

# Use of Contractor Data for Quality Acceptance -

## *Wisconsin Style*

Presented at the 2005 Louisiana  
Asphalt Technology Conference  
Shreveport, LA

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# Overview

- How Wisconsin went to Contractor Data Acceptance
- Required Testing by WisDOT Specifications.
- Examples of Contractor QC and CA data.
- How does it really work?
- Quality Verification (QV) samples:
  - QC, QA, QA and QV results agree and
  - when they don't.

# Use of Contractor Data for Pay

## Development time line

### 1 Methods and Materials Specifications

- DOT QC and Acceptance Testing **Total DOT Control**

### 2 QC Specifications

**Us vs. Them**

- Highway Technician Certification Program
- Contractor QC testing
- DOT QA testing for acceptance

### 2a Workmanship and Materials Warranty Specifications

- Contractor QC Testing **Us vs. Them**
- DOT QA testing for acceptance
- Wisconsin has a 1 year W & M Specification

# Con't - development time line

- 3 Contractors and DOT developed comfort level with volumetrics
- 4 QMP Specifications Partnering
  - Contractor QC and Acceptance Testing
  - DOT Independent Assurance Sampling (IAS)
- 5 **Performance** Warranty Specifications
  - Contractor QC testing and acceptance
  - Contractor ownership of pavement
  - open communication with DOT**Partnering**

# WisDOT Required Testing

## QC Testing

Daily Plant Production  
in tons

Samples  
per day

\_\_\_ 50 - 600

1

601- 1500

2

1501 - 2700

3

2701 - 4200

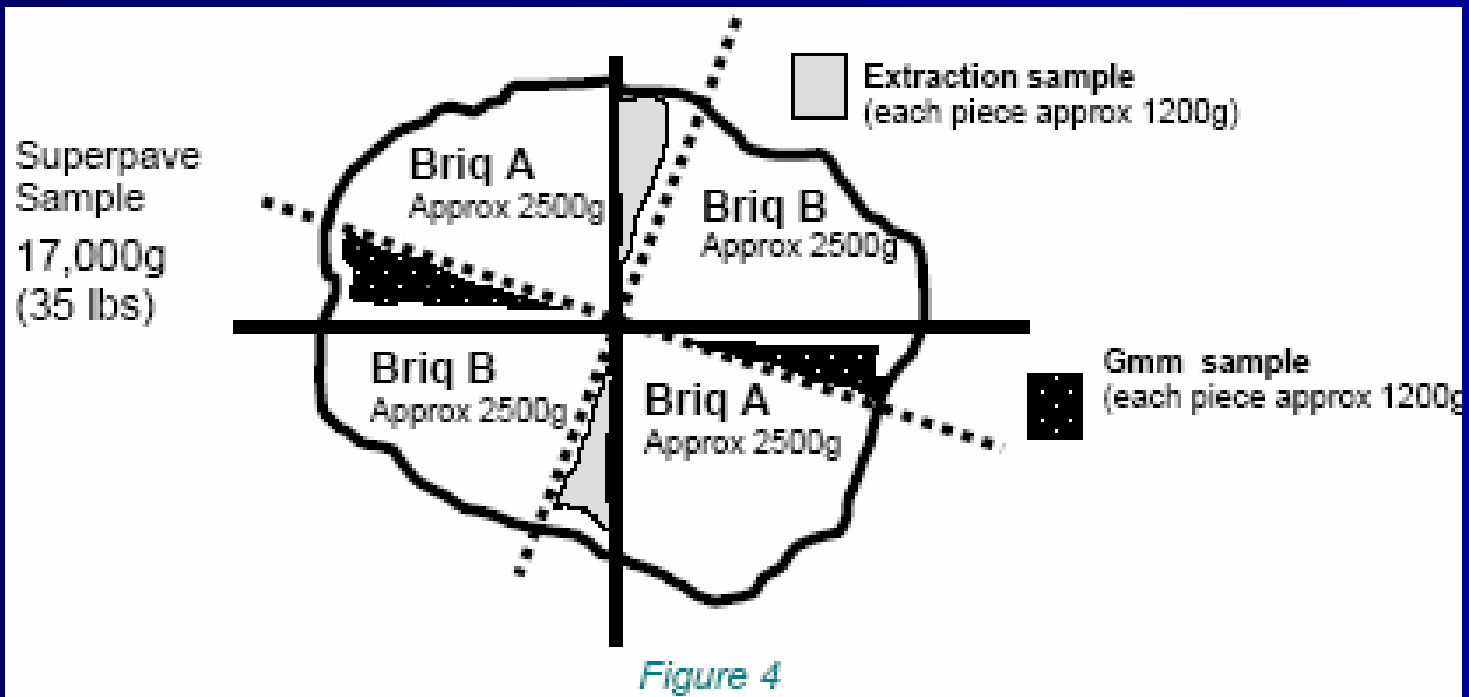
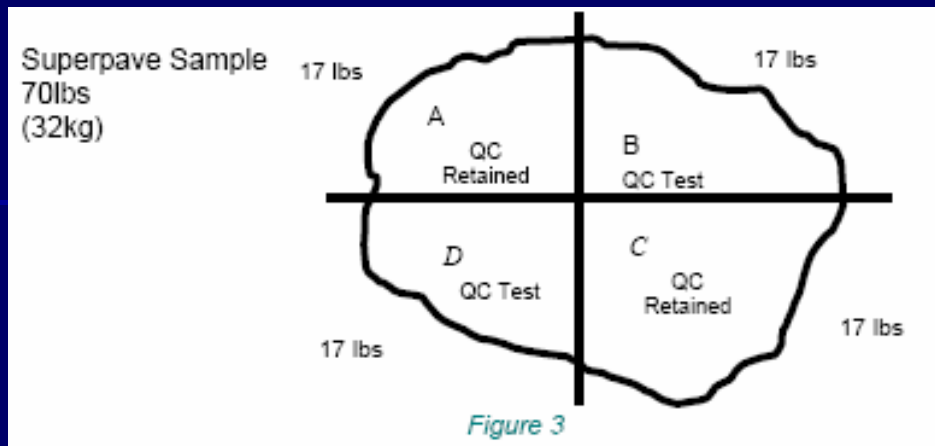
4

greater than 4200

add sample for each  
additional 1500 or fraction

Sample size large enough to split for QC-test and  
QC-retained portions.

# QC Sampling and Splitting

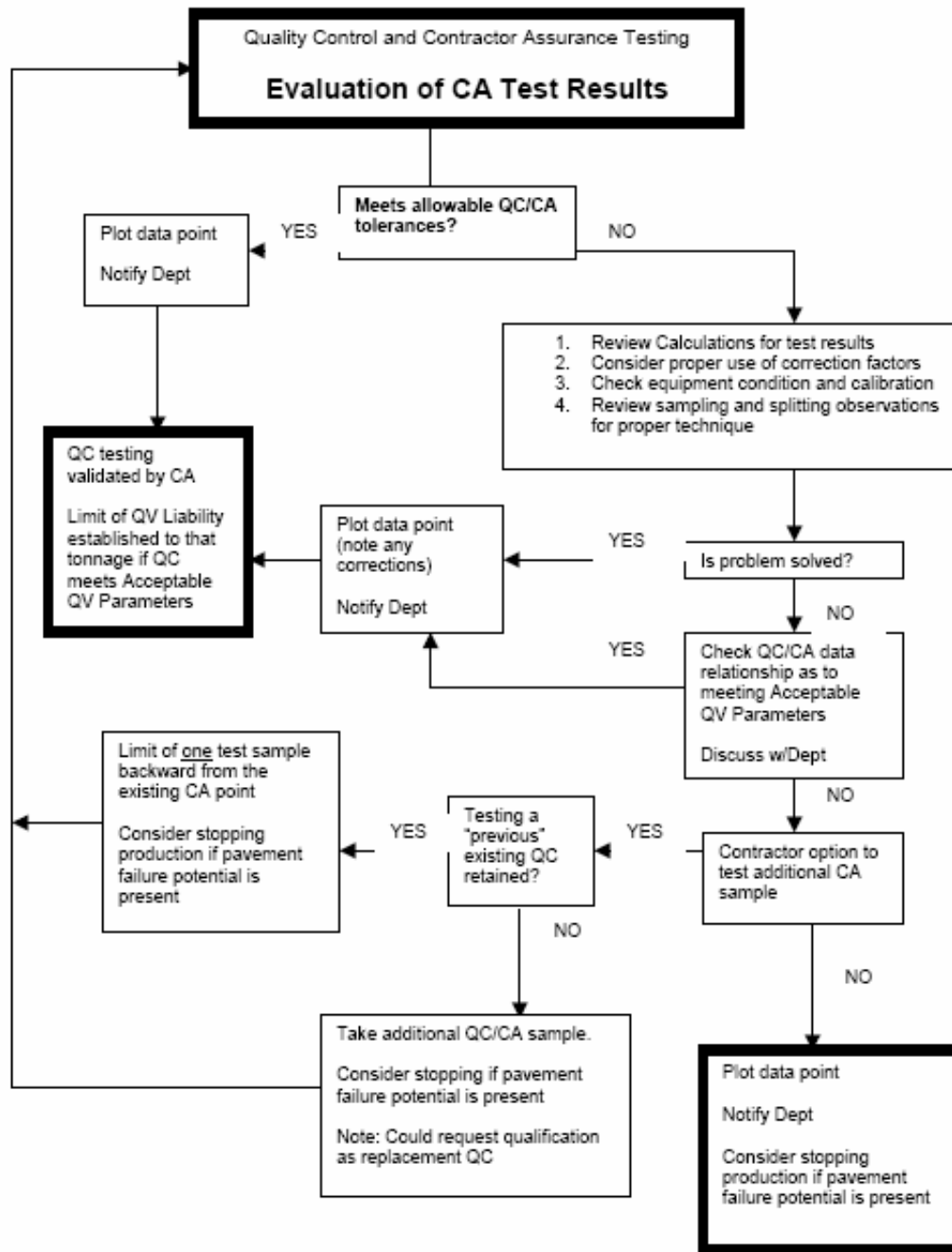


# WisDOT Required Testing

## CA Testing - frequency set by Contractor

- independent check on QC results using
- QC - retained sample with
- separate set of equipment and
- different certified technician and can
- set firewall to limit contractor liability if
- notify Engineer using QC-ret as CA.

## Evaluation of CA Test Results





## Asphalt Mixture Running Average Data Sheet

Project Name
Nelson-Durand STH 25 Warranty
Project Number
7171-09-71

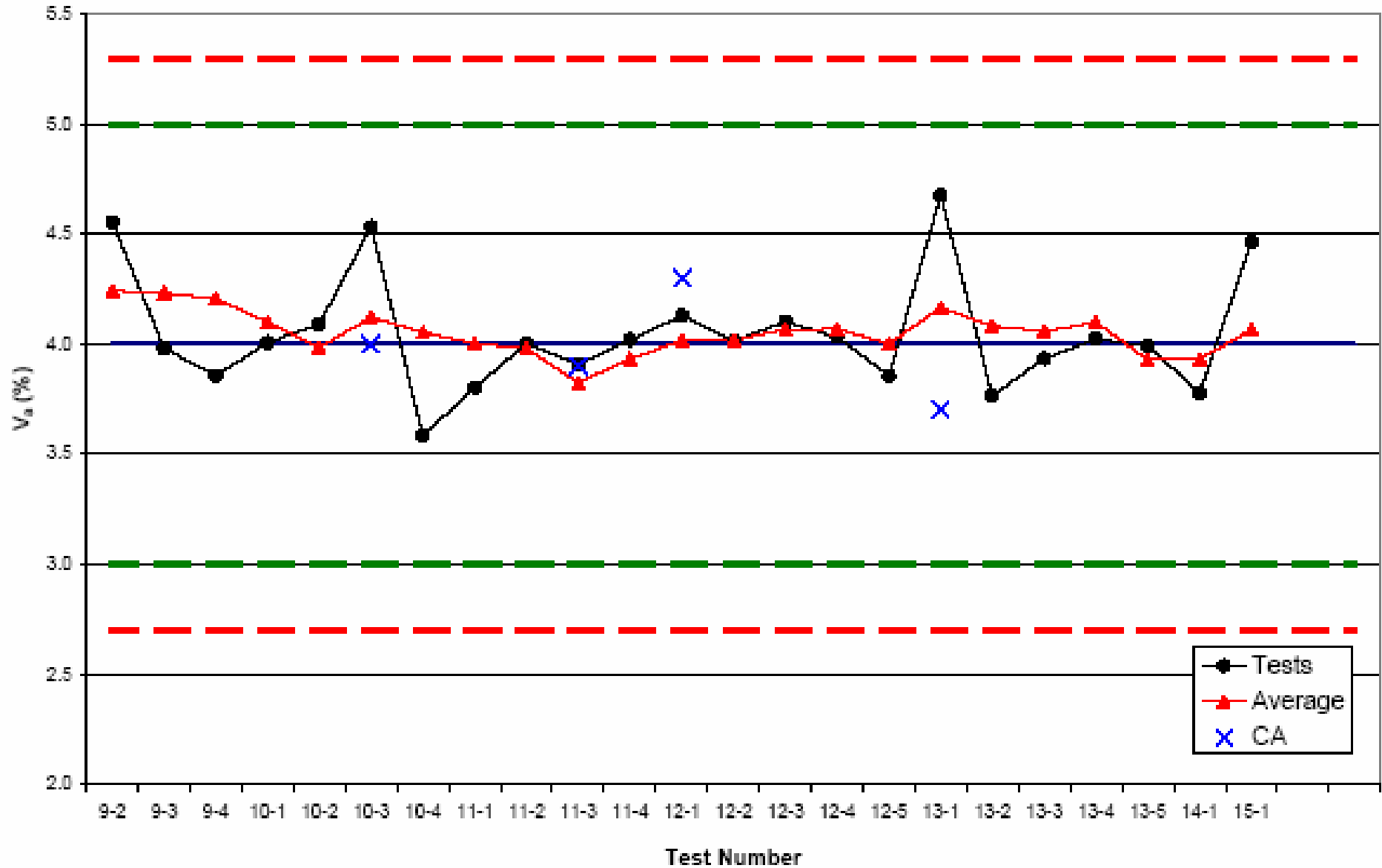
Plant Location
Durand
State / County
Wisconsin / Buffalo

Design No.
55-4-04-E3-12.5(W)
Asphalt Type
PG 58-28

	Date	Test	G <sub>mb</sub>	Avg G <sub>mb</sub>	G <sub>mm</sub>	Avg G <sub>mm</sub>	V <sub>s</sub> (%)	Avg V <sub>s</sub> (%)	VMA (%)	Avg VMA (%)	P <sub>s</sub> (% Mix)	Avg P <sub>s</sub> (% Tank)	P <sub>s</sub> (% Tank)
Design			2.405		2.505		4.0		14.2		5.2		
							Low	High	Low		Low	High	
JMF							2.7	5.3	12.7		4.8	5.6	
Warning							3.0	5.0	13.0		4.9	5.5	
	11-Aug	5-2	2.400	2.406	2.498	2.508	3.9	4.1	14.4	14.2	5.2	5.2	
	12-Aug	6-1	2.407	2.406	2.524	2.514	4.7	4.3	14.2	14.3	5.2	5.2	
	12-Aug	6-2	2.409	2.406	2.499	2.508	3.6	4.1	14.1	14.3	5.2	5.2	
	12-Aug	6-3	2.423	2.410	2.513	2.509	3.6	3.9	13.6	14.1	5.2	5.2	
	12-Aug	6-4	2.421	2.415	2.505	2.510	3.3	3.8	13.7	13.9	5.2	5.2	
	<b>Blend Change</b>					New Gab =	2.658						
	13-Aug	7-1	2.415	2.417	2.532	2.512	4.6	3.8	13.9	13.8	5.2	5.2	
	13-Aug	7-2	2.419	2.420	2.522	2.518	4.1	3.9	13.7	13.7	5.2	5.2	
	17-Aug	8-1	2.420	2.419	2.511	2.517	3.6	3.9	13.7	13.8	5.2	5.2	
	17-Aug	8-2	2.409	2.416	2.507	2.518	3.9	4.1	14.1	13.8	5.2	5.2	
	17-Aug	8-3	2.403	2.413	2.503	2.511	4.0	3.9	14.3	14.0	5.2	5.2	
	17-Aug	8-4	2.409	2.410	2.509	2.508	4.0	3.9	14.1	14.0	5.2	5.2	
	18-Aug	9-1	2.413	2.409	2.525	2.511	4.4	4.1	13.9	14.1	5.2	5.2	
	18-Aug	9-2	2.417	2.411	2.532	2.517	4.6	4.2	13.8	14.0	5.2	5.2	
	18-Aug	9-3	2.414	2.413	2.514	2.520	4.0	4.2	13.9	13.9	5.2	5.2	
	18-Aug	9-4	2.423	2.417	2.521	2.523	3.9	4.2	13.7	13.8	5.3	5.2	
	19-Aug	10-1	2.405	2.415	2.506	2.518	4.0	4.1	14.3	13.9	5.3	5.3	
	19-Aug	10-2	2.413	2.414	2.516	2.514	4.1	4.0	14.0	14.0	5.3	5.3	
	19-Aug	10-3	2.416	2.414	2.531	2.518	4.5	4.1	13.9	14.0	5.3	5.3	
	19-Aug	10-4	2.416	2.413	2.505	2.515	3.6	4.1	13.9	14.0	5.3	5.3	
	20-Aug	11-1	2.411	2.414	2.506	2.515	3.8	4.0	14.1	14.0	5.3	5.3	
	20-Aug	11-2	2.411	2.413	2.512	2.513	4.0	4.0	14.1	14.0	5.3	5.3	
	20-Aug	11-3	2.411	2.412	2.509	2.508	3.9	3.8	14.1	14.1	5.3	5.3	

0-402740304-0  
WISCONSIN  
DNR

### $V_a$ Control Chart #2



# WisDOT Required Testing

## QV Testing

- **minimum 1 test / 30,000 tons of HMA produced per mix design**
- **unannounced random sample**
- **taken by contractor under direct observation of Engineer**
- **split into QV and QV-retained portions**
- **Engineer takes immediate possession**

# WAPA / DOT Tech Team: Verification Program

## In-the-Quality-Box

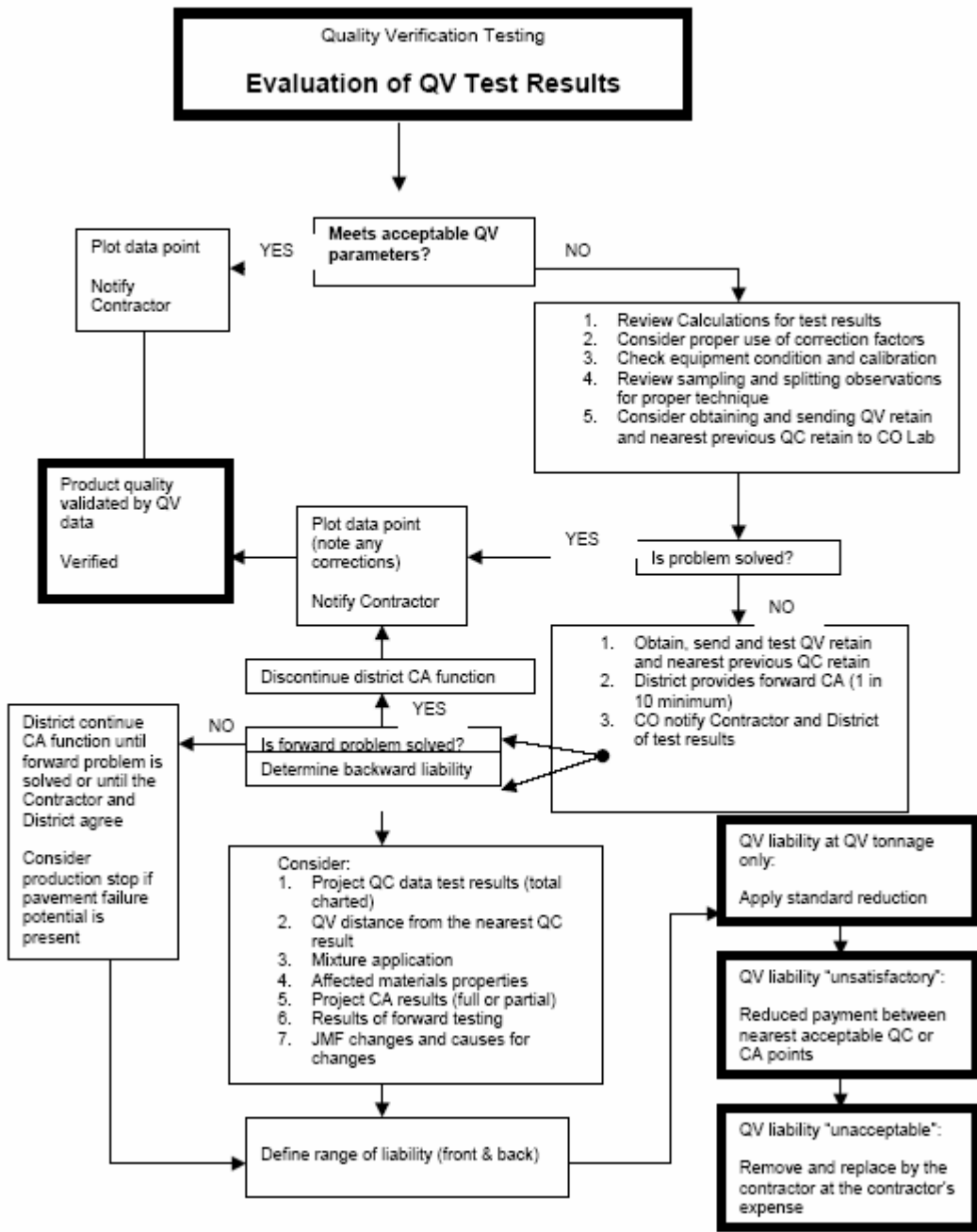
**Air Voids: between 2.7% and 5.3%**

**VMA: (JMF Limit - 1.5%)**

**example: for a 12.5mm nom. Max.  
size mix**

**Min JMF VMA is 14%, therefore, the  
required QV minimum: 14%-**

## Evaluation of QV Test Results



# Comment

Note: As part of the review process one of the options is:

## ***Stop Production***

Observe, communicate, correct, resume production

Contractor point of view:

- ***If we're not going to get paid, why make it?***



District \_\_\_\_\_  
 HWY # USH 88  
 Project Number 1190-22-55  
 WisDOT Test Number 250-0159-01  
 Mix Type E - 3 12.5mm w/Recycle

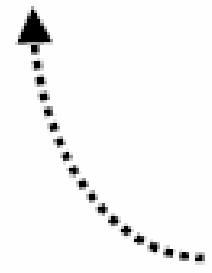
Isolated Truck = 25 ton at 50%

Date Sampled	09/17/04	09/20/04	09/21/04	09/21/04	09/21/04	09/21/04
Tonnage Daily		180	205	670	850	1620
Tonnage Cumulative						

Sample Number	7 - 3	8-1	9-1	QV 9-1 +	9-2	9-3
QC	Avg 4 Va = 3.8 3.5 VMA = 15.2 15.0	Avg 4 Va = 4.2 3.7 VMA = 15.5 15.3	Avg 4 Va = 4.1 3.7 VMA = 15.9 15.3		Avg 4 Va = 6.0 4.3 VMA = 16.3 15.7	Avg 4 Va = 4.6 4.4 VMA = 15.9 15.9
QC-ret		CA Va = 3.8 Tol VMA = 15.0	BHC Va = 3.8 Tol VMA = 14.7		Dist Va = 6.1 Tol VMA = 16.2	
	Va = VMA =					Va = VMA =

QV-Dist	Avg 4 Va = 1.6 Out VMA = 12.2 Out
QV-ret BHC	Va = 1.7 Out VMA = 12.4 Out

**Problem: Bad Sample**





District  
 Location STH 13  
 Project Number 1430-08-70  
 WisDOT Test Number 250-0116-03  
 Mix Type E-3 12.5mm

Date Sampled			10/28/03	10/28/03	10/28/03	10/29/03
Tonnage						
Daily			310			480
Cummulative						

Sample Number			2-1	2-1+	2-2	3-1
	QC Va = VMA =	QC Va = VMA =	QC Avg# Va = 4.0 3.7 VMA = 13.6 13.7		QC Avg# Va = 3.9 3.8 VMA = 13.8 13.9	QC Avg# Va = 4.3 4.0 VMA = 13.5 13.8
	Va = VMA =	Va = VMA =	QC-ret BHC Va = 4.3 VMA = 14.4		QC-ret Va = VMA =	QC-ret Dist Va = 4.0 VMA = 13.6

QV Va = 2.1 VMA = 13.0
QV-ret BHC Va = 4.2 VMA = 14.3

**No Mix Adjustment, Investigate District low bias - history previous SGC problem.**

District \_\_\_\_\_  
 Location \_\_\_\_\_  
 Project Number \_\_\_\_\_  
 WisDOT Test Number 250-0183-03  
 Mix Type E-30 12.5mm (w/Recycle)

Tonnage  
 Daily/Cumm

		812		208		135		135		280	9809
--	--	-----	--	-----	--	-----	--	-----	--	-----	------

Sample  
 Number

		7-2		8-1		9-1		9-1		9-2	
--	--	-----	--	-----	--	-----	--	-----	--	-----	--

( SAME TRUCK )

QC Va =  VMA =
QC-ret Va =  VMA =

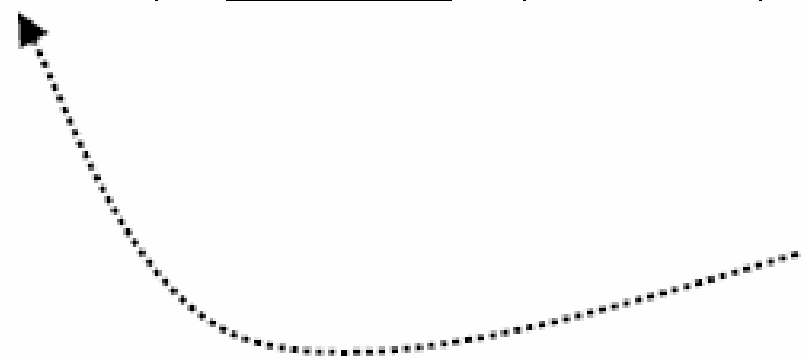
QC	Avg-4
Va = 3.7	4.0
VMA = 14.1	14.3
QC-ret	
Va =	
VMA =	

QC	Avg-4
Va = 4.1	4.0
VMA = 14.7	14.4
QC ret CA	
Va = 4.7	
VMA =	

QC	Avg-4
Va = 2.7	3.6
VMA = 13.6	14.1
QC-ret	
Va =	
VMA =	

QV	
Va = 2.2	out
VMA = 13.0	
QV-ret	
Va =	
VMA =	

QC	Avg-4
Va = 4.8	3.6
VMA = 15.0	14.4
QC-ret	
Va =	
VMA =	



District \_\_\_\_\_  
 Location \_\_\_\_\_  
 Project Number \_\_\_\_\_  
 WisDOT Test Number 250-0183-03  
 Mix Type E-30 12.5mm (w/Recycle)



Tonnage Daily/Cumm	812	208	135	135	145	280	725
Sample Number	7-2	8-1	9-1	9-1	9-2	9-3	
QC	Avg-4 Va = 3.7 4.0	Avg-4 Va = 4.1 4.0	Avg-4 Va = 2.7 3.6	Avg-4 Va = 4.8 3.6	Avg-4 Va = 3.8 3.6		
VMA	14.1 14.3	14.7 14.4	13.5 14.1	15.0 14.4	14.5 14.5		
Va	QC-ret / BHC Va = 4.4 In / tol	CA Va = 4.7	Va =	QC-ret / Dist Va = 6.3 tol	CA Va = 4.8		
VMA	14.7	VMA =	VMA =	VMA = 15.7	VMA =		
				QV Va = 2.2 out VMA = 13.0			
				QV-ret / BHC Va = 1.8 out VMA = 12.9			

District \_\_\_\_\_  
 Location IH 38/90  
 Project Number 1001-08-79  
 WisDOT Test Number 2SD-0174-03  
 Mix Type E-35 12.5mm (w/Recycle)

Contractor decreases to 5.2% AC

Date Sampled		10/04/04	10/04/04	10/04/04		10/09/04	10/09/04	10/11/04
Tonnage								
Daily		1418	1553	1848		1859	2466	2568
Cumulative								

Sample Number		31-2	31-3 - V	31-3		33-3	33-4	34-2+
QC		QC Avg # Va = 3.5 3.5		QC Avg # Va = 3.6 3.5		QC Avg # Va = 4.3 3.9	QC Avg # Va = 4.5 4.2	
VMA =		VMA = 14.0 14.0		VMA = 14.5 14.2		VMA = 15.0 14.8	VMA = 15.2 15.0	
BHC		QC-ret BHC Va = 3.0 3.3 Tot		QC-ret Dist Va = 2.6 3.3 Tot		CA Va = 3.7 3.7 Tot	Retest on Job Va = 4.3 3.9 Tot	
VMA =		VMA = 14.0 14.0		VMA = 13.5 13.9		VMA = 14.8 14.7	VMA = 14.8 14.8	

QC-Dist Avg # Va = 2.6 Out
VMA = 13.6
QC-ret BHC Va = 2.3 Out
VMA = 13.4

Day 32 QMP avg 3.6 % Va

Dryer looking mix

Check Sample
Contractor Va = 5.3
VMA = 15.7
BHC Va = 4.3
VMA = 14.8

Contractor decreased Fb by -0.1%, air voids jumped an unexpected full 1.0%  
 Decision made to run the mix using original plant settings, versus adjusting it to bring "up" department results  
 An approximate 0.5% bias seems to exist for this mix (as evaluated by the project GGC)  
 Most likely the production air void level is close to 3.1%

District \_\_\_\_\_  
 Location IH 35/90  
 Project Number 1001-03-79  
 WisDOT Test Number 250-0174-03  
 Mix Type E-30 12.5mm (w/Recycle)

Contractor decreases to 5.2% AC

10/04/04	10/04/04	10/04/04		Operator A. ran split 10/9/2004 10/09/04	Operator B. ran split 10/9/2004 10/09/04	10/11/04
1418	1563	1848		1869	2466	2568

Visual assessment of the samples and roadway indicated no need to decrease the binder content so plant reset to run at design 5.3% AC  
 Future adjustments to the mix, based on use of the job SGC, should be considered for values below 3.3% Va

31-2	31-3-V	31-3		33-3	33-4	34-2+
<b>QC</b> Avg 4 Va = 3.6 3.5 VMA = 14.0 14.0 <b>QC-ret BHC</b> Va = 3.0 3.3 Tol VMA = 14.0 14.0	<b>QV-Dist</b> Avg 4 Va = 2.6 Out VMA = 13.5 <b>QV-ret BHC</b> Va = 2.1 Out VMA = 13.4	<b>QC</b> Avg 4 Va = 3.8 3.5 VMA = 14.5 14.2 <b>QC-ret Dist</b> Va = 2.8 3.3 Tol VMA = 13.5 13.9	<b>QC</b> Va = VMA = <b>QC-ret CA</b> Va = 3.7 3.7 Tol VMA = 14.8 14.7	<b>QC</b> Avg 4 Va = 4.3 3.9 VMA = 15.0 14.8 <b>QC-ret Retest</b> Va = 4.3 3.9 Tol VMA = 14.8 14.8	<b>QC</b> Avg 4 Va = 4.6 4.2 VMA = 15.2 15.0	<b>Check Sample Contractor</b> Va = 6.3 VMA = 15.7 <b>BHC</b> Avg 4 Va = 4.1 VMA = 14.8

Day 32 QMP avg 3.6 % Va

Dryer looking mix

Pb increased to 5.3%



AMERICAN  
ASPHALT  
OF AMERICA

INGERSOLL-RAND

# Pavement performance

Hwy 10



# QMP Density - HMA pavement

## Pavement Density:

- measured by calibrated and certified Nuclear Density Gauge
- certified technicians
- Pre-project correlation between Contractor and Engineer's Nuclear Density Gauge to  $\pm 1$  pcf average on standard block.
- Daily correlation at standard location  $\pm 1$  pcf on average.
- QC and QA measurements must correlate by  $\pm 1.5$  pcf.
- For Density Bonus:
  - ▶ greater than 93.1% of  $G_{mm}$  density and
  - ▶  $3.5\% \leq V_a \leq 5\%$



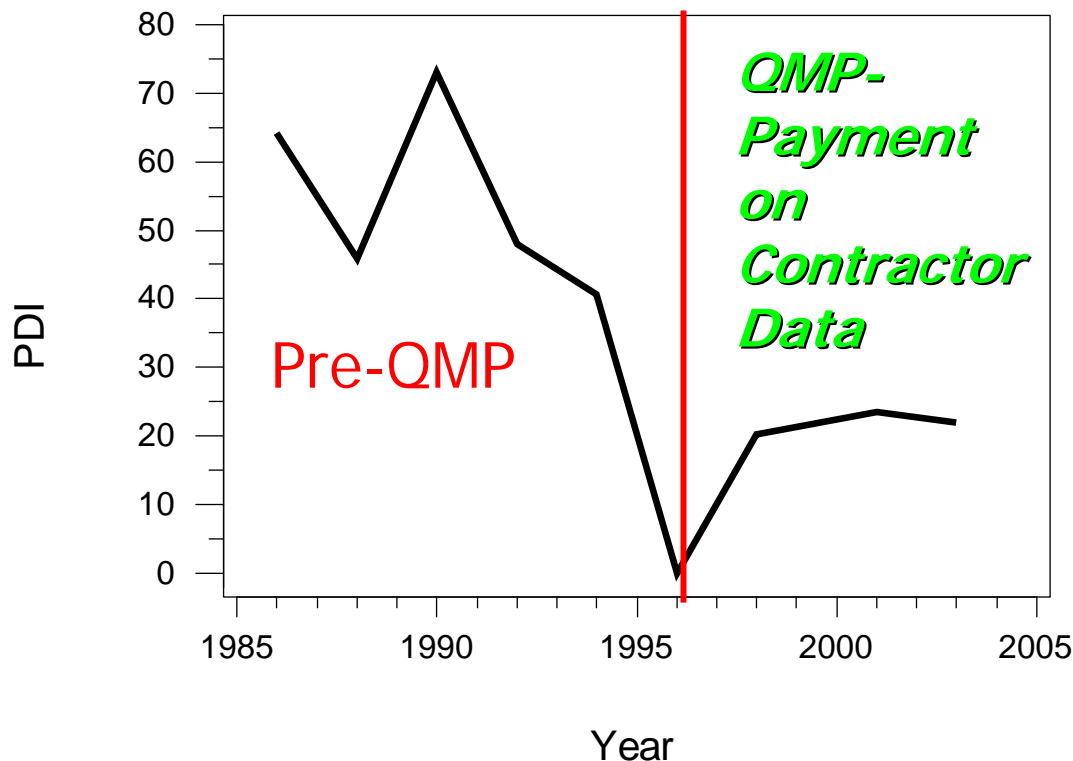
# Use of Contractor Data for Quality Acceptance

## DOT Concerns:

- Can they meet the **Specification**? YES
- How well?
  - 54 Warranty Projects with Contractor QC only.
  - Nine are 7 years or older
  - with minimal Maintenance - route and sealed cracks at 4th year.
  - WisDOT computes pavement life has increase from 17 to 23 years.

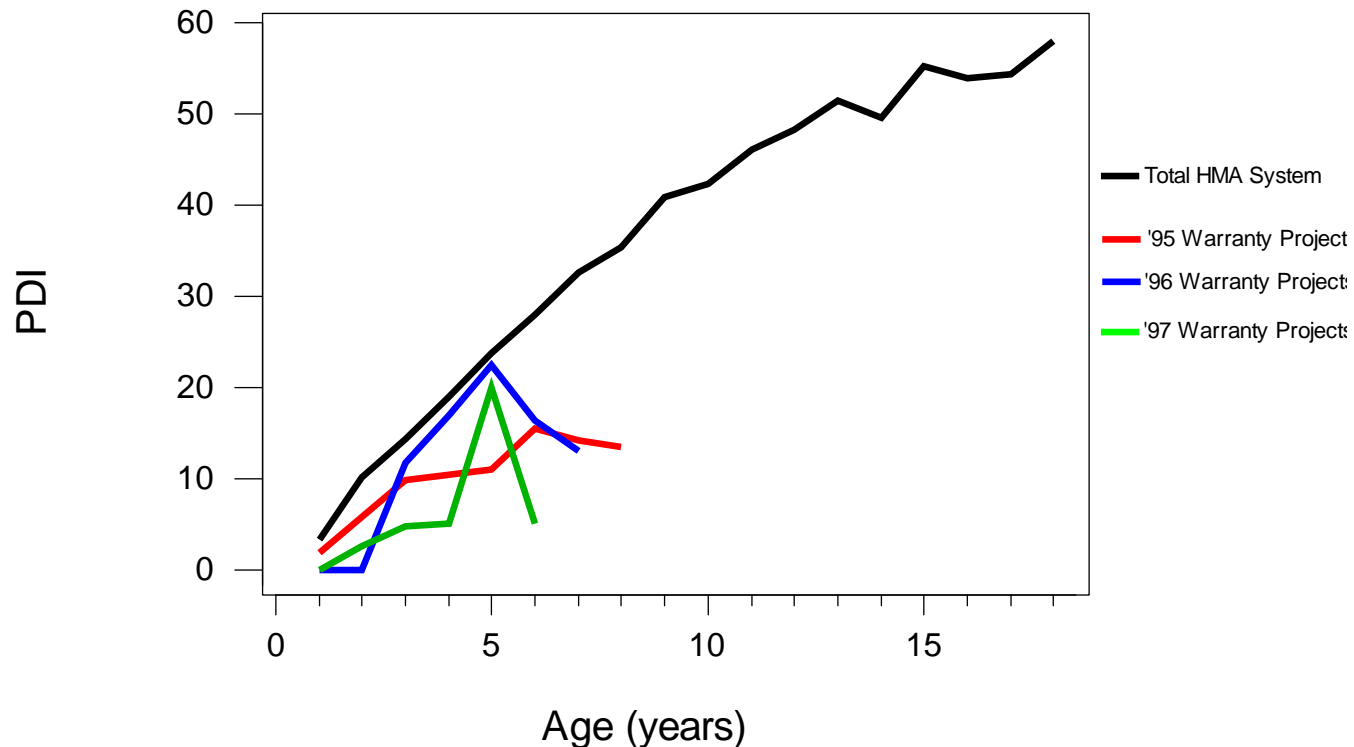
# Use of Contractor Data for Quality Acceptance -

Historical Pavement Distress Trend  
(HWY 11 Project)

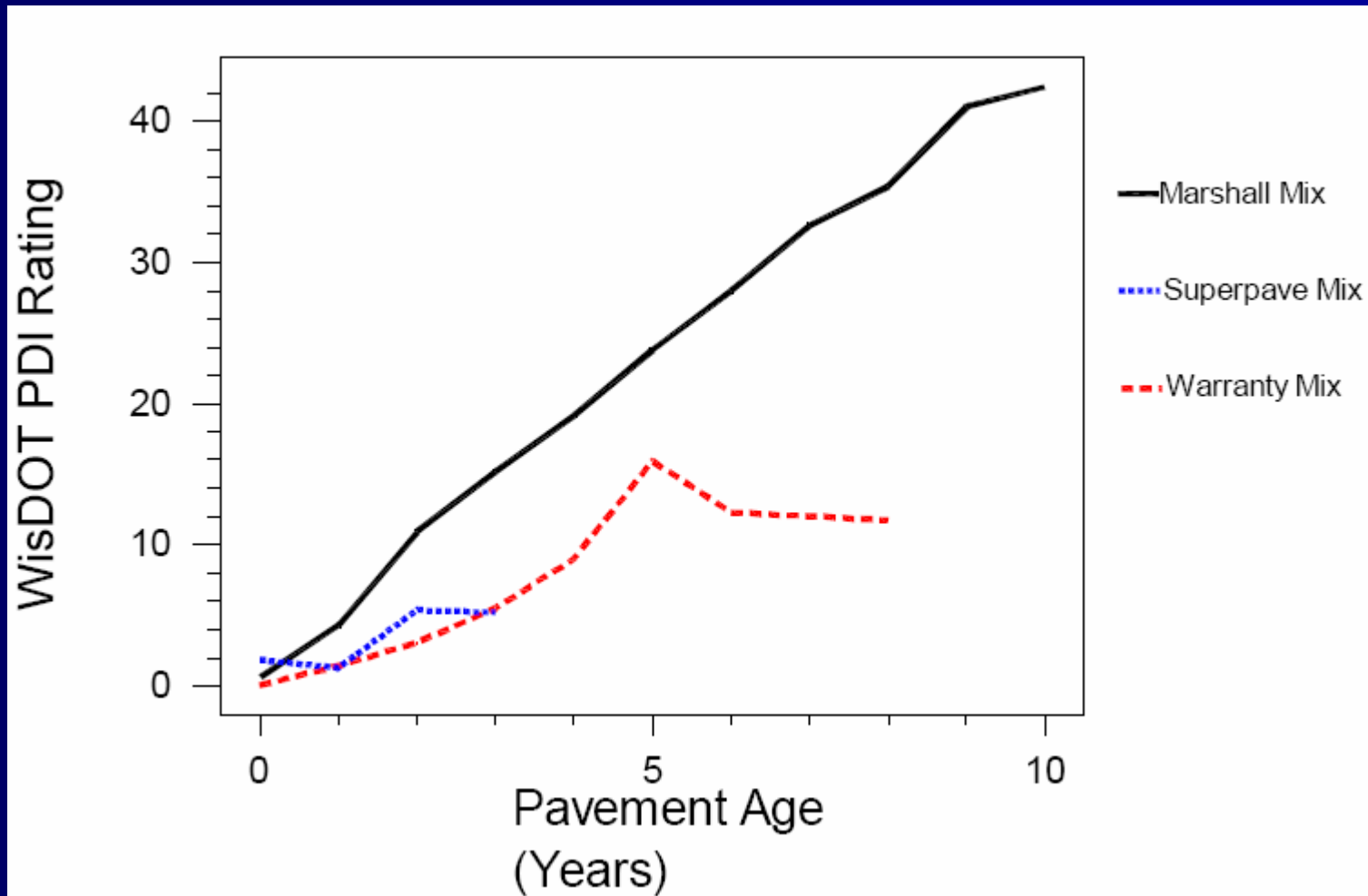


# Use of Contractor Data for Quality Acceptance -

Pavement Distress Trends



# Use of Contractor Data for Quality Acceptance -





The End