#### Measuring In-Place Density of New Roadway Pavements in Connecticut NESMEA 2013 – Portsmouth NH





# Connecticut HMA Pavements

- 3719 miles State maintained roads (20% of total).
- 1.2 million tons HMA placed in 2012.
- In-place density is measured for all lifts designed to be 1.5" thick or more.
- 4838 Core Samples in 2012.
- Use of 15% RAP is typical.
- AASHTO T-331 "…Automatic Vacuum Sealing Method" is used to determine density.



# Lot limits - sample locations







Roadway
 Bridge
 Combination (for 2013)
 Roadway and Bridge <500'</li>

### **Notched Wedge Joint**







8" – 12" Taper Notched Wedge Joint





# **Core Removal and Labeling**







#### Core Transport and Documentation

Project



#### Laboratory





## **Core Receiving and Sorting**









#### **Core Sorting and Storage**



Secured cores ready for testing







## **Core Preparation**



# **Core Preparation**







# **Core Sawing**







# **Core Drying and Sealing**







# **Density Results per Lot**

	N	18	▼ (*	f <sub>x</sub>											
2	A	B	С	D	E	F	G	Н	I	J	К	L	м	N	0
3															
4		DD	DIECT		171 -	36463	10	т.#	-	5		1	1		
6	_	r.K	UJLCI	_	1/15	70405	LU	1 17		~		J			
8		R	DUTE		I-	84	MI	Х	S1	W0.5 (405	8)	DAVAD	E TONS	-	
		T	OWN		Manchester		I EVEI		3		DENSITY LOT				
9	_			_	10				-	~	_	COLOR WINGS			
11		DIST	RICT NO.		1 a	1	1			628	_				
12								DUCER	-			UNIT PRIC	E PER ION		
14	Р	AVING C	ONTRAC	TOR	Til	con		JUUCLIN	Ti	Icon Plain	ville				
15 16					1.075					_	_	ļ			
17							Pavement	Density Ad	ljustme	nt Deta	il				Ī
					MAT DENS	ITY CORES			JOINT DENSITY CORES						
18		-	paper	DATE	THOMATON	BULK	THEODEOTICAL	COMPACTION		PRIDOCE	DATE	THEORETAN	BULK	THEODEOTICAL	COMPLETION
19 20	AASHTO T-331 Bulk	ID	NUMBER	PLACED	(IN.)	SPECIFIC GRAVITY	GRAVITY	(%)	ID	NUMBER	PLACED	(IN.)	SPECIFIC GRAVITY	GRAVITY	(%)
21	Gravity and	M5-1		9/22/13	2.000	2.446	2.669	91,6	J5-1		9/22/13	2.250	2.465	2.669	92.4
22	Compacte d HMA Using	M5-2		9/22/13	2.000	2.470	2.669	92.6	J5-2		9/22/13	2.125	2.468	2.669	92.5
23	Automatic Vacuum Sealing	M5-3		9/19/13	2.500	2.524	2.671	94.5	J5-3		9/22/13	2.250	2.447	2.669	91.7
24	Method	M5-4		9/19/13	2.125	2.590	2.671	97.0	J5-4		9/22/13	2.000	2.500	2.669	93.6
25 26					AVERA	GE LOT COM	PACTION %	93.9				AVER/	AGE LOT COMI	PACTION %	92.6
27 28		MAT BONU			S %	1				JOINT BONUS %			1		
29															
30															
31															
ECTIC	61-						T	ONS ADJUS	TED FO	R DENS	SITY (T <sub>D</sub> )				
No. of Concession, Name	1º														
						DENS	SITY ADJUS	TMENT	COST (		T \$)				
TRA	/														

# **Dispute Resolution Results**

30       31       32 <th< th=""><th></th><th>A</th><th>В</th><th>С</th><th>D</th><th>E</th><th>F</th><th>G</th><th>н</th><th>I I</th><th>J</th><th>К</th><th>L</th><th>м</th><th>N</th><th>0</th></th<>		A	В	С	D	E	F	G	н	I I	J	К	L	м	N	0
OBS UNDER SOLUTION SO	39															
IDISPUTE TOTAL USPUTE TOTAL USPUT US	40		-					_		_	_					
Image: specific	41	_		Dispute Resolution Adjustment												
9         SAMP         BRIDE         BRIDE         DATE         THECKESS         BRUCK SPECIFIC (RAVITY         INFORMATION (RAVITY         SAMPLE         BRIDE         DATE         INFORMATION (N)         SAMPLE         BRIDE         DULK SPECIFIC (RAVITY         COMPACTION (R)         SAMPLE         BRIDE         DATE         INFORMATION (R)         SAMPLE         BRIDE         DULK SPECIFIC (RAVITY         Compactor (R)         SAMPLE         BRIDE         DATE         INFORMATION (R)         SAMPLE         BRIDE         DATE	42				MA	T DISPUTE D	ENSITY CO	RES		JOINT DISPUTE DENSITY CORES						
1       2       33-10       7/28/13       2.375       2.339       2.673       87.5         2       000000000000000000000000000000000000	43 44	AASHTO	SAMPLE ID	BRIDGE NUMBER	DATE PLACED	THICKNESS (IN.)	BULK SPECIFIC GRAVITY	THEORECTICAL GRAVITY	COMPACTION (%)	SAMPLE ID	BRIDGE NUMBER	DATE PLACED	THICKNESS (IN.)	BULK SPECIFIC GRAVITY	THEORECTICAL GRAVITY	COMPACTION (%)
Comparison Comparison Automation Service Automation Severing Wethold         Comparison Automation Severing Methold         Comparison Severing Methold         Comparison Severing Methold </th <th>45</th> <th>T-331 Bulk Specific Gravity and</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>J3-1D</th> <th></th> <th>7/28/13</th> <th>2.375</th> <th>2.339</th> <th>2.673</th> <th>87.5</th>	45	T-331 Bulk Specific Gravity and								J3-1D		7/28/13	2.375	2.339	2.673	87.5
Maximum	46	Compacted HMA Using Automatic								J3-2D		7/28/13	2.000	2.454	2.673	91.8
48       49       40       40       40       J3-4D       7/28/13       2.375       2.271       2.673       84.9         49       <	47	Vacuum Sealing Method								J3-3D		7/23/13	2.250	2.388	2.670	89.5
49 NEW AVERAGE LOT COMPACTION % (ALL 8 MAT CORES) NEW AVERAGE LOT COMPACTION % (ALL 8 JOINT CORES) 87.8   50 MAT NOT DISPUTED JOINT RESOLUTION DISINCENTIVE % -30   52 MAT NOT DISPUTED -30   53 MAT NOT DISPUTED -30   54 FINAL TONS ADJUSTED FOR DENSITY (T_0) -30   55 FINAL DENSITY ADJUSTMENT COST (T_0 x UNIT \$) -30	48								_	J3-4D		7/28/13	2.375	2.271	2.673	84.9
MAT NOT DISPUTED     JOINT RESOLUTION DISINCENTIVE %     -30       52     MAT NOT DISPUTED     -30       53     FINAL TONS ADJUSTED FOR DENSITY (Tp)     -30       54     FINAL TONS ADJUSTED FOR DENSITY (Tp)       55     FINAL DENSITY ADJUSTMENT COST (Tp x UNIT \$)	49					NEW AVE	RAGE LOT CO ALL 8 MAT CO	OMPACTION % DRES)					NEW AVE	RAGE LOT CO	OMPACTION % ORES)	87.8
52    30       63    30       64    30       65    30       66    30       67    30       68    30       69    30       61    30       62    30	51					MAT NOT DISPUTED							JOINT RESOLUTION DISINCENTIVE %			
53 54 55 56 57 57 58 59 59 59 59 50 50 50 50 50 50 50 50 50 50 50 50 50	52														_	-30
Final Tons Adjusted For Density (T <sub>D</sub> )       Final Density AdjustMent Cost (T <sub>D</sub> x UNIT \$)	53								-							
56     FINAL TONS ADJUSTED FOR DENSITY (Tp)       57       58       59       FINAL DENSITY ADJUSTMENT COST (Tp x UNIT \$)       60       61       62	55															
57 58 59 FINAL DENSITY ADJUSTMENT COST (T <sub>D</sub> x UNIT \$) 60 61 62	56							EINA	TONSAD	ILISTER		ENSITY /	T.)			
50 59 50 60 61 62	57							C IIIA	L TONS AD	JUSIEL	TORD	LINGITT	0			
FINAL DENSITY ADJUSTMENT COST (T <sub>D</sub> x UNIT \$)	58															
60 61 62	59						1	FINAL DENSI	TY ADJUST	MENTC	OST (TD	X UNIT	5)			
61 62	60												640			
	61 62															



# **Pre-Recycled Core Samples**



Minimum Density Requirement Based on Maximum Theoretical Density

92 % on the Mat
91 % on the Joint



#### **Density Adjustments**

above minimum



#### **Density Adjustments**

below the minimum



# 2012 Average Density Values

#### 2012 Individual Core Results

uge anu i	Bridge and Non-bridge							
Avg % density	Stdev	Total Samples						
92.81	2.13	2532						
91.23	2.22	2306						
	Avg % density 92.81 91.23	Avg % density         Stdev           92.81         2.13           91.23         2.22						

4838

No	on-brid	lge	Bridge				
Avg %	Stdev	Total Samples	Avg % density	Stdev	Total Samples		
93.02	2.07	2082	91.96	2.17	450		
91.35	2.40	1863	90.55	2.16	443		
		3945			893		

#### **Required Minimum Density 92% Mat, 91% for Joint**



# 2012 Adjustments by month





# 2013 results last paving input Oct 4, 2013

#### IN-PLACE DENSITY (%) BY LOT TYPE 2013 Season based on cores

	Roadway	Bridge	Combo
MAT	93.10	88.81	92.73
JOINT	91.83	89.00	91.89
# of Lots	368	5	40



### Conclusions

- Process is working well.
- Industry involvement critical.
- Data consolidation is very important.
- Consistent test method is vital.
- Analysis of industry data is priceless!
  - During the season
  - Year to year
- More Research is needed.



# The End

# Thanks for your attention! Questions?