Connecticut Superpave Gyratory Round Robin – 2003

Final Report

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16. Abstract

The Superpave gyratory compactor is a key component for Quality Control and Quality Acceptance for Hot Mix Asphalt (HMA). Recent research has shown test result differences between various models of gyratory compactors. If this difference is large enough, disputes may arise between the HMA suppliers and the Accepting Agencies.

This project was to evaluate the differences between Superpave gyratory compactors used for Connecticut Department of Transportation Projects. Two different Superpave mixes were sent to each participating facility. The specimens were fabricated by the facility and then they were shipped back to the Connecticut Advanced Pavement Laboratory (CAP Lab) for determination of their Bulk Specific Gravity in accordance with AASHTO T166.

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The authors would like to acknowledge all of the participants in the Round Robin for their cooperation.

PROBLEM STATEMENT

The Superpave gyratory compactor is a key factor for Quality Control and Quality Acceptance for hot mix asphalt (HMA) pavements. Each model and manufacturer of Superpave gyratory compactor has a slightly different way of inducing the angle used for compaction. AASHTO T312 requires the angle in the gyratory to be $1.25 \pm 0.02^{\circ}$ without any vertical force applied to it. There currently is no provision in AASHTO T312 to measure the angle when the vertical consolidation force is applied. Research performed by the Federal Highway Administration has indicated differences exist in the angle of the loaded mold between gyratory models. This difference in loaded angle changes the amount of compactive energy that is applied to the specimens ultimately affecting the volumetric properties of the specimens. As these volumetric properties are used as a basis for determining pay factors for the mix, any significant differences between Quality Control results and Agency Acceptance results could cause a dispute to arise.

Gyratories are used to simulate field compaction by compacting loose HMA material in a 6 inch diameter mold to form a specimen with a height between 110 and 120 mm. The gyratory compactor simulates field compaction by applying vertical force to top and bottom plates of the mold. The mold is then gyrated by having one edge of the mold elevated and rotating this point of elevation around the mold. Each complete revolution around the mold is one gyration.

OBJECTIVE

The Connecticut Advanced Pavement Lab at the University of Connecticut in conjunction with the Connecticut Department of Transportation organized a Round Robin for Superpave Gyratories used on Connecticut paving projects to examine the volumetric differences in samples produced by different models of gyratories.

RESEARCH APPROACH AND MATERIALS INFORMATION

The CAP Lab solicited suppliers of HMA to Connecticut as well as a testing consultant for their participation in the Round Robin. The participants were: All States Asphalt, CAP Lab, Connecticut Department of Transportation (2 Gyratories), Galasso Materials, Lane Construction, O & G Industries (7 Gyratories), Tilcon – Connecticut (7 Gyratories) and Vanasse Hangen Brustlin Inc. The models of gyratories used for the Round Robin were: 2 Pine 125X, 2 Pine AFG1A, 5 Troxler 4140 and 12 Pine TestQuip.

Personnel from the Connecticut Department of Transportation collected the HMA mixes used in the Round Robin from 2 different suppliers. Both mixes were Superpave with a nominal maximum size of 12.5 mm. Mix A was designed for a Traffic Level 4 (9-125-205 gyrations) and its gradation was primarily below the maximum density line as seen in Figure 1. Mix B was designed for a Traffic Level 2 (7-75-115 gyrations) and its gradation was primarily above the maximum density line as seen in Figure 2. The maximum theoretical specific gravity for Mix A was 2.646 and Mix B was 2.550.

Figure 1,
Gradation of Mix A – 205 Gyrations

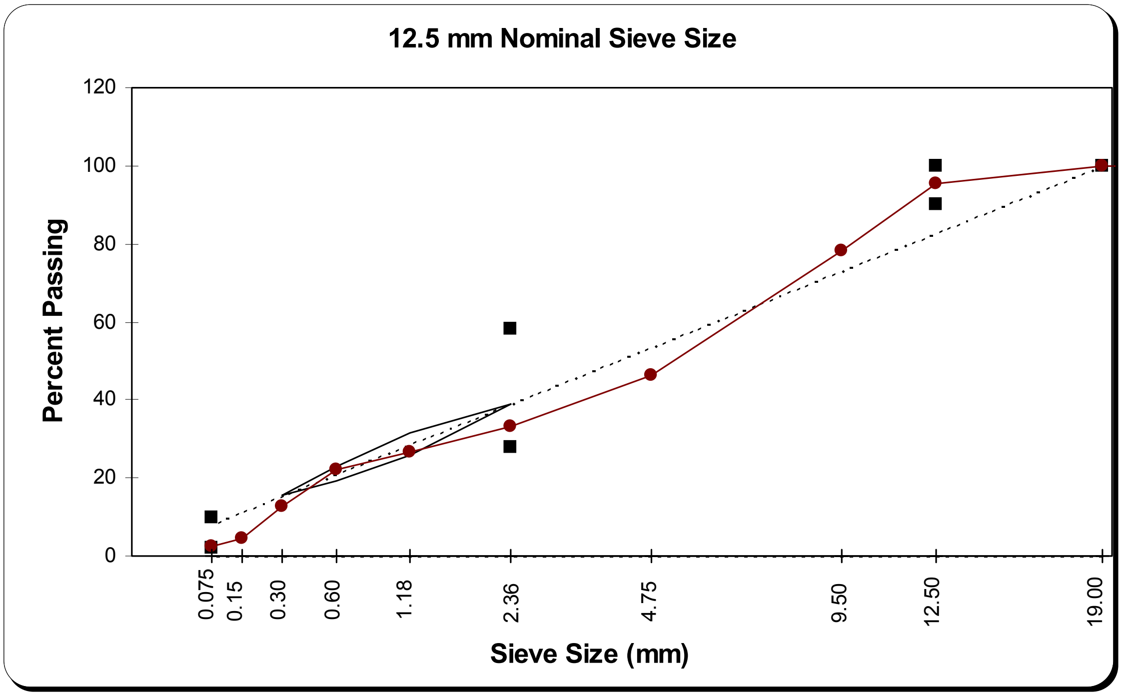
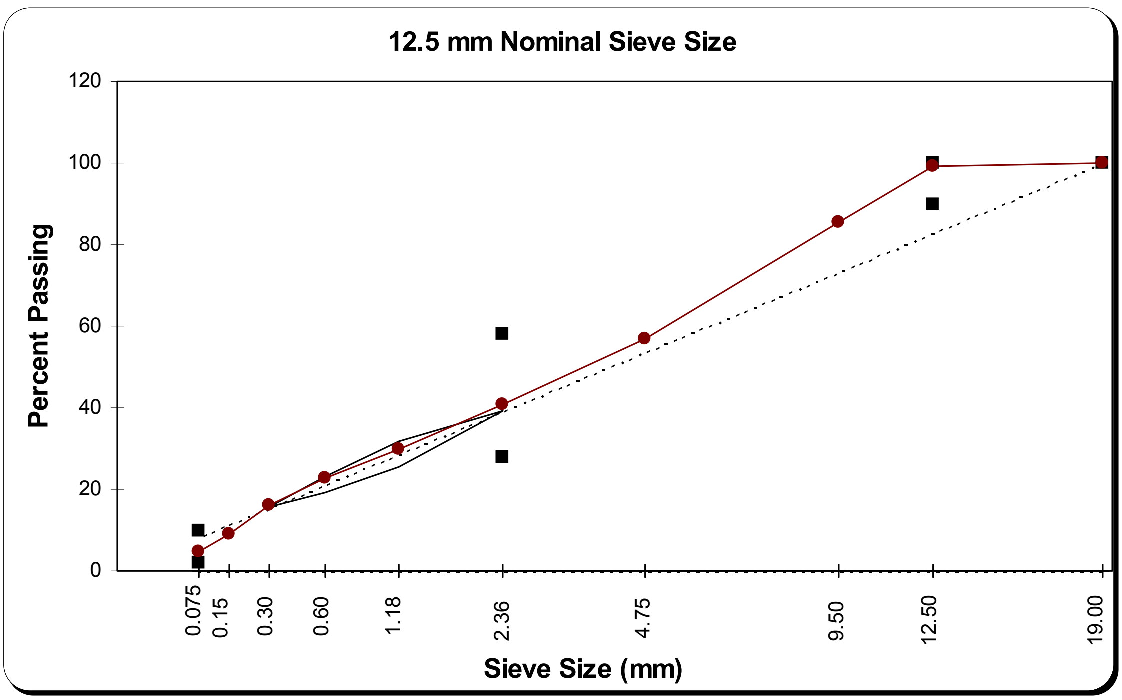


Figure 2,
Gradation of Mix B – 115 Gyrations



Prior to sending out the materials, the CAP Lab fabricated 10 randomly chosen specimens from both Mix A and Mix B. This was done to ensure the samples of both mixes were uniform. One specimen from both Mix A and Mix B were discarded because they were compacted to the design number of gyrations rather than the maximum number of gyrations. Figure 3 shows the Bulk Specific Gravity results of the CAP Lab's trial of Mix A. The span of the results for the Bulk Specific Gravity at 205 gyrations was 0.009 and the standard deviation was 0.0026. Figure 4 shows the Bulk Specific Gravity results of the CAP Lab's trial of Mix B. The span of the results for the Bulk Specific Gravity at 115 gyrations was 0.005 and the standard deviation was 0.0018. The precision and bias statement published in AASHTO T166 states that results should be deemed suspect if there is a difference of more that 0.020 between Bulk Specific Gravities for a single operator. Based upon these results, the samples of both Mix A and Mix B were deemed to be uniform.

The CAP Lab sent out 2 samples of Mix A and 2 samples of Mix B for each participating gyratory. Each participant was given instructions regarding the preparation and fabrication of the gyratory specimens. The instructions are included in Appendix A. After fabricating the specimens, the participants made arrangements for the specimens to be collected by the CAP Lab. The CAP Lab performed the Bulk Specific Gravity Testing in accordance with AASHTO T166. All of the bulk specific gravity testing was performed by a single technician. The goal of having all of the Bulk Specific Gravities determined by the CAP Lab was to eliminate variations that could have been caused by multiple operators performing the Bulk Specific Gravity test.

Figure 3
CAP Lab Mix A Uniformity Trials

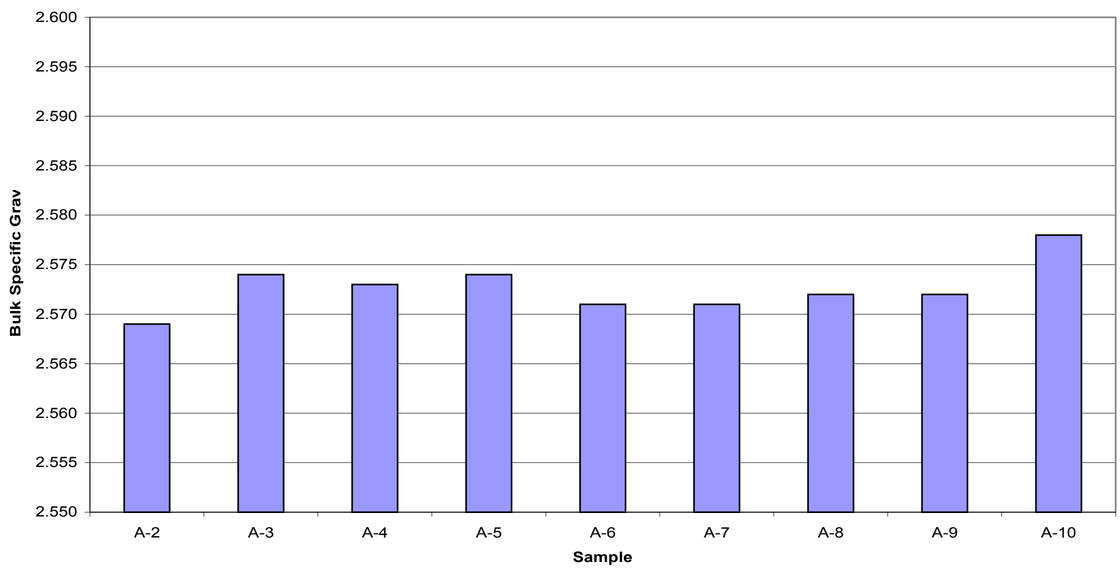
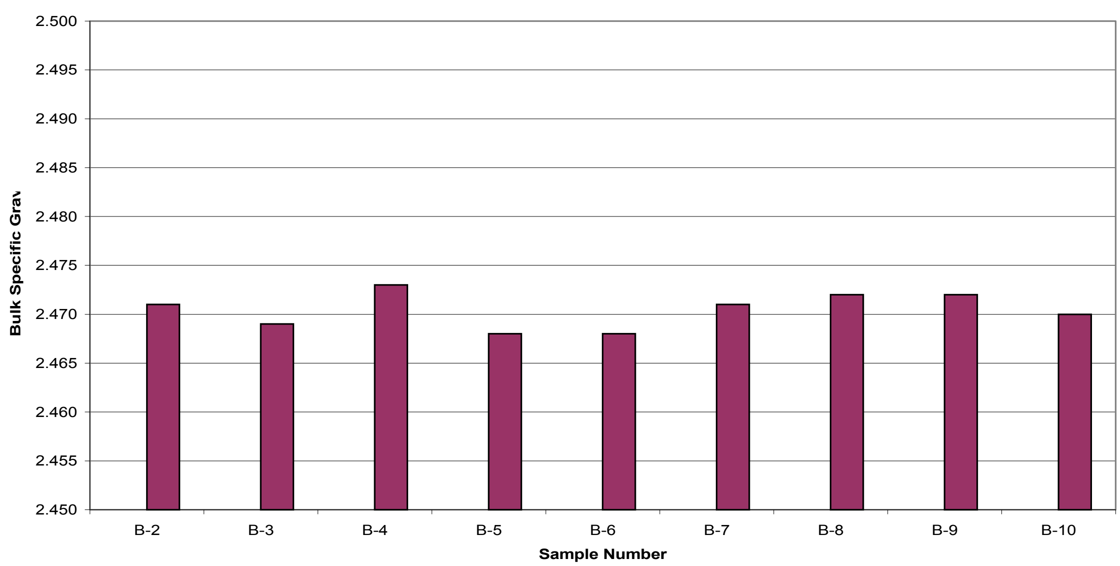


Figure 4,
CAP Lab Mix B Uniformity Trials



FINDINGS

Table 1 provides a summary of the data for Mix A. The results for specimen A-33 were treated as an outlier and excluded from the computations. The average air voids for the entire data set for Mix A was 2.75% with a standard deviation of 0.31% at 205 gyrations. The average Bulk Specific Gravity for the entire data set for Mix A was 2.573 with a standard deviation of 0.008 at 205 gyrations. Figure 5 shows the Bulk Specific Gravity of all samples for Mix A. The range of the Bulk Specific Gravity data for Mix A at 205 gyrations was 0.050.

Table 2 provides a summary of the data for Mix B. The results of specimen B-33 were treated as an outlier and excluded from the computations. The average air voids for the entire data set for Mix B was 3.16% with a standard deviation of 0.44% at 115 gyrations. The average Bulk Specific Gravity for the entire data set for Mix B was 2.469 with a standard deviation of 0.011 at 115 gyrations. Figure 6 shows the Bulk Specific Gravity of all samples for Mix B. The range of the Bulk Specific Gravity data for Mix B at 115 gyrations was 0.068.

Appendix B contains the complete data sets for both Mix A and Mix B.

Table 1
Connecticut Gyratory Round Robin - Winter 2003
Summary of Results - Mix A

		Air Voids @ N max		Bulk Sp Gravity		Height, mm N Initial=9		Height, mm N Design=125		Height, mm N Maximum=205	
	# of Specimens	Average	St Dev	Average	St Dev	Average	St Dev	Average	St Dev	Average	St Dev
Entire Data Set	48*	2.75%	0.31%	2.573	0.008	125.4	0.97	115.9	0.67	114.6	0.67
Pine 125X	11	2.73%	0.13%	2.574	0.003	125.6	0.70	115.9	0.45	114.7	0.42
Pine Test Quip	23*	2.70%	0.20%	2.575	0.005	125.5**	0.83**	115.7**	0.49**	114.4**	0.51**
Troxler 4140	10	2.93%	0.53%	2.569	0.014	125.4	1.49	116.2	1.05	114.8	1.14
Pine AFG1A	4	2.63%	0.47%	2.577	0.012	124.7	0.48	115.8	0.79	114.5	0.59

* Results of A-33 excluded from all calculations
** Height data for A-42 not available

Figure 5,
Overall Results Bulk Specific Gravity - Mix A

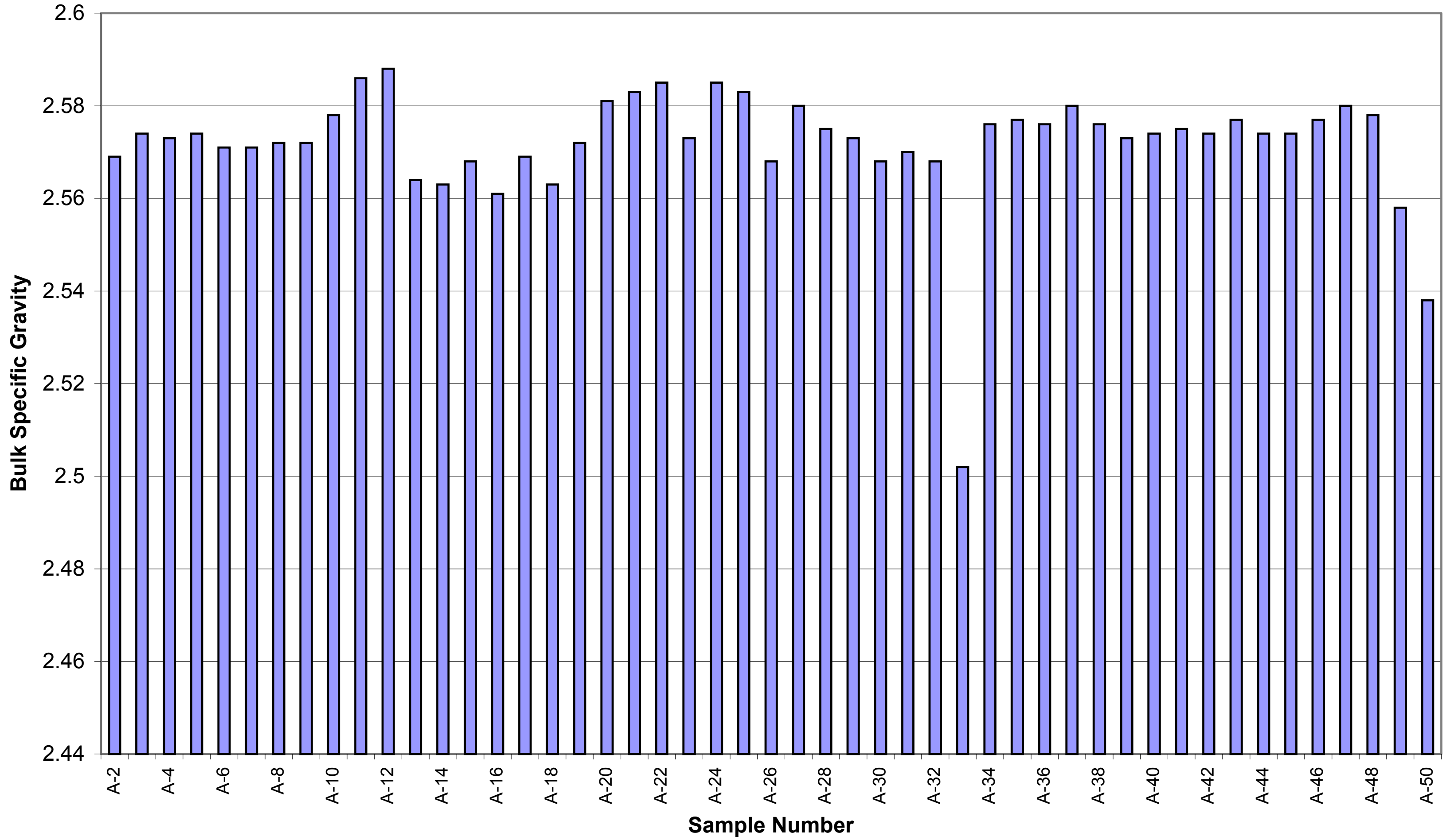
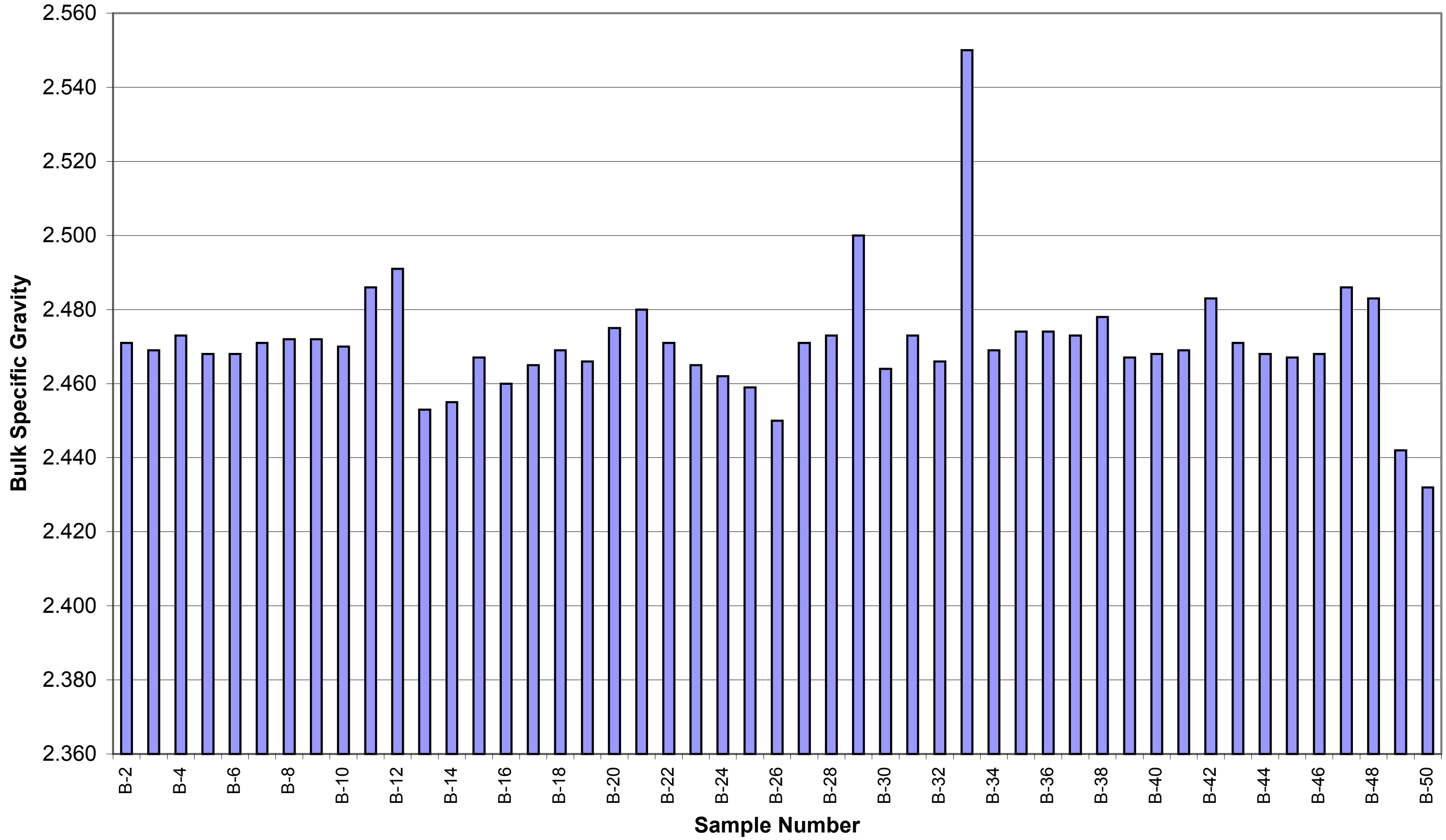


Table 2
Connecticut Gyratory Round Robin - Winter 2003
Summary of Results - Mix B

		Air Voids @ N max		Bulk Sp Gravity		Height, mm N Initial=7		Height, mm N Design=75		Height, mm N Maximum=115	
	# of Specimens	Average	St Dev	Average	St Dev	Average	St Dev	Average	St Dev	Average	St Dev
Entire Data Set	48*	3.16%	0.44%	2.469	0.011	127.9	1.02	117.5	0.74	116.1	0.71
Pine 125X	11	3.02%	0.23%	2.473	0.006	127.7	0.34	117.3	0.23	115.9	0.25
Pine Test Quip	23*	3.06%	0.31%	2.472	0.008	127.7	1.08	117.2	0.56	115.9	0.55
Troxler 4140	10	3.71%	0.47%	2.456	0.012	128.5	1.13	118.3	0.84	116.9	0.78
Pine AFG1A	4	2.83%	0.50%	2.478	0.013	127.5	1.23	117.2	0.93	115.9	0.91

* Results of B-33 excluded from all calculations

Figure 6,
Overall Results Bulk Specific Gravity - Mix B



DISCUSSION

For this limited Round Robin, the results between models of gyratory are similar. The average air voids determined for specimens fabricated in the Troxler 4140 for both Mix A and Mix B were higher than the other models in the study. The Troxler 4140 produced specimens with an average air void content for Mix A of 2.93%. The average air void content for the non-Troxler gyratories was found to be 2.70% which is 0.23% lower than the average for the Troxler gyratories. The average for the Troxler gyratories with Mix A was greatly influenced by the results from specimens A-49 and A-50. A-49 and A-50 were produced by the same gyratory and the air voids were considerably higher than specimens produced by the other gyratories. These specimens were not outliers when tested in accordance with ASTM E178 with a 5% significance level. The average air void content of the specimens produced with Troxler gyratories excluding specimens A-49 and A-50 was 2.74% which compares well with specimens produced with the Pine 125X. The average air void content for the Pine 125X was 2.73%.

For Mix B, the Troxler 4140 produced specimens with an average air void content of 3.71%. The average air void content for the non-Troxler gyratories was found to be 3.02% which is 0.69% lower than the average for the Troxler gyratories. None of the 10 specimens produced by the Troxler gyratories had air void contents below 3.10% for Mix B. This result is similar to results reported by the Maryland State Highway Agency. In a presentation made during the 2002

Northeast Asphalt User/Producer Group, Larry Michael presented results of a Round Robin comparing gyratory compactors for differences in specimens air content. Their study indicated the Troxler 4140 produced the highest air void contents of the 7 models of gyratory compactors represented.

The Pine AFG1A produced the lowest average air void content for both Mix A and Mix B. Unfortunately, there were only 2 Pine AFG1A in the Round Robin. One of the two sets of data had considerably lower air voids than the other. The set of data that had higher air void contents for the Pine AFG1A was very close to the average air void contents for the entire data set for both Mix A and Mix B.

The results for the Pine 125X show the smallest standard deviation for all of the machines tested. The results include the testing performed by the CAP Lab using a single machine to verify the uniformity of the samples. To investigate the results that would have been obtained by the CAP Lab had some of the specimens been fabricated using the CAP Lab's second Pine 125X gyratory, additional testing was performed by the CAP Lab. This testing indicated that the results would have been very similar to the results obtained during the testing to determine the uniformity of the samples. Therefore, the results of the uniformity testing were included in the calculations. There was only one additional Pine 125X gyratory used outside of the CAP Lab.

The Pine TestQuip had results that were nearly the same as the Pine 125X. In this case, the Pine TestQuip was the most represented gyratory in the Round Robin with 12 units.

The level of variation found in the bulk specific gravity for the Connecticut Gyratory Round Robin are smaller than those published for the AASHTO Materials Reference Laboratory (AMRL) Proficiency Samples. For the most recent set of data published by AMRL, the standard deviation expressed as a percentage of the bulk specific gravity was 1.18% for samples 13 and 14. The standard deviation of the specimens in the Connecticut Gyratory Round Robin was found to be 0.31% for Mix A and 0.45% for Mix B. The difference between the Connecticut Round Robin and the AMRL Proficiency Samples can be misleading. The bulk specific gravity for the AMRL Proficiency Sample results are performed by each participating laboratory. Therefore the larger variation observed with the AMRL proficiency samples would be expected because they include not only variations in the gyratory but in the bulk specific gravity determination. The specimens fabricated for the Connecticut Gyratory Round Robin were all tested for their bulk specific gravity by a single technician at the Connecticut Advanced Pavement Lab to minimize variations in the bulk specific gravities caused by equipment or procedure.

CONCLUSIONS

The results of this limited study show a relatively small amount of variation in volumetrics for specimens generated by gyratory compactors used for Connecticut DOT work. This would indicate the induced angle under load used for compaction purposes as well as the calibration for each machine are similar with the possible exception of the Troxler 4140. The Troxler 4140 results indicate a higher air void standard deviation. The Pine AFG1A also exhibited a similarly high air void content standard deviation but there were only 2 of this model in the study which makes drawing conclusions about the Pine AFG1A gyratory difficult. The larger air void content standard deviation for the Troxler 4140 could indicate differences in either the calibration of the machines or in the loaded induced angle. In all cases, maintaining the machines in calibration is essential to obtaining reproducible results.

With the limited data, there is no way to discriminate differences caused by different operators. It is a well established fact that the observed level of difference between test results will increase when the test is performed by multiple operators on the same material.

Mix B was subjected to 90 fewer gyrations than Mix A. At the lower number of gyrations, compactive energy differences between gyratory compactors would be more likely to be observed as differences in air contents. This effect should be reduced as the number of gyrations increases as the higher number of gyrations should reduce the effects.

The limited number of gyratories and specimens in this Round Robin limits the amount of data analysis that can be performed. The higher air void contents found with the Troxler 4140 are of some concern. With air content differences between different models of gyratories and the Troxler 4140 as large as 0.18 – 0.30% for Mix A and 0.55 – 0.88% for Mix B, differences in data sets could occur. Differences such as these need to be addressed to minimize disputes in the data gathered with the Troxler 4140 for the Quality Assurance process.

RECOMMENDATIONS

Additional work should be done to identify the potential cause of the differences observed between the Troxler 4140 gyratory and the others. This would include an additional Round Robin with a higher number of replicates per mix as well as a greater number of mixes. This would provide a larger data set, which could then provide more information. By testing various types of mixes, the results would show just how sensitive the Troxler 4140 is to varying the number of gyrations.

If additional study of the differences between gyratories does not provide insight as to the cause of the differences and ways to correct the differences, it may become necessary to use the Dynamic Angle Validator to measure the internal angle for the compaction. The Dynamic Angle Validator measures the internal angle of compaction while the specimen is being compacted. Several States' Transportation Agencies, including Maine, require that the gyratory's internal angle of compaction be set at 1.16° for all gyratories.

REFERENCES

AASHTO Materials Reference Laboratory, Hot Mix Asphalt Gyratory Proficiency Sample Program, Final Report, September 2002.

AASHTO, *Standard Specifications for Transportation Materials and Methods of Sampling and Testing,* 22nd Edition, 2002.

Michael, Larry, Maryland State Highway Agency, North East Asphalt User/Producer Group Presentation, Newport, RI, October 2002.

Appendix A

Round Robin Instructions

Gyratory Round Robin Instructions
Winter 2003

Please have the same technician fabricate all of the specimens for a particular gyratory. This does not mean that the same person must fabricate all of the specimens for organizations with multiple gyratories.

Place cardboard box containing sample into oven set at 149°C (300°F) for 45 minutes

Place at least 2 gyratory molds into oven at 149°C (300°F)

Remove sample from box and place into a pan. Gently stirring the sample to break up the material. If unable to break up all of the material, place in oven for an additional 15-20 minutes and then finish breaking up the material.

Continue heating at same temperature for approximately 2 hours at 149°C (300°F) stirring after the first hour

Check temperature of material to ensure it is between 143-149°C (290-300°F). If material is not in the specified range, continue heating until desired range is achieved. Please note any additional heating time on data sheet.

For A samples compact 5100 grams of material per specimen and for B samples compact 4975 grams of material per specimen. Please take care in portioning out this material to ensure the material is representative of the mix.

After meeting the temperature requirement, place material in gyratory mold minimizing segregation.

Please compact two A samples and two B specimens per gyratory.

Compact specimens labeled A-XX to 205 gyrations and specimens labeled B-XX to 115 gyrations.

Eject specimen from mold, allow to cool slightly before handling and label the specimen with the number found on the box.

Place height data and other requested data into the attached data sheet.

DO NOT perform bulk specific gravity tests on these specimens!!!

Contact the CAP Lab to arrange for specimens to be picked up. (860) 486-5956

Contact Jim Mahoney with any questions. Please complete by January 24, 2003.

Gyratory Round Robin - Data Sheet
December 2002

Company or Organization ____

Gyratory Location _______________ Technician ________________________

Gyratory Manufacturer _________________ Model __________ Serial # ________

SAMPLE A

	Box ID #	
Height @	A -	A -
9		
125		
205		

Notes: ____

SAMPLE B

	Box ID #	
Height @	B -	B -
7		
75		
115		

Notes: ____

Appendix B

Round Robin Data

Pine 125X - Mix A

Sample ID	Gmb	Height at Number of Gyrations N=9, mm	N=125, mm	N=205, mm	Air Voids
A-2	2.569	124.5	115.3	114.3	2.91%
A-3	2.574	124.6	115.1	114.0	2.72%
A-4	2.573	125.3	115.7	114.5	2.76%
A-5	2.574	125.6	116.2	115.1	2.72%
A-6	2.571	126.3	116.1	114.8	2.83%
A-7	2.571	126.5	116.4	115.2	2.83%
A-8	2.572	125.8	115.9	114.7	2.80%
A-9	2.572	126.2	116.2	114.9	2.80%
A-10	2.578	126.3	116.4	115.1	2.57%
A-47	2.580	125.9	116.4	114.6	2.49%
A-48	2.578	125.0	115.7	114.0	2.57%
Average	2.574	125.6	115.9	114.7	2.73%
Stand Dev	0.003	0.70	0.45	0.42	0.13%

Pine TestQuip - Mix A

Sample ID	Gmb		Height at Number of Gyrations N=9, mm	N=125, mm	N=205, mm	Air Voids
A-15	2.568		125.3	115.8	114.6	2.95%
A-16	2.561		126.2	116.4	115.1	3.21%
A-21	2.583		124.3	115.3	113.7	2.38%
A-22	2.585		124.4	115.3	113.8	2.31%
A-27	2.580		124.9	114.9	113.7	2.49%
A-28	2.575		125.2	115.3	114.1	2.68%
A-29	2.573		126.0	116.4	115.1	2.76%
A-30	2.568		125.9	116.4	115.2	2.95%
A-31	2.570		127.2	116.3	115.1	2.87%
A-32	2.568		127.3	116.4	115.1	2.95%
A-33	2.502	**	129.0	117.7	116.2	5.44%
A-34	2.576		124.8	114.9	113.7	2.65%
A-35	2.577		125.4	115.5	114.4	2.61%
A-36	2.576		126.1	115.6	114.3	2.65%
A-37	2.580		124.6	115.4	114.2	2.49%
A-38	2.576		125.2	115.8	114.5	2.65%
A-39	2.573		125.1	115.4	114.2	2.76%
A-40	2.574		125.5	115.8	114.6	2.72%
A-41	2.575		125.1	115.4	114.1	2.68%
A-42	2.574		Heights not Available			2.72%
A-43	2.577		125.1	115.6	114.3	2.61%
A-44	2.574		126.4	116.1	114.8	2.72%
A-45	2.574		126.1	116.1	114.9	2.72%
A-46	2.577		124.5	115.1	113.9	2.61%
Average	2.575		125.5	115.7	114.4	2.70%
Stand Dev	0.005		0.83	0.49	0.51	0.20%

** Excluded from Computations

Troxler 4140 - Mix A

Sample ID	Gmb	Height at Number of Gyrations N=9, mm	N=125, mm	N=205, mm	Air Voids
A-13	2.564	125.9	116.6	115.4	3.10%
A-14	2.563	124.7	115.9	114.7	3.14%
A-19	2.572	124.1	115.4	113.7	2.80%
A-20	2.581	125.5	115.5	113.9	2.46%
A-23	2.573	123.7	115.6	114.0	2.76%
A-24	2.585	123.9	115.0	113.4	2.31%
A-25	2.583	124.7	115.6	114.3	2.38%
A-26	2.568	125.5	116.3	115.1	2.95%
A-49	2.558	127.4	117.6	116.2	3.33%
A-50	2.538	128.2	118.3	116.9	4.08%
Average	2.569	125.4	116.2	114.8	2.93%
Stand Dev	0.014	1.49	1.05	1.14	0.53%

Pine AFG1A - Mix A

Sample ID	Gmb	Height at Number of Gyrations N=9, mm	N=125, mm	N=205, mm	Air Voids
A-11	2.586	125.0	115.3	114.1	2.27%
A-12	2.588	124.1	115.0	113.8	2.19%
A-17	2.569	124.4	116.5	114.9	2.91%
A-18	2.563	125.1	116.5	115.0	3.14%
Average	2.577	124.7	115.8	114.5	2.63%
Stand Dev	0.012	0.48	0.79	0.59	0.47%

Pine 125X - Mix B

Sample ID	Gmb	Height at Number of Gyrations N=7, mm	N=75, mm	N=115, mm	Air Voids
B-2	2.471	127.3	117.1	115.8	3.10%
B-3	2.469	128.1	117.5	116.2	3.18%
B-4	2.473	128.1	117.6	116.2	3.02%
B-5	2.468	127.5	117.3	115.9	3.22%
B-6	2.468	128.0	117.7	116.4	3.22%
B-7	2.471	127.8	117.3	115.9	3.10%
B-8	2.472	127.7	117.2	115.8	3.06%
B-9	2.472	127.7	117.2	115.9	3.06%
B-10	2.470	127.6	117.3	116.0	3.14%
B-47	2.486	127.5	116.9	115.5	2.51%
B-48	2.483	127.0	117.1	115.8	2.63%
Average	2.473	127.7	117.3	115.9	3.02%
Stand Dev	0.006	0.34	0.23	0.25	0.23%

Pine TestQuip - Mix B

Sample ID	Gmb		Height at Number of Gyrations N=7, mm	N=75, mm	N=115, mm	Air Voids
B-15	2.467		127.7	117.2	115.9	3.25%
B-16	2.460		128.3	118.0	116.7	3.53%
B-20	2.475		128.0	117.3	115.9	2.94%
B-21	2.480		126.0	115.6	114.3	2.75%
B-27	2.471		127.5	117.0	115.6	3.10%
B-28	2.473		127.3	116.8	115.5	3.02%
B-29	2.500		126.3	116.1	114.9	1.96%
B-30	2.464		124.1	117.6	116.5	3.37%
B-31	2.473		128.9	117.4	115.9	3.02%
B-32	2.466		129.2	117.7	116.3	3.29%
B-33	2.550	**	122.6	113.5	112.3	0.00%
B-34	2.469		127.7	116.9	115.5	3.18%
B-35	2.474		127.8	117.0	115.7	2.98%
B-36	2.474		128.4	117.4	116.1	2.98%
B-37	2.473		128.2	117.2	115.9	3.02%
B-38	2.478		127.7	117.3	115.9	2.82%
B-39	2.467		128.1	117.7	116.3	3.25%
B-40	2.468		128.4	117.6	116.1	3.22%
B-41	2.469		127.8	117.2	115.9	3.18%
B-42	2.483		127.1	116.5	115.2	2.63%
B-43	2.471		128.1	117.4	115.9	3.10%
B-44	2.468		128.0	117.2	115.7	3.22%
B-45	2.467		128.1	117.7	116.4	3.25%
B-46	2.468		128.8	117.9	116.6	3.22%
Average	2.472		127.7	117.2	115.9	3.06%
Stand Dev	0.008		1.08	0.56	0.55	0.31%

** Excluded from Computations

Troxler 4140 - Mix B

Sample ID	Gmb	Height at Number of Gyrations N=7, mm	N=75, mm	N=115, mm	Air Voids
B-13	2.453	127.9	118.1	116.7	3.80%
B-14	2.455	127.6	117.8	116.4	3.73%
B-19	2.466	127.8	117.8	116.4	3.29%
B-22	2.471	127.6	117.3	116.0	3.10%
B-23	2.465	128.1	117.9	116.6	3.33%
B-24	2.462	127.9	117.9	116.5	3.45%
B-25	2.459	128.7	118.5	117.1	3.57%
B-26	2.450	128.6	118.4	117.0	3.92%
B-49	2.442	130.8	120.1	118.6	4.24%
B-50	2.432	130.3	119.4	117.9	4.63%
Average	2.456	128.5	118.3	116.9	3.71%
Stand Dev	0.012	1.13	0.84	0.78	0.47%

Pine AFG1A - Mix B

Sample ID		Gmb	Height at Number of Gyrations N=7, mm	N=75, mm	N=115, mm	Air Voids
B-11		2.486	126.6	116.5	115.2	2.51%
B-12		2.491	126.2	116.3	115.0	2.31%
B-17		2.465	128.7	118.1	116.8	3.33%
B-18		2.469	128.3	117.9	116.5	3.18%
	Average	2.478	127.5	117.2	115.9	2.83%
	Stand Dev	0.013	1.23	0.93	0.91	0.50%