties and Construction Quality properties are tested and for which purp... - Agency Acceptance/Validation (CT)



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Aggregate gradation	1.00	2.00	1.33	0.47	0.22	6
2	Aggregate angularity	1.00	2.00	1.83	0.37	0.14	6
3	Binder Content	1.00	1.00	1.00	0.00	0.00	6

4	Maximum Theoretical Specific Gravity (Gmm)	1.00	1.00	1.00	0.00	0.00	6
5	Air Voids	1.00	1.00	1.00	0.00	0.00	6
6	Voids in Mineral Aggregates (VMA)	1.00	2.00	1.50	0.50	0.25	6
7	Voids filled with asphalt (VFA)	1.00	2.00	1.67	0.47	0.22	6
8	Mix Temperature	1.00	2.00	1.50	0.50	0.25	6
9	Surface Temperature	1.00	2.00	1.83	0.37	0.14	6
10	In-place density for mat	1.00	1.00	1.00	0.00	0.00	6
11	In-place density at joint	1.00	2.00	1.33	0.47	0.22	6
12	Pavement thickness	1.00	2.00	1.33	0.47	0.22	6
13	Ride smoothness	1.00	1.00	1.00	0.00	0.00	6
14	Cross slope	1.00	2.00	1.50	0.50	0.25	6
15	Other	1.00	2.00	1.83	0.37	0.14	6

#	Question	Tested		Not Tested		Total
1	Aggregate gradation	66.67%	4	33.33%	2	6
2	Aggregate angularity	16.67%	1	83.33%	5	6
3	Binder Content	100.00%	6	0.00%	0	6
4	Maximum Theoretical Specific Gravity (Gmm)	100.00%	6	0.00%	0	6
5	Air Voids	100.00%	6	0.00%	0	6
6	Voids in Mineral Aggregates (VMA)	50.00%	3	50.00%	3	6
7	Voids filled with asphalt (VFA)	33.33%	2	66.67%	4	6
8	Mix Temperature	50.00%	3	50.00%	3	6
9	Surface Temperature	16.67%	1	83.33%	5	6
10	In-place density for mat	100.00%	6	0.00%	0	6
11	In-place density at joint	66.67%	4	33.33%	2	6
12	Pavement thickness	66.67%	4	33.33%	2	6

13	Ride smoothness	100.00%	6	0.00%	0	6
14	Cross slope	50.00%	3	50.00%	3	6
15	Other	16.67%	1	83.33%	5	6

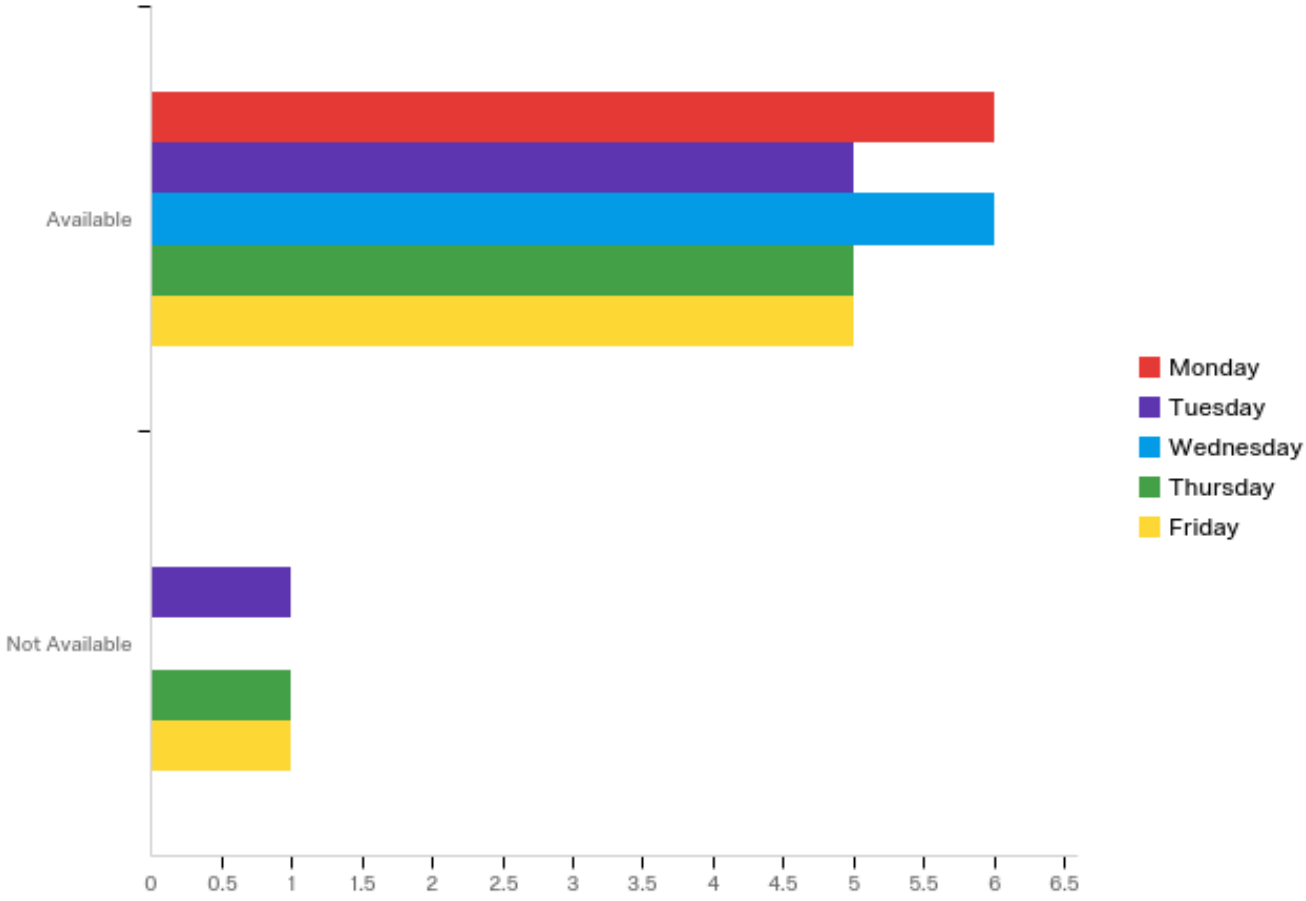
6a - If applicable, list other properties tested, who is responsible for testing them, and the test conducted for each. If those listed in the table above are sufficient for your current QA practice, please write "None."

If applicable, list other properties tested, who is responsible for testing them, and the test conducted for each. If those listed in the table above are sufficient for your current QA practice, please write "None."
None
We also do periodic testing of aggregate stockpiles (including RAP), belt cuts and liquid binder as part of our overall QA program. We preform consensus testing on the aggregates and belt cuts including micro-deval, fractured faces, FA Angularity, sand equivalent, Gsb, Specific Gravity and Absorption.
Wheel path deviations
Question 5 suggests that acceptance and QA are identical. This table suggests otherwise. It wouldn't let me complete the survey so I answered "Not Tested" for all "Agency QA" and "Contractor QC" questions.
Effectiveness of Anti-Stripping Additive in PG Binder (Boiling Method) (VT-AOT-MRD 10): Performed by plant Quality Control Technician (QCT) for QC purposes on QA projects. For non-QA projects, Agency plant inspector performs test for Agency Acceptance/Verification.

6b - Is there anything else specific about your current QA process that you feel is essential to note at this time? Please explain.

Is there anything else specific about your current QA process that you feel is essential to note at this time? Please explain.
This table does not distinguish between mix-design approval testing and production testing. Agency QA column was marked "not tested" to allow completion of the survey.
Ride smoothness and joint density testing is only done on specific projects.
In order to have a full QA program there has to be a level of confidence in the technicians and labs thus we make sure to qualify the labs for the testing they need to perform as well as IA all technicians and also perform proficiency sample testing.

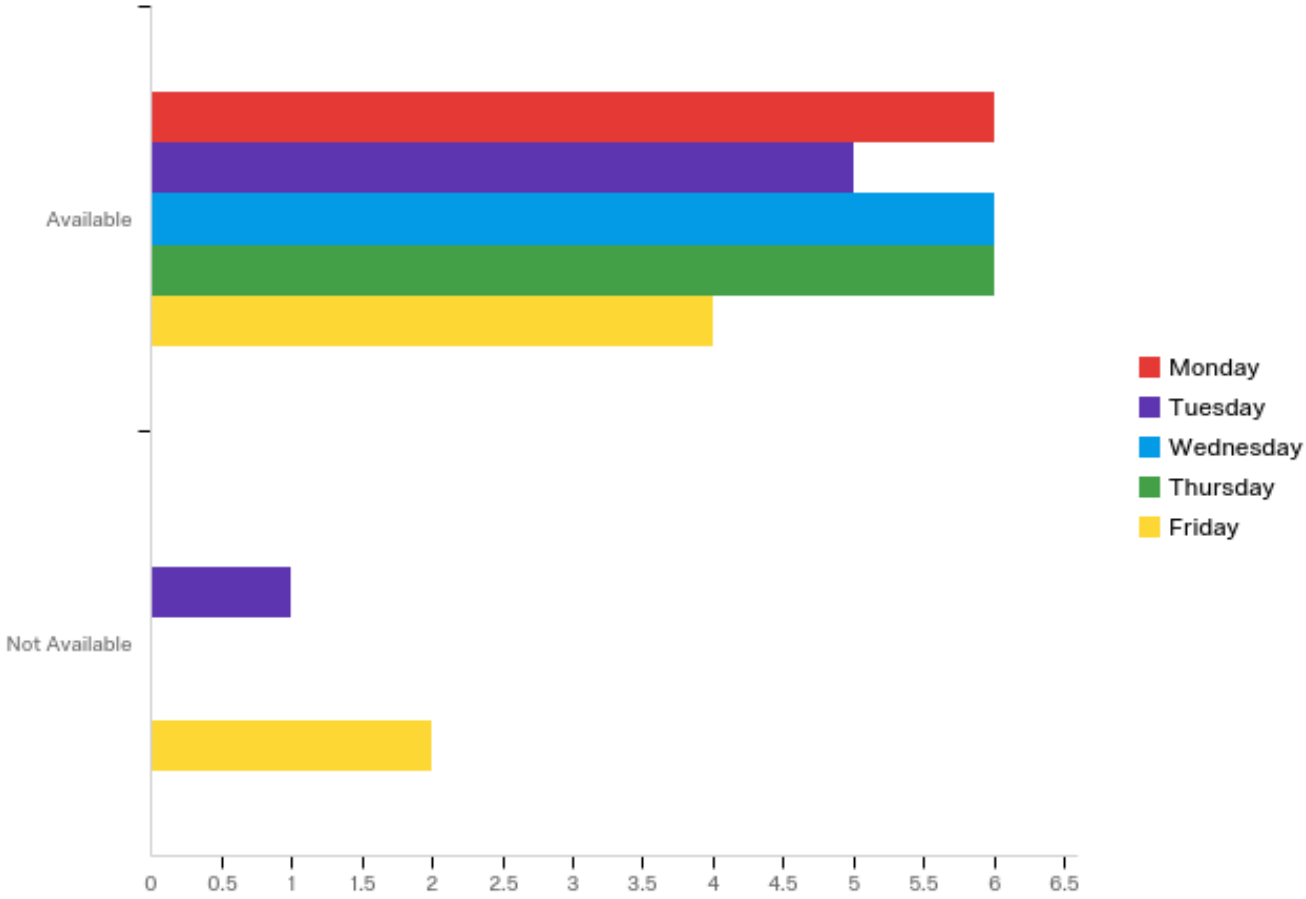
11#1 - Please note the times you are generally available to be contacted for the purposes of follow up t... - Morning



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Monday	1.00	1.00	1.00	0.00	0.00	6
2	Tuesday	1.00	2.00	1.17	0.37	0.14	6
3	Wednesday	1.00	1.00	1.00	0.00	0.00	6
4	Thursday	1.00	2.00	1.17	0.37	0.14	6
5	Friday	1.00	2.00	1.17	0.37	0.14	6

#	Question	Available		Not Available		Total
1	Monday	100.00%	6	0.00%	0	6
2	Tuesday	83.33%	5	16.67%	1	6
3	Wednesday	100.00%	6	0.00%	0	6
4	Thursday	83.33%	5	16.67%	1	6
5	Friday	83.33%	5	16.67%	1	6

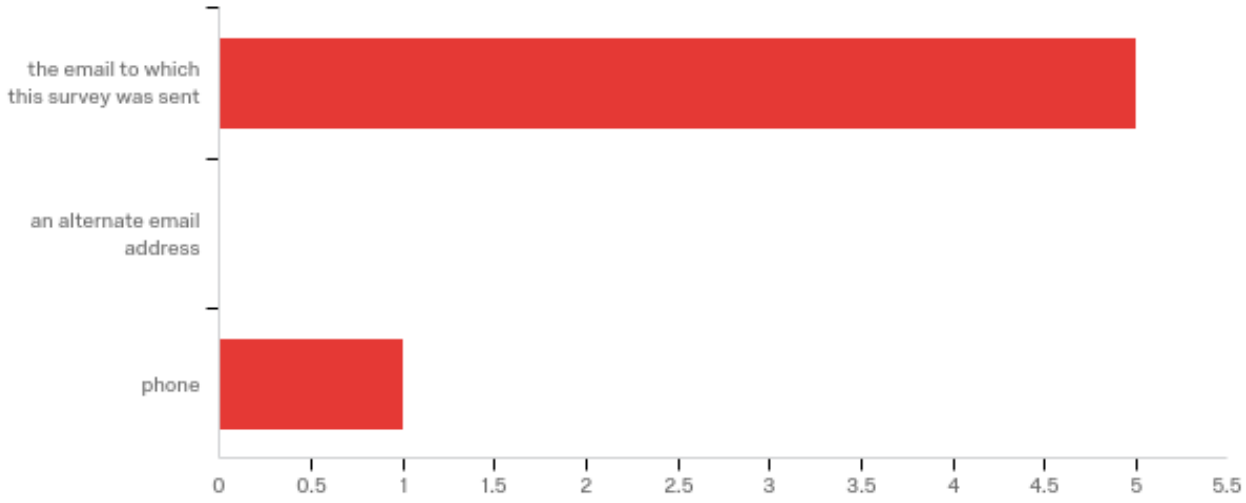
11#2 - Please note the times you are generally available to be contacted for the purposes of follow up t... - Afternoon



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Monday	1.00	1.00	1.00	0.00	0.00	6
2	Tuesday	1.00	2.00	1.17	0.37	0.14	6
3	Wednesday	1.00	1.00	1.00	0.00	0.00	6
4	Thursday	1.00	1.00	1.00	0.00	0.00	6
5	Friday	1.00	2.00	1.33	0.47	0.22	6

#	Question	Available		Not Available		Total
1	Monday	100.00%	6	0.00%	0	6
2	Tuesday	83.33%	5	16.67%	1	6
3	Wednesday	100.00%	6	0.00%	0	6
4	Thursday	100.00%	6	0.00%	0	6
5	Friday	66.67%	4	33.33%	2	6

12 - Please note the method of contact that you prefer.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Please note the method of contact that you prefer.	1.00	3.00	1.33	0.75	0.56	6

#	Answer	%	Count
1	the email to which this survey was sent	83.33%	5
2	an alternate email address	0.00%	0
3	phone	16.67%	1
	Total	100%	6

12a - If you selected "an alternate email address," please provide the alternate email address you would prefer be used to contact you.

If you selected "an alternate email address," please provide the alternate email address you would prefer be used to contact you.

12b - If you selected "phone," please provide the telephone number, including area code, that can be used to contact you for follow up.

If you selected "phone," please provide the telephone number, including area code, that can be used to contact you for follow up.

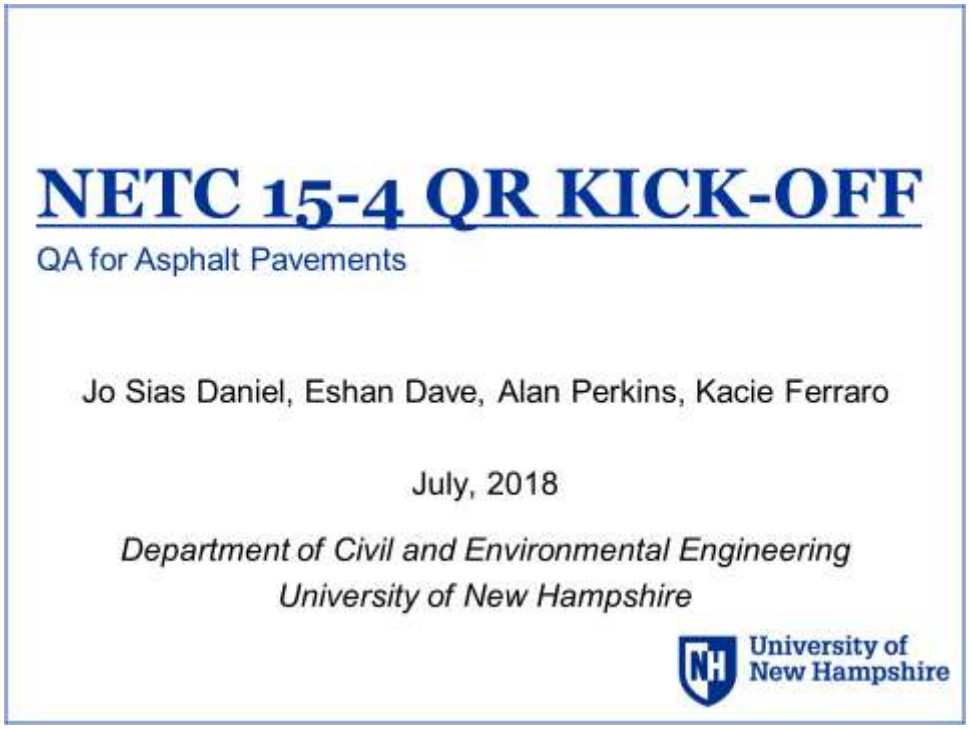
(401) 222-2524 x4135

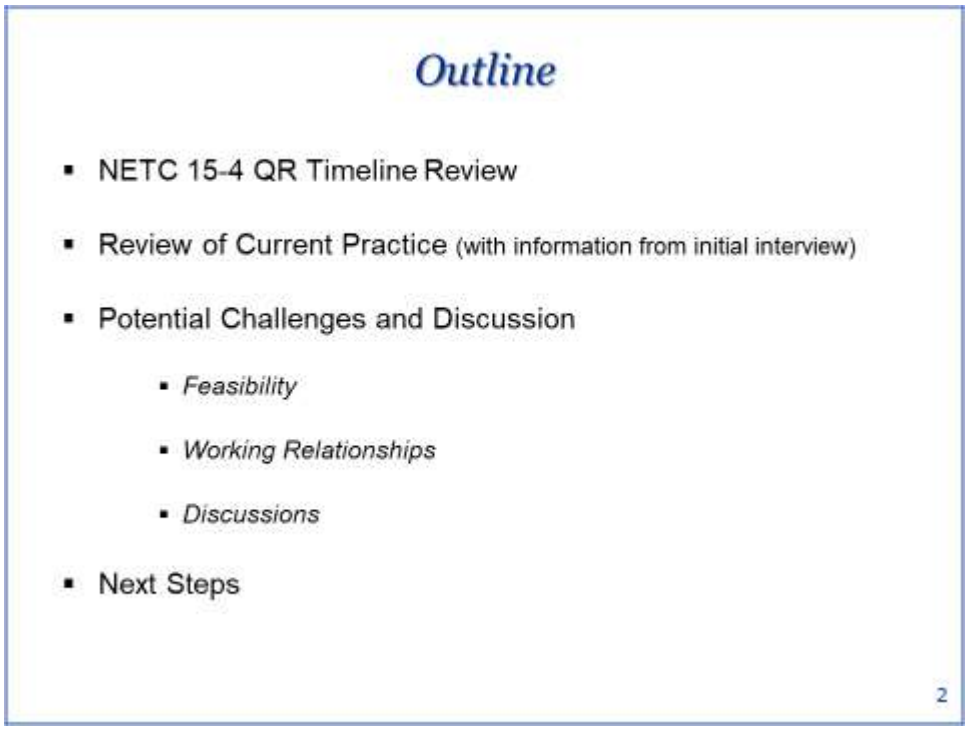
1 - To start, please enter the your name, title, state/agency and email address

Name	Title	State / Agency	Email Address
Bob Lauzon	Principal Engineer (Materials)	Connecticut	robet.lauzon@ct.gov
Denis Boisvert	Chief of Materials Technology	NHDOT	denis.boisvert@dot.nh.gov
Kevin Cummings	QA Engineer	Maine Dept of Transportation	kevin.cummings@maine.gov
Mark Brum	Materials Quality Systems Engineer	MassDOT	mark.brum@dot.state.ma.us
Michael Byrne	Principal Civil Engineer	RIDOT	michael.byrne@dot.ri.gov
Aaron Schwartz	HMA Materials Engineer	Vermont Agency of Transportation	aaron.schwartz@vermont.gov

Appendix B: Proceedings from Kickoff Meeting

This section contains the PowerPoint presentation slides from the kickoff meeting.





TIMELINE REVIEW

NETC 15-4 QR

3

Proposed NETC 15-4 QR Project Schedule

Tasks	✓ Months											
	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
1. State of the Practice/Literature Review	■	■	■									
2. Kick-off Meeting		■										
3. Cross-border Issues: Challenges and Opportunities		■	■	■	■	■	■	■				
4. Roadmap of Actions and Workshop								■				
5. Draft Final Report, Readiness Evaluation, and Initial Roadmap								■	■			
6. Presentation of Draft Final Report to Project TAC										■		
7. Final Report and Recommendations										■	■	■
Quarterly Report						■						

Task 1:

- Review of current state of practice of QA for asphalt pavement construction
  - *Standard and Provisional specs reviewed; literature review is ongoing*
- Interview of NETC member agencies and select contractors
  - *Initial agency survey complete, including identification of select contractors*
- Identification of potential cross-border issues and challenges
  - *Underway and on-going*

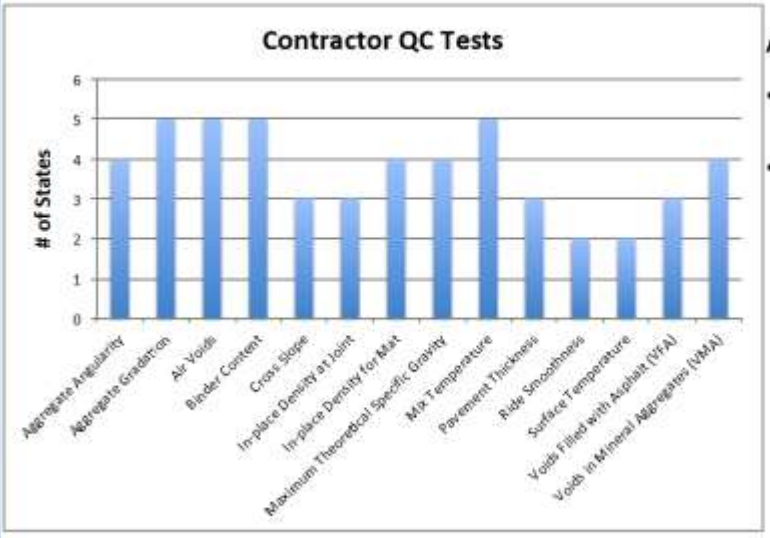
4

REVIEW OF CURRENT PRACTICE

From preliminary survey data and published specifications

5

What is being tested?



Also tested:

- **MA-** wheel path deviations
- **ME-** effectiveness of anti-stripping additive in PG binder (boiling method)

***RI** marked "Not Tested" for all

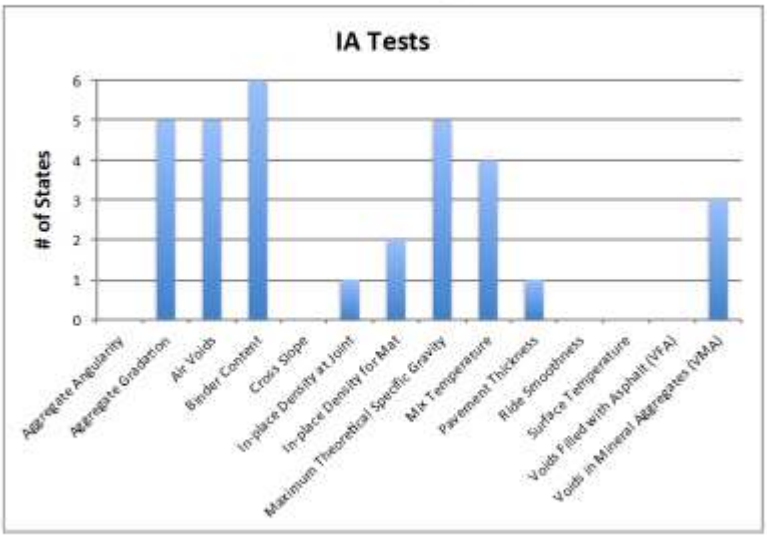
6

Contractor QC Tests

Attribute	CT	MA	ME	NH	RI	VT
Aggregate Gradation	✓	✓	✓	✓		✓
Air Voids	✓	✓	✓	✓		✓
Binder Content	✓	✓	✓	✓		✓
Mix Temperature	✓	✓	✓	✓		✓
Aggregate Angularity	✓	✓	✓			✓
In-place Density for Mat	✓	✓	✓	✓		
Maximum Theoretical Specific Gravity	✓	✓	✓	✓		
Voids in Mineral Aggregates (VMA)	✓	✓	✓			✓
Cross Slope		✓	✓	✓		
In-place Density at Joint	✓	✓	✓			
Pavement Thickness		✓	✓	✓		
Voids Filled with Asphalt (VFA)	✓	✓	✓			
Ride Smoothness		✓	✓			
Surface Temperature		✓	✓			

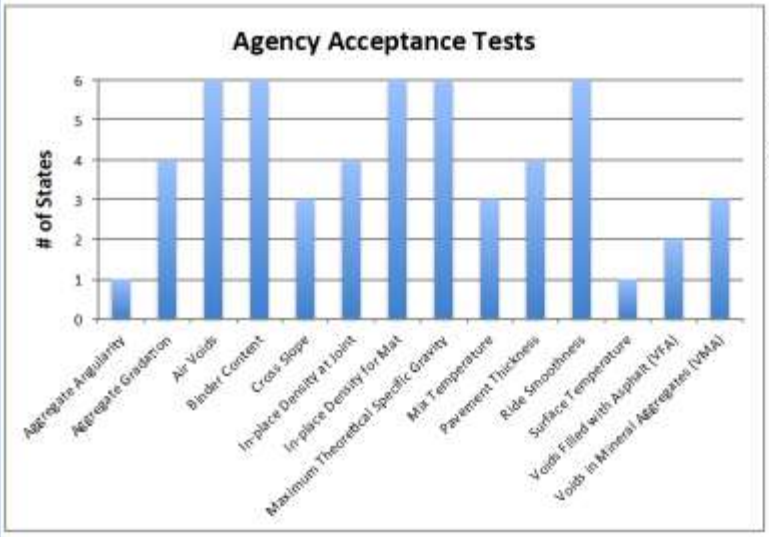
7

What is being tested?



8

What is being tested?



Also tested:

ME-
on some projects:

ride smoothness
& joint density

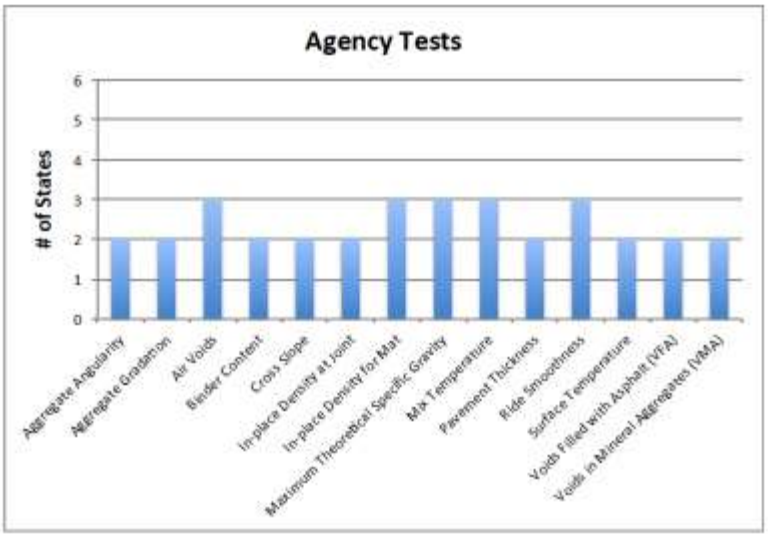
10

QC Commonalities

- In general, QC testing is:
  - Sampled from the truck
  - Tested at least once per 500 ton sublot, and
  - Tested by contractor personnel in the QC lab at the plant
  - Contractor personnel draws and tests their own samples and is responsible for their own process control

11

Differences in Agency Validation Tests



MA, ME & VT represented

12

Differences in Agency Validation Tests

Also tested:

- **MA-** wheel path deviations
- **ME-** periodic testing of aggregate stockpiles (RAP), belt cuts & liquid binder.
  - RAP is tested for gradation and PGAB content (using solvent extraction).
  - Belt cuts are tested for
    - *Gradation*
    - *Fractured Faces*
    - *FA Angularity*
    - *Sand Equivalent*
    - *Course Micro Deval*
    - *Combined Aggregate Gsb*
    - *Fine aggregate Gsb and absorption*
    - *Course aggregate Gsb and absorption*

13

Differences in Agency Validation Tests

Basically, there are two identified approaches:

1. DOT personnel periodically oversee testing and/or validate splits (CT, MA, ME & VT)
   - *VT staffs Agency Plant Inspector*
2. No validation is done by DOT personnel. QC results are purely for contractor's use. (NH & RI)

14

Agency Acceptance Tests

Attribute	CT	MA	ME*	NH	RI	VT
Binder Content	✓	✓	✓	✓	✓	✓
Air Voids	✓	✓	✓	✓	✓	✓
In-place Density for Mat	✓	✓	✓	✓	✓	✓
Ride Smoothness	✓	✓	✓	✓	✓	✓
Maximum Theoretical Specific Gravity (Gmm)	✓	✓	✓	✓	✓	✓
Aggregate Gradation			✓	✓	✓	✓
In-place Density at Joint	✓		✓		✓	✓
Pavement Thickness	✓	✓		✓	✓	
Voids in Mineral Aggregates (VMA)	✓		✓			✓
Mix Temperature	✓				✓	✓
Cross Slope	✓			✓		✓
Voids Filled with Asphalt (VFA)	✓		✓			
Aggregate Angularity					✓	
Surface Temperature					✓	

**ME also sometimes tests ride smoothness & joint density*

15

Acceptance Commonalities

Break up all loose mix vs. cores

- All six states sample from the truck.
  - Several detailed specifications for core sampling for mat.
  - A few also added specifications for core sampling at joint.
- DOT personnel either draws their own sample to test or is present & witness while the contractor samples
- Samples are transported in some sort of secure, damage-resistant, tamper-evident packaging

Break up all loose mix vs. cores

Get specific about types of packaging used, chain of custody, and security measures—this was an item of interest to DOTs

16

Acceptance Differences

- Frequency:
  - 1 per 750 ton sublot
  - 1 per 600 ton sublot (MA & RI)
  - 1 per 500 ton sublot (CT & VT)
- Location:
  - Central Lab (CT, ME, RI and VT)
  - District Lab (MA & ME)
  - Plant Lab (NH)
- Dispute Resolution:
  - Splits taken and tested (CT, MA & ME)
  - New random samples taken (NH & VT)
  - State results are validated (RI)

Break up each one loose mix vs. cores on its own slide

17

Acceptance Differences

Chain of Custody — Break up loose mix vs. cores here, too

- DOT personnel takes immediate possession of sample (CT, MA & ME)
- Contractor delivers sample to the agency (NH, RI, VT)
  - *VT uses sample couriers*
  - *Time frames?*

Security measure breakdown here?

Can this be combined either here or above with the security measure breakdown?

18

POTENTIAL CHALLENGES AND DISCUSSIONS

Based on preliminary survey data and published specifications

19

What you've said should be kept

Testing Methodology

- CT:
  - Sampling of cores for in-place density testing
    - *Logic: consistent and accurate method to determine critical HMA property*
- NH:
  - Volumetric design process used to determine job mix formula & gradation and AC content used to control production
    - *Logic: They are a stronger method. If gradation and AC content characteristics are met, volumetrics will follow.*

20

What you've said should be kept

Related to Contractors

- VT:
  - Minimum QC testing requirements & QC plan requirements
    - *Logic: It establishes the minimum testing requirements for the production of asphalt materials at the plant & defines the roles & responsibilities of contractor personnel*
- ME:
  - Dispute resolution process
  - IA program
  - random sampling & statistical acceptance
  - certification requirements for acceptance & QC staff
  - laboratory quality & accreditation system

Logic: It is a fair specification using measures that are known to have an impact on the life of our treatments so we can provide as much of an indication of how well they will perform. Our intent is to have an overall QA program with core elements that function well together and integrate with each other.

21

Where you're looking for improvement

- **NH & RI:**
  - No changes identified
- **CT:**
  - Change sampling from hauling unit to sampling at the paver.
- **VT:**
  - Change sampling location to behind the paver instead of at the plant to evaluate in-situ characteristics
  - Performance testing
    - (i.e.: Hamburg and SCB/IFIT testing with pay factors)

22

Where you're looking for improvement

- **MA:**
  - Straight-forward way of accepting binder, especially how to handle things when there is a failure.
    - ***Currently testing 1 per 12,000 tons per project but gets confusing***
- **ME:**
  - Greater presence at contractor plant facilities as well as improved QC/production requirements (***How much more?***)
    - More frequent plant inspections, improved process control by material producers

23

Feasibility Considerations: Operational

- *Can the current facilities (contractors and agencies) handle the changes, specifically related to increased testing and specifications?*
- *Can unified specifications work between states with significant geographic differences, sometimes even within a state (i.e.: ME)?*
  - *(e.g.: variety of projects & materials)*
- *Is there enough understanding of process control in the industry to make effective change?*

24

Feasibility Considerations: Personnel

- *How many personnel will need to be reassigned or added to satisfy changing needs?*
  - ***Regionalization vs. Year-to-year changes?***
- *Can qualified applicants be found?*
  - ***For what purpose? Inspection, QC, IA?***

25

Feasibility Considerations: Procedural

- *What are the optimal specifications, procedures, and documentation required?*
- *Can we provide" proof of process," that a recommended change is actually an improvement on current QA practice?*

26

Working Relationships

- Internal Stakeholders (and FHWA)
  - *What fiscal and political considerations will arise to systemic changes in state QA practices?*
- Contractors
  - *Is it feasible to change their practices? Will they resist change?*
  - *Will they push back if DOT personnel have more presence in QC plant facilities?*
  - *How will they respond to developments and changes made with regard to their pay factors?*

27

Continued Discussion

- Topics of discussion:
  - QC/Process Control test differences
  - Acceptance testing differences
  - Validation and IA test differences

28

NEXT STEPS

Keeping to the proposed schedule

29

Next Steps

- Review Pay Factors
- Select and begin to interview contractors
- Investigate required certifications and staffing structure
- Further literature review
- Further investigation of cross-border challenges
  - **Internal discussions within agencies regarding tests (QC, Accept., Valid., IA) and frequencies**

30

Select Contractors

Contractor Name	No. States
Lane Construction Corporation	5
Brox Industries	4
Pike Industries	3
P.J. Keating	
Warner Bros. (All States Materials Group)	
Continental Paving	2
J. Hutchins, Inc.	
J.H. Lynch	1
Tillcon	

31

Required Positions & Certifications

Required Positions/Certifications	No. States
Plant Technician Certified	4
HMA Paving Technician Certified	
Quality Control Plan Administrator	3
Quality Assurance Technologist	
Quality Control Technician	2
Process Control Technician	1

*ME *RI does not require certification

- QCTA is QAT certified
- HMA Plant Inspector (PCT & Plant Tech Cert)
- Paving Inspector (QCT & Paving Tech Cert)

32

Thank you for your continued cooperation as we move forward.

University of New Hampshire

Appendix C: Contractor Survey Results

This section contains the responses from the contractor survey conducted in the course of this study.

Default Report

NETC 15-4 QR Survey for Asphalt Contractors

October 26th 2018, 8:21 am MDT

1 - To start, please enter your name, title, company name and email address

Name	Title	State / Agency	Email Address
Jeff Lewis	QC Manager	Brox Industries	jlewis@broxindustries.com
Albert G Zander Jr	Quality Control Manager	LANE Construction	AGZander@laneconstruct.com
Matthew Teto	Quality Control Manager	P.J. Keating Company	mteto@pjkeating.com
Mary Wescott	NH QC Manager	Pike Industries	mwescott@pikeindustries.com
Jeffrey Greer	QC Manager	J Hutchins Inc	jeffgreer@jhutchinsinc.com
Peter Moulton	QC Manager	Pike Industries	pmoulton@pikeindustries.com
Herrick Randall	Regional Quality Control Manager	Pike Industries,Inc.	hrandall@pikeindustries.com

2 - For which New England State Agencies does your company do asphalt paving work? Select all that apply

Name	Agencies
Jeff Lewis	Maine Department of Transportation, Massachusetts Department of Transportation, New Hampshire Department of Transportation
Albert G Zander Jr	Connecticut Department of Transportation, Massachusetts Department of Transportation, New Hampshire Department of Transportation, Vermont Agency of Transportation
Matthew Teto	Massachusetts Department of Transportation, Rhode Island Department of Transportation
Mary Wescott	Maine Department of Transportation
Jeffrey Greer	New Hampshire Department of Transportation, Vermont Agency of Transportation

Peter Moulton	Maine Department of Transportation, New Hampshire Department of Transportation
Herrick Randall	Maine Department of Transportation, New Hampshire Department of Transportation, Vermont Agency of Transportation

3 - What differences in sampling (frequency and sampling location) for QC testing of materials across various New England states pose challenges to your operations and final product quality?

The biggest difference is the location of QA samples. MA does it at the plant, and ME and NH uses field samples. NH uses in place loose samples, and ME uses mix out of pacer hopper and split 4 ways. I mirror my QC sample location (plant or field) to the states.

Only big difference is that Vermont might take mix property tests from the paving hopper. Vermont takes more cores than the other states.

Rhode Island and Massachusetts sample from the haul unit at the plant. Sampling interval is similar for both states.

Sampling out of the paver hopper in Maine presents challenges in that we have to stop paving operations to follow protocol. This leads to potential issues with heat loss, density loss, and ride quality.

I feel the freq. for both is good but I prefer sampling at the plant and on tier work in New Hampshire does from the road.

It's been a couple years since we have done NH work. QC sampling is always at the same place, at the plant from a haul unit. No challenges with that.

None- fairly used to the process now and have streamlined it to make it reasonably quick

3a - How will you like to see sampling process requirements improved?

(Requirements) Each state believes their way is the best way to sample, so after 27 years in QC, I just mirror the QA . specifications in regards to sampling technique,

All sampling for the mix taken at the plant from sampling rack.

Sampling interval is adequate and sufficient in both states. No real improvements are necessary.

Sample behind the paver, in the mat (NHDOT); or sample out of the haul unit(s) at the production facility (VtAOT)

I feel New Hampshire gives you faster results than Vermont but they both have different coring deadlines for marking out the cores.

Eliminate the need for MDOT to have the contractor take extra boxes of a QC sample each time. Take the extra boxes when a the MDOT inspector is there. Otherwise I have no problem with what we sample for and the frequency.

N/A

3b - How would making these changes affect your productivity and delivery of quality materials?

As long as the sampling technique is consistent, all is good.

Material testing would be collected sooner and tested sooner so that changes can be made to correct any problems faster. No real change to production and delivery.

Sampling from trucks at the production facility has no real impact on productivity or delivery.

See first question #3

We are always trying to make the best mix we can at the plant because we all know variables will effect the quality down the road.

No difference. Just eliminate the need to store and hold extra samples all the time.

N/A

3c - How would you prioritize the changes if they were to be made gradually?

In this case since there is only one real change I would make that one first.

N/A

N/A

Vermont and New Hampshire both have different specs but get the same end result.

N/A

N/A

3d - What do you think should be the optimal sampling frequency to better assess your products and why? (could be different frequency for different purposes, for example in-place density samples versus binder content or gradation control samples)

500 tons for 9.5 and 12.5 nom. max mix, 600 tons for 19 nom. max mixes and 750 for 25 or 37.5 nom. max mixes. For AC content, gradation, cores and volumetrics for those states that run volumetrics.

Plant testing 1 agency and 1 QC test per 600 tons produced, selective QC as deemed necessary by plant QC. Field Coring, same as above 1 for agency and 1 for QC per 600 tons, can be done using distance instead but sublots for large projects should match up and using two different units can cause more or less cores in comparison to the produced mix depending on yield.

Minimum frequency of 600 tons is sufficient. Contractor is allowed (and encouraged) to sample at a greater frequency to control the process.

Sampling every 750 tons on larger projects, or every 500 tons on smaller projects would be doable while providing a good sized sample population.

Both Vermont and New Hampshire have good points. Both go for consistency. My issue in New Hampshire you deign through the plant and set up your aims there and then sample from the road and there is always a difference in my experience. Vermont has joint cores and New Hampshire requires joint adhesive. Which one is right?

I am satisfied with the frequency we have now. Every 500 tons. We very often take a PC sample if there issues or a gap in randoms.

We're good with the frequency

3e - Where do you think the sampling should be done and why? (could be different locations for different purposes, for example loose mix at one location versus liquid binder or aggregate elsewhere)

In a perfect world, behind the paver for everything mix related. PGAB should be sampled in-line before it enters the drum or weigh hopper.

Lab testing - Sample rack Field testing - really only one choice, cores from the road Liquid AC - In line from plant to mixer Aggregate - stockpiles by loader back drag

Sampling has less impact on productivity when conducted at the production facility. Adjustments can be made in "real time". Having early data gives us the ability to reject truck en route instead of finding out after the paving is complete that non-conforming material was placed.

loose mix from haul unit at plant or behind paver. All other sampling is self-explanatory, in that it can be sampled at the source. One concern with volumetric testing would be situations where the material has to be re-heated. This potentially changes volumetric values do to absorption and oxidation.

Gradations of Stockpiles should be on the contractor. New Hampshire still has stockpile specs. but Vermont has done away. New Hampshire should allow you to have 2 aims or have a road pay factor and a plant pay factor for gradation. I feel Vermont at the plant is very busy with air voids and there daily req. But you know where you are at pay factor wise. New Hampshire is more up in the aim until the end with slope depth ride

Loose mix at the plant only. MDOT samples QA from paver hopper-stops the placement, creates a cold spot in the mat from not being able to roll all the way up, have to shovel mix that fell out of hopper back into hopper if done at all, just creates another area that can have lower density in the mat. Liquid is fine with the inline valve at the plant, aggregate from a stockpile designated for the production of HMA.

Good with the MDOT system

4 - What differences in QC testing for projects across the states you work in pose challenges to you?

The only challenges are when an agency tells me what type of QC testing I need to do.

None, the differences are extremely minor in the testing procedures.

No real differences between the states. Biggest issue is contractor's testing is pooled with DOT results for pay factor calculations is MA. This is not the case in RI, and as a result pay adjustments are calculated using a much smaller pool of data.

None

Vermont has a long turn around on core results.

No challenges. We know what we need to do for each state.

None

4a - How would you generally like to see them improved?

Let the contractor be in control of frequency and tests that need to be run to control the process.
No real adjustment necessary, testing is nicely standardized.
Allow contractor's test results to be used in pay calculations in RI.
N/A
In Vermont sometimes Resident Engineers do not make coring and getting cores to the lab priority.
Satisfied with how they work now.
N/A

4b - How would making these changes affect your productivity and delivery of quality materials?

We could concentrate more on the entire production process and not just the testing aspect of QC.
No change
It doesn't. It just allows the product quality to be measured/assessed more accurately.
N/A
I have questionable core results that have sat in a job trailer for 3-5 days.
N/A
N/A

4c - How would you prioritize the changes if they were to be made gradually?

N/A
not sure
N/A
N/A

medium

N/A

N/A

4d - Which tests do you think are optimal to evaluate the quality of your products and why?

N/A

AC content, gradation, volumetrics, temperature, density, ride, PGAB evaluation.

Gmb and Gmm - both values can be generated much more quickly than asphalt content and gradation. I can make a pretty accurate assumption of mix quality based on those two values. AC content and gradation are more helpful in determining WHAT caused non-conformance.

Stockpiles: Gradation, SpG, LA Wear (potentially), Soundness, angularity, hydrometer or sand equivalent HMA: Gradation, binder content, plant voids, VMA Density: Calibrated gauge shots, cores Binder: Appropriate M320 / MSCR testing

Air voids at the plant with a extraction and gradation. Cores on the road.

I think they all play an important part. Air Voids for compaction, AC% and gradation for structure and particle coating, GMM for tracking the gravity of the materials, field density for projected life of the road, and durability values such as the Fine Micro Deval, HWT and ride smoothness for life cycle projections.

Voids,VMA, Pgab content

5 - What differences in QA process related paperwork/reports for projects across the states you work in pose challenges to you?

The potential volume and required reporting time specified.

Paperwork for the states during production is nicely uniform, only trip up we've had in CT like to do their work by individual sieve instead of cumulative and therefore are not uniform with the other states.

None really. No paperwork required for RI, and MA utilizes NETTCP test forms.

Vermont has a system that is difficult to navigate, and is sometimes problematic / redundant NH and Vermont binder test results are not transparent and are difficult to retrieve in a timely manner.

This was our first year paving and producing mix in the 2 states and both states were very helpful on what they needed from us to approve our facilities and mix designs.

No real challenges. The requirements in each state usually spell out what is required. Everyone has a different reporting format and that takes getting used to.

Often times the results come to us in huge clusters 10 +/- results at a time and often late in the afternoon after hours or on a Saturday- would like to see more regular reporting for comparison reasons and to troubleshoot potential issues with equipment

5a - How would you generally like to see them improved?

not sure

CT using Cumulative and NETTCP forms would be nice, not a major problem though.

N/A

Asking for contractor suggestions for streamlining in an open forum Making the reports and results for both QC and QA test results viewable by the contractor

New Hampshire lets you submit your mix design on paperwork and spread sheets of your choice. I actually like Vermont provides you with what they are looking for.

One standardized form would be helpful in a format that is accepted by all parties.

would like to see more regular reporting for comparison reasons and to troubleshoot potential issues with equipment and to receive them during work hours.

5b - How would making these changes affect your productivity and delivery of quality materials?

no affect

Slightly faster analysis of data and more ability for newer people to use data from similar projects to help influence adjustment.

N/A

Trends and / or potential issues could be addressed in a more timely manner, yielding less rework, lower bid prices, and more efficient production.

It would just streamline the design submittals.

It wouldn't affect productivity and delivery from a production standpoint. It would reduce the amount of time spent on figuring out how to report to a different state agency.

It would allow us to do our comparisons and possibly catch a piece of malfunctioning equipment or catch a process out of control or nearing such a case.

5c - How would you prioritize the changes if they were to be made gradually?

not sure

Really if it didn't happen it would not be a problem.

N/A

Open forum on Vt database 3 year stepped improvement and streamlining of both Vt QA results and Agency binder results

medium

Roll out forms for everyone to work with and see what changes would be needed. Uniformity of agency specifications would be needed. Will any one agency be willing to relax one area to pick up another agency's requirements? I don't think so is my opinion.

just implement

6 - What is your opinion on the current chain of custody in the states in regards to samples for acceptance testing?

Whatever each state requires is fine with me.

Generally good, a time and date delivered on the cores to make sure cores are being secured in environmentally stable areas as not to take damage would be nice.

Chain of custody at plants is no issue. In MA, there are occasional issues with cores not being delivered to the District Lab in a timely fashion or in a manner which preserves the integrity of the sample. These issues have diminished greatly over the last few years. Not much experience with chain of custody in RI where we are primarily a material supplier and do minimal paving work.

Vt - Good NH - Good Maine - Fair. However, Maine is a large state, and delivery of samples can be challenging for that reason.

I do not like waiting 7-10 days on core results in Vermont

It works in Maine. Once the sample is taken and sealed it is the responsibility of the contractor to deliver sample to the respective testing lab for the agency within the required time frame. Not familiar with NH since it has been some time since we did any work there.

We are good

6a - If they are not similar, which state's approach are you most comfortable with and why?

NH, the samples are witnessed, labeled and secured. Samples are delivered back to the production lab at the mix supplier for testing.

They are almost exactly the same.

Most comfortable with MA, but strictly due to familiarity with the process. I am familiar with ConnDOT's system, and if that were implemented in MA the contractors would need to hire more personnel.

NH - It's secure, efficient, and encourages communication between contractor and Agency - always a good thing.

New Hampshire has more real time results

Not familiar with other agency requirements.

not sure on the other states

6b - Do you have any suggestions on a better approach?

no
See 6
In MA, we need to begin using special transport boxes for cores to eliminate any chance the samples could be damaged in transit.
No
none
None at this time.
no

6c - How will this approach facilitate the chain of custody process?

NA
Just adds a small set so that cores can be identified as handled properly and in a timely manner as to remove that from possible reasons during any dispute resolution.
Currently the technician simply hands cores over to a DOT inspector. No record of when, to whom, and how many samples were submitted. The process just needs to be more formal.
N/A
needs to be more urgency on core results in Vermont. Although it is the contractors resposibilty to provide a good product so It makes the contractor have more priority on quality.
N/A
N/a

7 - Are there any other elements of the QA process and specifications in New England states that should be reviewed in your opinion (especially in context of unifying processes between the agencies)?

Name	Response
Jeff Lewis	No
Albert G Zander Jr	Yes
Matthew Teto	Yes
Mary Wescott	No
Jeffrey Greer	Yes
Peter Moulton	No
Herrick Randall	Yes

7a - If yes, please kindly explain what it is and what you feel can be done better

The specifications between the states are so vastly different, I am not sure there will come a day when each agency will have one common spec
All states should come together to settle on a VMA target. Each state has there own and with all the testing over all the states someone must be able to figure out if raising the VMA actually helped increase the life in the road.
The current specifications are trending towards being more prescriptive in nature (particularly in regards to paving operations) yet the contractor is still saddled with a lot of liability.
Hamburg Wheel Tracker - consistency between Maine and Vermont re: sample height and chamber temperature Binder Grades - MSCR or not? Let's get the JnR and other questions cleared up.
The QA process for small quantity projects is ridiculous. Bridge approaches and decks require multiple samples for each lift being placed. We have had many projects that had 3 HMA field samples taken on 60-100 tons for each lift along with 3 cores for each lift. That is the reduced quantity of testing. It could

be more if the contractor requested it. The potential for taking 9 separate samples that include 54 boxes of HMA and 9 cores is overkill. That's for a 3 lift project.

8 - Are there any additional comments or recommendations you feel are noteworthy at this time? Please explain

I am looking forward to the discussion.
No, overall they have been very similar and it makes it easy to jump from state to state with only minor adjustments to the process.
N/A
We would like to feel that the MDOT trusts us. There is a general feeling that the MDOT feels we are always out to screw them. A better sense of working "together" to produce the best possible product. We pay taxes too!
Gsb should be allowed to move with the material instead of hard limits. I have not seen one source that does not contain volatility in the specific gravity. Figure a way to measure from each test that works for all parties.
"As we look toward Design, Bid, Build; more PMA's; continued efforts to put more binder in our mixes: It would be very helpful if the Northern New England states would meet and look to greater consistency in mixes, binder grades, contract requirements."

9 - Will you be willing to participate in a half-day workshop November 14th or 16th?

Yes
No
Yes
Yes
Yes
Yes.
Yes

10 - Please note the method of contact that you prefer.

the email to which this survey was sent
the email to which this survey was sent
the email to which this survey was sent.
the email to which this survey was sent

Appendix D: Proceeding from Workshop

This section contains the PowerPoint presentation slides from the Workshop.

Agenda

- NETC 15-4 QR Timeline Review
- Review of Kickoff Meeting
- Contractor Survey Summary
- Structured Discussions
- Summary

3

TIMELINE REVIEW

NETC 15-4 QR

4

Proposed NETC 15-4 QR Project Schedule

Tasks	Months											
	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
1. State of the Practice/Literature Review												
2. Kick-off Meeting												
3. Cross-border Issues: Challenges and Opportunities												
4. Roadmap of Actions and Workshop												
5. Draft Final Report, Readiness Evaluation, and Initial Roadmap												
6. Presentation of Draft Final Report to Project TAC												
7. Final Report and Recommendations												
Quarterly Report												

5

REVIEW OF TASKS 1-3

- Current Practice: From agency survey and interview data, published specifications, and kick-off meeting

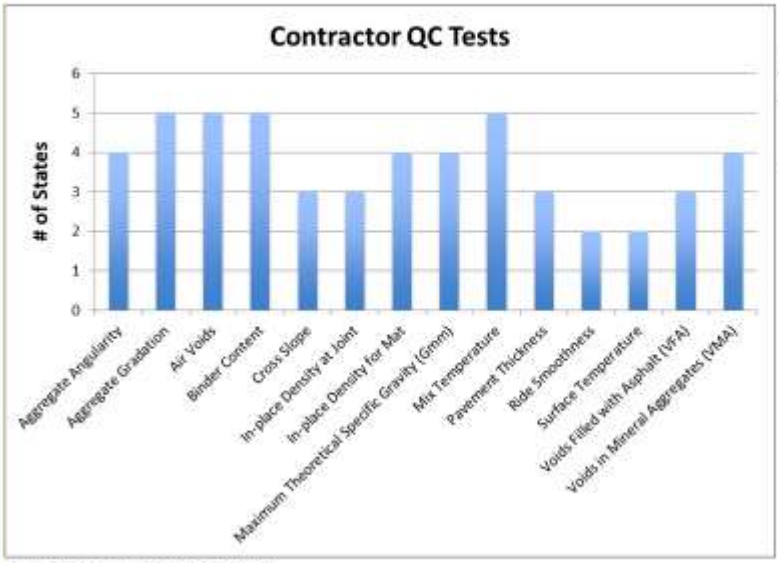
6

QC Sampling

- In general, common among all states:
  - Sampled from the truck
  - Tested at least once per 500 ton sublot, and
  - Tested by contractor personnel in the QC lab at the plant
  - Contractor personnel draws and tests their own samples and is responsible for their own process control

7

QC Tests



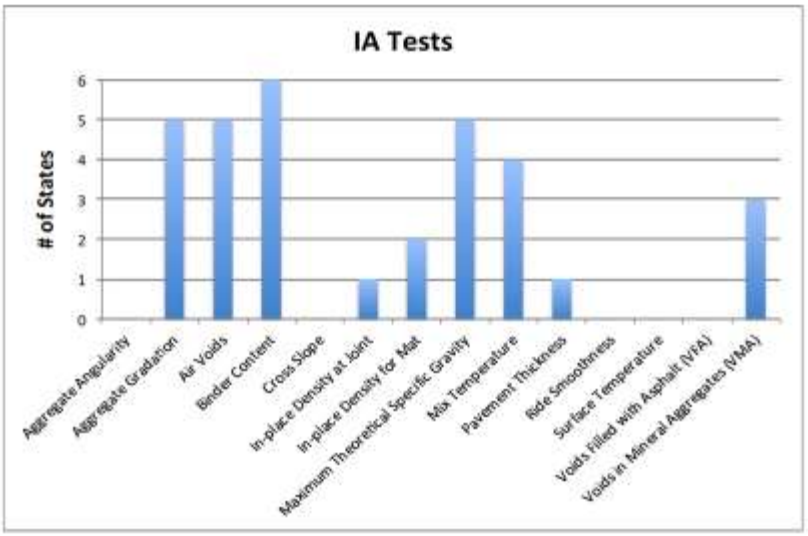
Also tested:

- **MA-** wheel path deviations
- **VT-** effectiveness of anti-stripping additive in PG binder (boiling method)

***RI** marked "Not Tested" for all

8

IA Tests



9

Agency Sampling

- Cores taken from mat
- Loose mix
  - Sampled from
    - *Truck at Plant* (CT, MA, RI & VT)
    - *Paver Hopper* (ME)
    - *Behind Paver* (NH)
  - Frequency
    - *1 per 750 ton sublot* (ME & NH)
    - *1 per 600 ton sublot* (MA & RI)
    - *1 per 500 ton sublot* (CT & VT)

*CT **plans to take at the paver from 2019 season**

Location of Testing:

- Central Lab (CT (cores), ME, RI and VT(cores))
- District Lab (ME)
- Plant Lab (CT (loose mix), MA, NH& VT(loose mix))

10

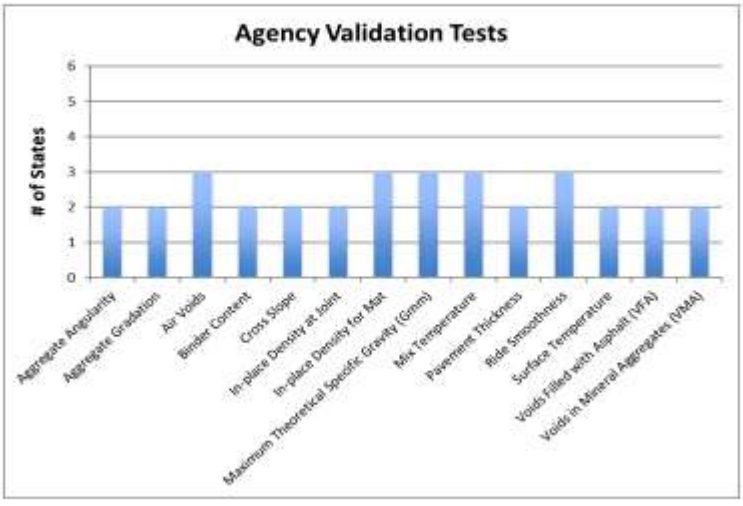
Agency Validation of QC Tests

Basically, there are two identified approaches:

1. DOT personnel periodically oversee testing and/or validate splits (CT, MA, ME & VT)
   - *VT staffs Agency Plant Inspector*
2. No validation is done by DOT personnel. QC results are purely for contractor's use. (NH & RI)

11

Agency Validation of QC Tests



MA, ME & VT represented

12

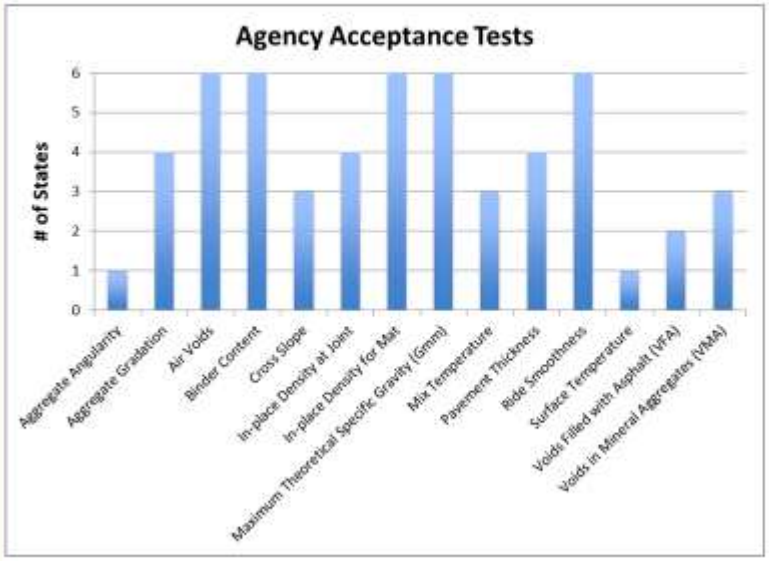
Agency Validation of QC Tests

Also tested:

- **MA-** wheel path deviations
- **ME-** periodic testing of aggregate stockpiles (RAP), belt cuts & liquid binder.
  - RAP is tested for gradation and PGAB content (using solvent extraction).
  - Belt cuts are tested for
    - *Gradation*
    - *Fractured Faces*
    - *FA Angularity*
    - *Sand Equivalent*
    - *Course Micro Deval*
    - *Combined Aggregate Gsb*
    - *Fine aggregate Gsb and absorption*
    - *Course aggregate Gsb and absorption*

13

Agency Acceptance Tests



Also tested:

ME-
on some projects:

ride smoothness & joint density

14

Dispute Resolution

Splits taken and tested (CT, MA (central lab is arbitrator) & ME)
New samples taken (NH (cores only at same offsets) & VT)
State results are validated (RI)

Chain of Custody

- Loose Mix:
  - DOT personnel takes immediate possession of sample (CT, MA, NH, VT)
  - Contractor delivers sample to the agency (ME, RI)
- *Cores*
  - DOT personnel takes immediate possession of sample (MA)
  - Contractor delivers sample to the agency (CT, ME, NH, RI)
  - *VT uses sample couriers*

15

Required Positions & Certifications

Required Positions/Certifications	No. States
Plant Technician Certified	4
HMA Paving Technician Certified	
Quality Control Plan Administrator	3
Quality Assurance Technologist	
Quality Control Technician	2
Process Control Technician	1

*ME
- QCTA is QAT certified
- HMA Plant Inspector (PCT & Plant Tech Cert)
- Paving Inspector (QCT & Paving Tech Cert)

*RI does not require certification

16

REVIEW OF CONTRACTOR SURVEY

17

Survey Responses (7)
(17 requests sent)

Contractors (No. of Personnel)	States
Lane Construction Corporation (1)	CT, MA, NH, VT
Brox Industries (1)	ME, MA, NH
Pike Industries (3)	ME, NH, VT
P.J. Keating (1)	MA, RI
J. Hutchins, Inc.(1)	NH, VT

18

QA Sampling (Frequency and Location)

- Minimal issues with sampling frequency
  - Vermont takes more cores than other states (Lane)
  - Maine have contractors take extra boxes of QC sample each time (Pike)
- Sampling Location
  - All good with in-line binder sampling
  - (Maine) Sampling out of paver hopper results in halt in paving operations which leads to issue with heat loss, density loss and ride quality (Pike)
  - Prefer sampling loose mix in plant for real time adjustments or behind paver. Cores should be taken from road

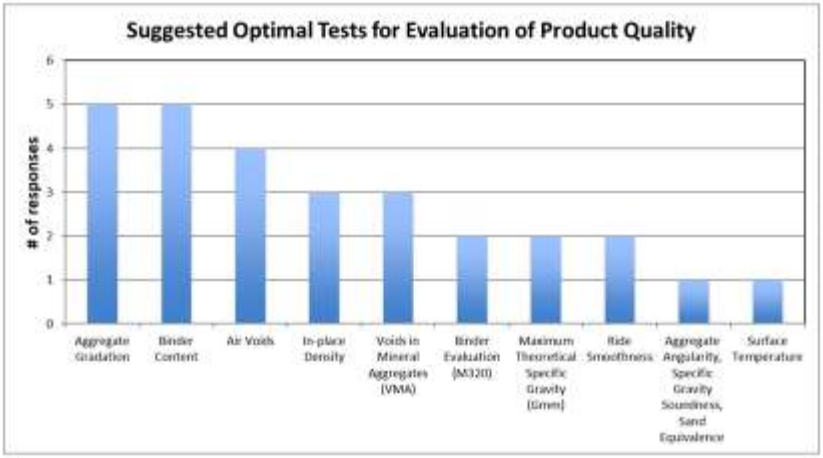
19

QC Testing

- Minimal issues: Minor differences in QC testing
  - Contractor's testing is pooled with DOT results for pay factor calculations in MA. RI uses smaller pool of data (only DOT results). (P.J. Keating)
- Recommendations:
  - Allow contractor's test results to be used in pay calculations in RI as it allows the product quality to be measured/assessed more accurately. (P.J. Keating)
  - Let the contractor be in control of frequency and tests that need to be run to control the process so that the focus will be more on the entire production process and not just the testing aspect of QC. (Brox)

20

QA Testing



*Pike Industries:
Durability values such as the Fine Micro Deval

21

QA Paperwork/Reports

- Most contractors did not have issues
  - CT do their work by individual sieve instead of cumulative (Lane)
    - *CT should consider using Cumulative sieve and NETTCP forms*
  - Concerns on timing for retrieval of results, particularly VT (Pike)

Chain of Custody

- Contractors all fine with current chain of custody even though slightly different.
  - In MA, special transport boxes should be used for cores to eliminate any chance the samples could be damaged in transit. (P.J. Keating)

22

Additional Comments

- All states should come together to settle on a VMA target. (Lane)
- G_{sb} should be allowed to move with the material instead of hard limits (J. Hutchins)
- Hamburg Wheel Tracker – should be consistent between Maine and Vermont (Pike)

23

POTENTIAL CHALLENGES

Based survey data and published specifications

24

What agencies said should be kept

Testing Methodology

- **CT:**
  - Sampling of cores for in-place density testing
    - *Logic: consistent and accurate method to determine critical HMA property*
- **NH:**
  - Volumetric design process used to determine job mix formula & gradation and binder content used to control production
    - *Logic: They are stronger methods. If gradation and AC content characteristics are met, volumetrics will follow.*

25

What agencies said should be kept

Related to Contractors

- **VT:**
  - Minimum QC testing requirements & QC plant requirements
    - *Logic: It establishes the minimum testing requirements for the production of asphalt materials at the plant & defines the roles & responsibilities of contractor personnel*
- **ME:**
  - Dispute resolution process
  - IA program
  - random sampling & statistical acceptance
  - certification requirements for acceptance & QC staff
  - laboratory quality & accreditation system

Logic: It is a fair specification using measures that are known to have an impact on the life of our treatments so we can provide as much of an indication of how well they will perform. Our intent is to have an overall QA program with core elements that function well together and integrate with each other.

26

Where agencies are looking for improvement

- **NH & RI:**
  - No changes identified
- **CT:**
  - Change sampling from hauling unit to sampling at the paver.
- **VT:**
  - Change sampling location to behind the paver instead of at the plant to evaluate in-situ characteristics
  - Performance testing
    - (i.e.: Hamburg and SCB/IFIT testing with pay factors)

27

Where agencies are looking for improvement

- **MA:**
  - Straight-forward way of accepting binder, especially how to handle things when there is a failure.
    - ***Currently testing 1 per 12,000 tons per project but gets confusing***
- **ME:**
  - Greater presence at contractor plant facilities as well as improved QC/production requirements (***How much more?***)
    - More frequent plant inspections, improved process control by material producers

28

DISCUSSIONS

29

Discussion Topics

- Sampling Frequency and Location: Loose mix and Cores
- Testing (QV vs IA vs Validation vs Acceptance):
- Chain of custody (loose mix vs Core)
- Dispute Resolution (loose mix vs Core)
- Pay Factors
- Paperwork
- Required certifications for contractor and agency personnel
- Political or fiscal barriers to making changes
- Agency presence in plant facility

30

Optimum Sampling Frequency (1)

- What do you think should be the optimum sampling frequency for binder?
- Agency:
  - MA: Challenge associated with which portion of project is related "failing" binder. May be consider sampling daily (may not need to test everyday). Potentially consider a system that takes into account changes in mixes or binders during production.
  - NH: Is already following above described approach of sampling daily, but not testing each day's sample.
  - ME: has different sampling rates for PMA vs. straight run (based on tonnage). Potential challenges with inspector personnel availability for daily sampling.
  - VTrans: Once per 1000 ton or once per project. Check with CT and RI regarding sampling location, other 4 are sampling in-line.
- Contractor:
  - Take sample every day and in-line for each type of binder. Advantage of daily sampling is that, if there is failing sample, you could go to previous day's sample.
  - Consider lower sampling frequency if it is low tonnage (< 500 ton).
- General consensus:
  - In-line sampling. Daily sampling should be considered (even with low tonnage especially for QC purposes).
  - Need to be resolved: QC/Process control daily or Agency QA sample daily?

31

Optimum Sampling Frequency (2)

- What do you think should be the optimum sampling frequency for loose mix? :QC
- Contractors:
  - 500 ton sublot or minimum once a day's production.
- Agency:
  - MA: 600 ton sublot (15,000 ton lot)
  - NH: max. 750 ton sublot.
  - VT: 500 ton.
  - CT: 500 ton sublot.
- Consensus:
  - Consider largest sublot size to be 500 ton.

32

Optimum Sampling Frequency (3)

- What do you think should be the optimum sampling frequency for loose mix? :QA

➢ Agency:

- NH: Largest sublot 750 ton.
- ME: Method B (smaller jobs), minimum 3 sublots. Method A and C (max 750 ton sublot), flexible on lot size, general guidance of 4500 ton lot. For Methods A and C, minimum 4 sublots. Method D (for very low risk project): 1 sample validation per 250 ton, no QC.
- MA: Once every 600/1200/2400 ton as function of lot size. 50% and 25% of sampling frequency lowering if QC validation is employed.
- VT: 500 ton largest sublot size. ME approach seems quite practical as it takes into account traffic volume and functional class of roadway
- CT: Similar to MA approach. QC results from contractor for acceptance and agency verification at 1:3.5 tests. Using statistical testing (f and t) to determine if agency and QC results agree, if not, then only agency results are used. There will be minimum 3 samples to be able to do statistical tests.

➢ Consensus:

- Might be challenging to have a consensus on frequency unless tiered approach is perhaps implemented

33

Optimum Sampling Frequency (4)

- What do you think should be the optimum sampling frequency for cores? :QA

➢ Agencies

- NH: Max 750 ton
- ME: 500 ton max. for non surface mix, 250 ton for surface mix and joint core once per 2000 feet and at least 5 cores;
- MA: Similar to loose mix, minimum 600/1200/2400; tend to take more cores than loose mix. No joint cores.
- VT: Similar to loose mix 500 tons max. or 6 cores per day and 2 joint cores per mile per lot. Lot size for joint cores = project length
- CT: 3 tiered approach. <2000 ton project → 1 mat and joint core/500 ton; 2000 – 3500 ton projects → 4 mat and 4 joint cores; >3500 ton → PWL, up to 7 mat cores (1/500 tons) and 7 joint cores (1/2000 ft)
- RI: One joint core per 3000 ft. One mat core per 300 tons
- Core size: NH: 6 inch; CT: 6 inch; RI: 4 inch; MA: 6 inch; VT: 6 inch

➢ Consensus:

- Might be challenging to have a consensus on frequency but everyone could agree on a core size of 6 inch. Joint cores?

34

Optimum Sampling Frequency (5)

- What do you think should be the optimum sampling frequency for cores? :QA
  - Contractors
    - Good with frequencies
    - Whatever the state wants. Cores are easier to get
    - Joint cores: Concerns with joint adhesive.
  - Raised questions
    - What are the core results use for:
      - *Tied with QA test results. For Gmm calculation*
    - Which Gmm to use: It is different for the states
      - *ME → Currently using the closest QA sample coming from corresponding sublot*
    - Where joints sample should be taken from:
      - *Contractors have the option to choose type of joint to employ*
      - *ME: Samples taken over center of wedge for wedge joint*

35

Sampling Location (1)

- What location will be the best to take loose mix samples from?
  - Agency:
    - NH: from the mat
    - CT: Transitioning to from the paver
    - RI: Practicality → From plant; Could be better from paver
    - ME: Sampled from hopper. Challenges with ultra thin overlays.
    - MA: Prefers to do from plant so that all results are conveyed quickly.
    - VT: Ideally from hopper or mat
    - Concerns with taking within the mat and hopper related to final mat/density/segregation/temperature
  - Contractor:
    - Prefer plant as it might help most consistent for process control
    - General experience is that for air void control samples at plant are better.
- Consensus:
  - From Truck at plant is not the most representative for loose mix property but time-wise and easier process control, it may be better

36

Sampling Location (2)

- What location will be the best to take core samples from?
  - ME: Taken only from mainline, none form shoulders
  - NH: Taken from shoulders for informational only for overlays, for full box designs, shoulder lot has its own sublots.
  - VT: Taken only from mainline if not a joint core; joint cores taken anywhere on mat

37

QC/IA/Validation/Acceptance Testing (1)

- What will be the optimal tests that could used to assess quality? In terms of: Binder

➢ Agencies
  - PG grading (M320)
  - NH, VT, MA, CT: extended aging (agreement needed on definition of extended aging)
  - ME, CT: MSCR polymer modified binder

➢ Contractors
  - Nothing additional to add

38

QC/IA/Validation/Acceptance Testing (2)

- What will be the optimal tests that could used to assess quality? In terms of: Loose mix

➢ Agency
  - All: AC content, gradation, air voids, VMA
  - Future: performance testing (and perhaps some of the volumetric measures drop off)

➢ Contractor
  - VMA difficult to measure in real time with Gsb fluctuations
    - *Consider calculating VMA with Gsa instead or a different parameter can be identified.*

39

QC/IA/Validation/Acceptance Testing (3)

- What will be the optimal tests that could used to assess quality? In terms of: Cores

➢ Agency
  - All: Air voids (NH: if core <80% of thickness, won't be used for air void)
  - Thickness (MA, NH tracks but not included in pay factor for overlays)

➢ Contractors
  - Nothing else

40

Chain of Custody

- Considering the chain of custody practiced by the six member states, which do you think is the safest, fastest and could easily be adopted by all states?
- Loose Mix
  - Contractor:
    - *use of a courier to pick up and deliver samples (loose & cores) to state lab,*
  - Agencies:
    - *NH testing at plant, so convenient.*
    - *Delivery is contractor's choice within specified time frame*
- Cores
  - Contractors: Delivered on site, state agency picks up at lab (VT time issue)
  - Agencies: MA, RI, VT take possession at site, MA like idea of sealing and delivering. VT thinks some contractors may be against delivering to plant and/or state lab
- Consensus:
  - Challenges associated with testing location: plant or state lab. Could be two common protocols. Everyone agrees with the idea of security boxes for cores similar to that used by ME.

41

Paperwork/Reports (1)

- Some states indicated they don't require any kind of QA paperwork. What will be the implication of each state having QA paperwork/report requirement?
- Agencies
  - ME: forms/reports generated from database, sent to contractor representative automatically
  - MA: varies by district in terms of what is shared, but developing database system
  - NH: all results emailed to contractors, also developing database
  - VT: just started using software systems to share results instead of email; will also send email to RE's and Contractors if requested
  - CT: loose mix at plant immediate results, cores through project personnel, has specific agency forms
  - RI: plant inspectors make a copy of the results and hand it to the contractor before they leave
- Contractors: generally happy with process, but would like to get results sooner and more detailed report
- Consensus:
  - It would be ideal for the contractors to get feedback as soon as it is available. An automatic database report generation will be the best approach

42

Paperwork/Reports (2)

- What are the most important information to be included in paperwork/reports related to the QA process?

➢ Quality level analysis
  - MA: will start looking at all results instead of just final summary
  - NH: looking at all info and not just summary
  - ME: Contractor results are submitted to states and entered into system

43

Dispute Resolution

- What will be best approach to resolving dispute between agencies and contractors?

➢ Agencies:

Disputes on pay factor results (and tests that relate to those)
  - ME: based on relative difference to state results; no disputes on cores, but there is a process with respect to location and thickness at the time of sampling
  - VT: can dispute core location but not results
  - NH: allowable disputes based on statistics

44

Pay Factor (1)

- What are the most important aspects of QA specifications that should affect pay factor?

– MA: density, thickness, ride quality, volumetrics, binder content (each separate)
– ME: density, volumetrics (Va, VMA), binder content, gradation (some) – combined. ride quality, joints (separate)
– NH (tier 1): binder content, gradation, Va, (most critical wrt longevity) ride, thickness, cross-slope
– VT: separate: design Va, in-place density (mat & joint), ride But think binder content would be good to add
– CT: density, volumetrics, binder content

45

Pay Factor (2)

- Is there currently any agency Pay Factor strategy that is considered the most practical and can possibly be adopted by other states?

➢ Composite vs separate
  – MA could go either way – but like the separate so that different elements are appropriate for project and timing
  – NH each lift has its own composite, could do separate but weighting factors need to be adjusted

46

Certification Requirements (1)

- Which certifications can be considered adequate for Contractor QC personnel?

➢ NETTCP

47

Certification Requirements (2)

- Which certifications can be considered adequate for Agency QA personnel?

➢ NETTCP

48

Agency Presence in Plant Facility

- How frequently should agencies inspect contractor plant facilities?

- Non-issue for states working at plant during production, have to be certified/calibrated
- VT: annual plant inspection
- ME: Annual inspection, production inspections, ideally would like to visit every plant every day
- MA: inspect lab, yearly check on plant
- CT: Annual inspection, IA inspections, current production coverage 40-50%

49

Political/Fiscal Barriers (1)

- Are there any political or fiscal barriers that could possibly hinder the adoption of a unified QA specification in your state?
  - Location of personnel – at plant lab or agency lab
  - State employee working for another state's job
  - Plant inspections – can one state accept certification of another
  - How often will one plant be producing mix for more than one state on same day – is it really an issue?
  - Number of personnel required to be on site and/or at plant

50

Political/Fiscal Barriers (2)

- Are there any barriers to adopting changes in QA specifications for your company?

  – No additional comment

51

Thank you for your continued cooperation as we move forward.

University of New Hampshire