



## ANALYSIS OF BACK CALCULATION METHOD FOR DETERMINATION OF BULK SPECIFIC GRAVITY AT N<sub>DESIGN</sub> AND N<sub>INITIAL</sub> LEVELS OF GYRATION

Research Report FL/DOT/SMO/99-434

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# **STATE MATERIALS OFFICE**

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#### **INTRODUCTION**

The current Superpave mix design procedure requires that specimens be compacted to the maximum number of gyrations,  $N_{max}$ , for the specified traffic level. Volumetric data for the design number of gyrations,  $N_{des}$ , and the initial number of gyrations,  $N_{ini}$ , are then back calculated based on the bulk specific gravity,  $G_{mb}$ , of the  $N_{max}$  specimens and the height data generated during the compaction process of those same specimens.

When computing volumes using the height data and cross sectional area of the mold, the calculated volume is always higher than the actual volume of the sample because the sample contains surface voids. The volume of the surface voids are mostly excluded in the determination of the volume of the specimen by the saturated surface dry method (such as AASHTO T 166 specification). This happens because the water in the pores either runs out of the pores upon removal of the specimen from the water bath or the water is removed from the pores as the specimen is rolled on the towel prior to determining the saturated surface dry weight.. Therefore, a correction factor is determined for the  $N_{max}$  specimens. The correction factor is computed as:

$$C.F. = \frac{G_{mb,measured}}{G_{mb,estimated}}$$

where: C.F. = correction factor  $G_{mb,measured}$  = measured bulk specific gravity at  $N_{max}$  $G_{mb,estimated}$  = estimated bulk specific gravity at  $N_{max}$ 

The correction factor is then applied to the estimated G<sub>mb</sub> values for the specimens compacted to

N<sub>des</sub> and N<sub>ini</sub> compaction levels using the following formula:

$$G_{mb,corrected} = C.F. X G_{mb,estimated}$$

where:  $G_{mb,corrected}$  = corrected bulk specific gravity at  $N_{des}$  or  $N_{ini}$ 

The issue in question is whether the correction factor calculated at  $N_{max}$  is applicable or accurate for the  $N_{des}$  and  $N_{ini}$  levels of gyration. One might reason that the correction factor might increase as the number of gyrations decreased due to the increasing size and number of voids present on the surfaces of a specimen. If the correction factor were not constant throughout the gyration process, then the back calculated values for  $G_{mb}$  and other volumetric properties such as air voids would be incorrect. One possible solution would be to actually gyrate samples to the  $N_{des}$  and  $N_{ini}$ levels during the mix design process, eliminating the need for a correction factor.

#### PURPOSE AND SCOPE OF EXPERIMENT

The purpose of this research study was to determine the error, if any, that occurs by back calculating volumetric properties based on a correction factor determined at  $N_{max}$ .

Six different coarse graded Superpave mix designs were tested. The mixes consisted of three Florida limestone mixes and three Georgia granite mixes. None of the mixes contained reclaimed asphalt pavement. Within each aggregate type, there was a 9.5, 12.5 and 19.0 mm mix type. See **Table 1** for a summary of the six mixes used.

For each mix type, four samples were gyrated to the N<sub>max</sub>, N<sub>des</sub>, and N<sub>ini</sub> compaction

levels. This amounted to 12 samples per mix type for a total of 72 samples for the study. All mixes were designed for traffic level five (10 - 30 million ESAL's) and were compacted to the following number of gyrations:  $N_{max}$  - 152;  $N_{des}$  - 96;  $N_{ini}$  - 8.

The  $G_{mb}$ 's of all specimens were determined in accordance with Florida Method FM 1-T 166 Method B (non-destructive). This Florida Method is the same as AASHTO Method T 166 Method A for determination of bulk specific gravity. In addition the  $G_{mb}$ 's of the  $N_{ini}$  specimens were also determined using a granular medium method for comparison. The granular medium used was glass beads conforming to AASHTO M 247-81 Type I. Basically, the glass beads replace the water in the above referenced methods. The procedure for determining the  $G_{mb}$  using glass beads was obtained from an article in March 1998 Asphalt Contractor Periodical (1).

#### RESULTS

The raw data for  $G_{mb}$ ,  $G_{mm}$ , % air voids, outlier determination, etc. is included in the **Appendix**. The variability in the  $G_{mb}$  values, as determined by FM 1-T 166, within a few of the mixes was high (see **Table 2**). The variability in this study is being defined as the range between the highest and lowest  $G_{mb}$  values for a set of four specimens. AASHTO T 166 states a maximum allowable range of 0.02 between two specimens (2). Since this study is using four specimens, the allowable range would be higher. ASTM D 2726-93a states a maximum allowable range of 0.045 for four specimens for single-operator precision (3). The multi-laboratory precision for four specimens is 0.097. As will be discussed later, the specimens made in this study were all prepared with the same equipment but with different operators. Therefore, a precision value somewhere in between single-operator and multi-laboratory would be appropriate. A precision statement for the glass bead method of G<sub>mb</sub> determination was not available.

The source(s) of the variability is difficult to determine, but is most likely due to operator error with some variability due to natural variation in materials and variability in the gyratory compaction process. The following conditions occurred during the study:

- 1. The aggregate gradations were fabricated by several lab technicians.
- 2. The same technician performed all mixing duties.
- All mixes were aged for two hours prior to compaction, therefore compaction temperatures were most likely consistent.
- 4. Three technicians performed gyration duties.
- 5. Bulk specific gravity measurements were performed by several technicians.

The G<sub>mb</sub> data was then analyzed for outliers using the FDOT method for outlier determination
(4). Excluding the outliers, the variability within each mix improved, as expected (see Table 3).

With respect to air voids, the data was analyzed with and without the outliers. Both methods of analysis resulted in the same trends with slightly different magnitudes. For the four  $N_{des}$  specimens of each mix type, the average air voids were determined and subtracted from the average air voids back calculated from the  $N_{max}$  specimens. Therefore, a positive difference would indicate that the back calculation method was overestimating air voids at  $N_{des}$ , whereas a negative difference would indicate that the back calculation method was underestimating air voids at  $N_{des}$ . The same procedure was used at  $N_{ini}$  except that two methods for determining the  $G_{mb}$  of the  $N_{ini}$  specimens were used, FM 1-T 166 Method B (water bath method) and glass

beads. The results including the outliers are displayed in **Table 4** and **Figures 1 and 2** and the results excluding the outliers are displayed in **Table 5** and **Figure 3 and 4**.

For the  $N_{des}$  specimens, the results show three mixes with positive differences and three mixes with negative differences, whether including the outliers or not. The magnitude of the differences is larger with the limestone mixes compared to the granite mixes.

For the  $N_{ini}$  specimens, the results show all of the mixes having a positive difference, indicating that the back calculation method is overestimating air voids at the  $N_{ini}$  level. The magnitude of the difference also increases as the nominal maximum aggregate size increases. This is logical due to the larger void spaces present on the surfaces of specimens containing larger size aggregates. The differences calculated do not vary greatly between the water bath method and glass bead method for the 9.5 and 12.5 mm mixes. However, for the 19 mm mixes, the differences are more pronounced. The differences are higher for the water bath method. This is because, at high air void levels, water will flow out of the specimen as it is lifted out of the water bath, affecting the accuracy of the results. This results in a lower saturated surface dry weight and therefore a calculated higher bulk density and lower air void content. Therefore, for the  $N_{ini}$  specimens, it is more appropriate to use the values calculated by the glass bead method for the 19.0 mm mixes.

#### **CONCLUSIONS / RECOMMENDATIONS**

The  $N_{des}$  data can be interpreted in at least two ways. First, it can be argued that because there were three mixes with positive differences and three mixes with negative differences, that no

firm conclusions can be drawn from the data and therefore, the current method of back calculation should continue to be used. One could also interpret the data by recognizing that because there is variability between mix types, that this is justification that one should gyrate to  $N_{des}$  instead of  $N_{max}$ . After a design aggregate blend and binder content is determined, then specimens could be compacted to  $N_{max}$  to verify the criteria that the percent of the maximum density is  $\leq 98\%$ . This would be an after the design check just as moisture sensitivity is currently done. However, the ramifications of failing the  $N_{max}$  criteria would likely result in a time consuming redesign of the mix.

The  $N_{ini}$  data is more conclusive. The back calculation method overestimates the air voids at this level. This effect is most pronounced for 19.0 mm mixes. This could result in a mix passing the  $N_{ini}$  requirements when in reality it should not. One solution is to compact specimens to  $N_{ini}$  as a check similar to the  $N_{max}$  specimens mentioned above. Another solution is to require  $N_{ini}$  specimens to be made for only those mix designs where the back calculated  $\% G_{mm}$  at  $N_{ini}$  is  $\ge$  86%. This would provide a 3%  $G_{mm}$  margin of error. If the back calculated  $\% G_{mm}$  was less than 86%, then even with a 3% error in the back calculation method, the %  $G_{mm}$  would be  $\le$  89%.

The findings in this report agree with the findings from Report 98-5 from the National Center for Asphalt Technology (NCAT) (5). That study also recommended that specimens be compacted to  $N_{des}$  at mix design. The study examined dense graded and stone matrix asphalt (SMA) mixes. The data showed both positive and negative air void differences at higher gyration levels and larger positive values at lower gyration values (both results similar to the findings in this report).

It should be noted that the current Superpave specifications for  $G_{mm}$ , VMA, VFA, etc. may have been based on the current back calculation method. These specification values may need to be reexamined and possibly adjusted if a if specimens at design are to be gyrated to  $N_{des}$  and possibly  $N_{ini}$  levels .

#### REFERENCES

- Crockford, Bill. More Tailgate Tips Estimating Bulk Specific Gravity without Water. <u>The Asphalt Contractor</u>, Independence, MO, June, 1998.
- 2. Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens, AASHTO Standard Method of Test T 166-93. 1993.
- Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens, ASTM D 2726-93a. 1993.
- Asphalt Paving Technician Manual, English Version. Pages 9-9 thru 9-12. Florida Department of Transportation, Gainesville, FL, 1996.
- Mallick, Rajib B., S. Buchanan, E. R. Brown, M. Huner. An Evaluation of Superpave Gyratory Compaction of Hot Mix Asphalt. Report 98-5, National Center for Asphalt Technology, Auburn, AL, January, 1998.

Mix #	SP98-0176A	SP98-0177A	SP98-0178A	SP98-0108A	SP97-0071A	SP96-0017B
Nom. Max. Agg. Size, mm	9.5	12.5	19.0	9.5	12.5	19.0
Agg. Type	Fl. Limestone	Fl. Limestone	Fl. Limestone	Ga. Granite	Ga. Granite	Ga. Granite
Gradation						
% Passing						
19.0 mm	100	100	99	100	100	99
12.5 mm	100	96	91*	100	100	63
9.5 mm	99	90	84	100	78	45
4.75 mm	72	61	53	75	43	35
2.36 mm	46	39	33	47	29	25
1.18 mm	28	22	18	32	18	20
600µm	15	11	9.5	23	12	14
300µm	8.1	6.0	5.5	16	8.6	11
150µm	4.9	4.1	4.2	11	5.9	7.2
75µm	3.9	3.6	3.7	6.4	3.7	4.5

Table 1 - Composite Gradation Summary of Mixes Used in Study

\* By definition, this composition gradation does not meet the Superpave requirements for a 19.0 mm mix because the % passing the 12.5 mm sieve is 91 %. This is 1% greater than that of the FDOT approved mix design.

Mix ID	Nmax	Ndes	Nini (SSD)	Nini (Beads)
176A-9.5 LS	0.053	0.026	0.038	0.056
177A-12.5 LS	0.013	0.089	0.018	0.045
	3 samples			
178A-19.0 LS	0.045	0.040	0.027	0.063
108A-9.5 GR	0.029	0.005	0.046	0.039
71A-12.5 GR	0.051	0.074	0.025	0.018
17B-19.0 GR	0.016	0.030	0.007	0.049

 Table 2 - Maximum Range in G<sub>mb</sub> Values of Four Specimens for

 Each Mix Type and Gyration Level (Including Outliers)

Table 3 - Maximum Range in  $G_{mb}$  Values of Three or Four Specimens for Each Mix Type and Gyration Level (Excluding Outliers)

Mix ID	Nmax	Ndes	Nini (SSD)	Nini (Beads)
176A-9.5 LS	0.009	0.026	0.038	0.056
	3 samples	4 samples	4 samples	4 samples
177A-12.5 LS	0.013	0.023	0.018	0.045
	4 samples	3 samples	4 samples	4 samples
178A-19.0 LS	0.022	0.015	0.027	0.030
	3 samples	3 samples	4 samples	3 samples
108A-9.5 GR	0.007	0.005	0.046	0.011
	3 samples	4 samples	4 samples	3 samples
71A-12.5 GR	0.012	0.042	0.006	0.018
	3 samples	3 samples	3 samples	4 samples
17B-19.0 GR	0.004	0.030	0.007	0.049
	3 samples	4 samples	4 samples	4 samples

Summary, 176A - 9.5 Limerock	N <sub>des</sub>	Ν	N <sub>ini</sub>
Average air voids, back calculated	5.23	16.28	16.28
Average air voids actual, SSD	5.43	15.73	NA
Average air voids actual, beads	NA	NA	15.16
Difference (Back calculated - actual)	-0.20	0.54	1.12
Summary, 177A - 12.5 Limerock	N <sub>des</sub>	Ν	V <sub>ini</sub>
Average air voids, back calculated	4.37	15.65	15.65
Average air voids actual, SSD	5.65	14.36	NA
Average air voids actual, beads	NA	NA	14.51
Difference (Back calculated - actual)	-1.28	1.29	1.14
Summary, 178A - 19.0 Limerock	N <sub>des</sub>	Ν	N <sub>ini</sub>
Average air voids, back calculated	6.89	17.75	17.75
Average air voids actual, SSD	6.45	15.06	NA
Average air voids actual, beads	NA	NA	15.74
Difference (Back calculated - actual)	0.43	2 69	2.01
Enterence (Buen culculated actual)	0	2.07	2.01
Santonioo (Buch calculation actual)	0110	2.07	2.01
Summary, 108A - 9.5 Granite	N <sub>des</sub>	2.09 N	V <sub>ini</sub>
Summary, 108A - 9.5 Granite Average air voids, back calculated	N <sub>des</sub>	13.26	N <sub>ini</sub> 13.26
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD	N <sub>des</sub> 4.11 3.54	13.26 11.66	13.26 NA
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads	N <sub>des</sub> 4.11 3.54 NA	13.26 11.66 NA	13.26 NA 11.21
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	N <sub>des</sub> 4.11 3.54 NA 0.56	13.26 11.66 NA 1.60	V <sub>ini</sub> 13.26 NA 11.21 2.04
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	N <sub>des</sub> 4.11 3.54 NA 0.56	N 13.26 11.66 NA 1.60	13.26 NA 11.21 2.04
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite	N <sub>des</sub> 4.11 3.54 NA 0.56 N <sub>des</sub>	13.26 11.66 NA 1.60	V <sub>ini</sub> <u>13.26</u> <u>NA</u> <u>11.21</u> <u>2.04</u> V <sub>ini</sub>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated	N <sub>des</sub> 4.11 3.54 NA 0.56 N <sub>des</sub> 5.58	NA 13.26 11.66 NA 1.60	V <sub>ini</sub> <u>13.26</u> <u>NA</u> <u>11.21</u> <u>2.04</u> V <sub>ini</sub> <u>15.37</u>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD	N <sub>des</sub> 4.11           3.54           NA           0.56           N <sub>des</sub> 5.58           5.76	NA 13.26 11.66 NA 1.60 N 15.37 12.81	V <sub>ini</sub> 13.26 NA 11.21 2.04 V <sub>ini</sub> 15.37 NA
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads	N <sub>des</sub> 4.11           3.54           NA           0.56           N <sub>des</sub> 5.58           5.76           NA	NA 13.26 11.66 NA 1.60 NA 15.37 12.81 NA	V <sub>ini</sub> 13.26 NA 11.21 2.04 V <sub>ini</sub> 15.37 NA 13.17
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	Ndes           4.11           3.54           NA           0.56           Ndes           5.58           5.76           NA           -0.18	NA 13.26 11.66 NA 1.60 NA 15.37 12.81 NA 2.56	Vini           13.26           NA           11.21           2.04           Vini           15.37           NA           13.17           2.19
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	Ndes           4.11           3.54           NA           0.56           Ndes           5.58           5.76           NA           -0.18	NA 13.26 11.66 NA 1.60 NA 15.37 12.81 NA 2.56	Na         13.26         NA         11.21         2.04         Nini         15.37         NA         13.17         2.19
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	Ndes           4.11           3.54           NA           0.56           Ndes           5.58           5.76           NA           -0.18	NA 13.26 11.66 NA 1.60 NA 15.37 12.81 NA 2.56	V <sub>ini</sub> 13.26 NA 11.21 2.04 V <sub>ini</sub> 15.37 NA 13.17 2.19 V <sub>ini</sub>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 17B - 19.0 Granite Average air voids, back calculated	Ndes           4.11           3.54           NA           0.56           Ndes           5.58           5.76           NA           -0.18           Ndes           4.26	NA 13.26 11.66 NA 1.60 NA 15.37 12.81 NA 2.56 N 13.68	Na         13.26         NA         11.21         2.04         Nini         15.37         NA         13.17         2.19         Nini         13.68
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 17B - 19.0 Granite Average air voids, back calculated Average air voids, back calculated Average air voids, back calculated	Ndes           4.11           3.54           NA           0.56           Ndes           5.58           5.76           NA           -0.18           Ndes           4.26           4.11	NA 13.26 11.66 NA 1.60 NA 1.60 NA 15.37 12.81 NA 2.56 N 13.68 9.43	V <sub>ini</sub> 13.26 NA 11.21 2.04 V <sub>ini</sub> 15.37 NA 13.17 2.19 V <sub>ini</sub> 13.68 NA
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 17B - 19.0 Granite Average air voids, back calculated Average air voids, back calculated	Ndes           4.11           3.54           NA           0.56           Ndes           5.58           5.76           NA           -0.18           Ndes           4.26           4.11           NA	NA 13.26 11.66 NA 1.60 NA 15.37 12.81 NA 2.56 N 13.68 9.43 NA	Nini         13.26         NA         11.21         2.04         Vini         15.37         NA         13.17         2.19         Nini         13.68         NA         10.36

## Table 4 - Air Void Data Including Outliers

Summary, 176A - 9.5 Limerock	N <sub>des</sub>	١	N <sub>ini</sub>
Average air voids, back calculated	4.68	15.66	15.66
Average air voids actual, SSD	5.43	15.73	NA
Average air voids actual, beads	NA	NA	15.16
Difference (Back calculated - actual)	-0.75	-0.07	0.50
Summary, 177A - 12.5 Limerock	N <sub>des</sub>	1	V <sub>ini</sub>
Average air voids, back calculated	4.37	15.65	15.65
Average air voids actual, SSD	6.46	14.36	NA
Average air voids actual, beads	NA	NA	14.51
Difference (Back calculated - actual)	-2.09	1.29	1.14
Summary, 178A - 19.0 Limerock	N <sub>des</sub>	1	N <sub>ini</sub>
Average air voids, back calculated	7.22	18.14	18.14
Average air voids actual, SSD	6.09	15.06	NA
Average air voids actual, beads	NA	NA	16.24
Difference (Back calculated - actual)	1.13	3.09	1.90
Summary, 108A - 9.5 Granite	N <sub>des</sub>	١	N <sub>ini</sub>
Summary, 108A - 9.5 Granite Average air voids, back calculated	N <sub>des</sub> 3.84	N 13.02	N <sub>ini</sub> 13.02
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD	N <sub>des</sub> 3.84 3.54	N 13.02 11.66	V <sub>ini</sub> 13.02 NA
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads	N <sub>des</sub> 3.84 3.54 NA	13.02 11.66 NA	N <sub>ini</sub> <u>13.02</u> <u>NA</u> 11.55
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	N <sub>des</sub> 3.84 3.54 NA 0.30	NA 1.37	N <sub>ini</sub> 13.02 NA 11.55 1.48
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	N <sub>des</sub> 3.84 3.54 NA 0.30	NA 1.37	V <sub>ini</sub> <u>13.02</u> <u>NA</u> 11.55 1.48
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite	Ndes           3.84           3.54           NA           0.30	NA 1.37 NA	N <sub>ini</sub> <u>13.02</u> <u>NA</u> 11.55 1.48 N <sub>ini</sub>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated	N <sub>des</sub> 3.84 3.54 NA 0.30 N <sub>des</sub> 5.16	NA 13.02 11.66 NA 1.37 N 15.05	V <sub>ini</sub> <u>13.02</u> <u>NA</u> <u>11.55</u> <u>1.48</u> V <sub>ini</sub> <u>15.05</u>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD	Ndes           3.84           3.54           NA           0.30           Ndes           5.16           5.20	NA 1.37 NA 1.37 N 15.05 12.59	N <sub>ini</sub> <u>13.02</u> <u>NA</u> <u>11.55</u> <u>1.48</u> N <sub>ini</sub> <u>15.05</u> <u>NA</u>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads	Ndes           3.84           3.54           NA           0.30           Ndes           5.16           5.20           NA	NA 13.02 11.66 NA 1.37 N 15.05 12.59 NA	N <sub>ini</sub> <u>13.02</u> <u>NA</u> <u>11.55</u> <u>1.48</u> N <sub>ini</sub> <u>15.05</u> <u>NA</u> <u>13.17</u>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	N <sub>des</sub> 3.84           3.54           NA           0.30           N <sub>des</sub> 5.16           5.20           NA           -0.04	NA 13.02 11.66 NA 1.37 N 15.05 12.59 NA 2.46	V <sub>ini</sub> <u>13.02</u> <u>NA</u> <u>11.55</u> <u>1.48</u> V <sub>ini</sub> <u>15.05</u> <u>NA</u> <u>13.17</u> <u>1.87</u>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	Ndes           3.84           3.54           NA           0.30           Ndes           5.16           5.20           NA           -0.04	NA 13.02 11.66 NA 1.37 N 15.05 12.59 NA 2.46	N <sub>ini</sub> 13.02 NA 11.55 1.48 N <sub>ini</sub> 15.05 NA 13.17 1.87
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual)	N <sub>des</sub> 3.84           3.54           NA           0.30           N <sub>des</sub> 5.16           5.20           NA           -0.04	N 13.02 11.66 NA 1.37 N 15.05 12.59 NA 2.46	V <sub>ini</sub> <u>13.02</u> <u>NA</u> <u>11.55</u> <u>1.48</u> V <sub>ini</sub> <u>15.05</u> <u>NA</u> <u>13.17</u> <u>1.87</u> V <sub>ini</sub>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 17B - 19.0 Granite Average air voids, back calculated	Ndes           3.84           3.54           NA           0.30           Ndes           5.16           5.20           NA           -0.04           Ndes           4.40	N 13.02 11.66 NA 1.37 N 15.05 12.59 NA 2.46 N 13.90	V <sub>ini</sub> <u>13.02</u> <u>NA</u> <u>11.55</u> <u>1.48</u> V <sub>ini</sub> <u>15.05</u> <u>NA</u> <u>13.17</u> <u>1.87</u> V <sub>ini</sub> <u>13.90</u>
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 17B - 19.0 Granite Average air voids, back calculated Average air voids, back calculated	N <sub>des</sub> 3.84           3.54           NA           0.30           N <sub>des</sub> 5.16           5.20           NA           -0.04           N <sub>des</sub> 4.40           4.11	NA 13.02 11.66 NA 1.37 N 15.05 12.59 NA 2.46 N 13.90 9.43	Nini 13.02 NA 11.55 1.48 Nini 15.05 NA 13.17 1.87 Nini 13.90 NA
Summary, 108A - 9.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 71A - 12.5 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads Difference (Back calculated - actual) Summary, 17B - 19.0 Granite Average air voids, back calculated Average air voids actual, SSD Average air voids actual, beads	N <sub>des</sub> 3.84           3.54           NA           0.30           N <sub>des</sub> 5.16           5.20           NA           -0.04           N <sub>des</sub> 4.40           4.11           NA	NA 13.02 11.66 NA 1.37 N 15.05 12.59 NA 2.46 N 13.90 9.43 NA	V <sub>ini</sub> <u>13.02</u> <u>NA</u> <u>11.55</u> <u>1.48</u> V <sub>ini</sub> <u>15.05</u> <u>NA</u> <u>13.17</u> <u>1.87</u> V <sub>ini</sub> <u>13.90</u> <u>NA</u> <u>10.36</u>

Table 5 - Air Void Data Excluding Outliers



Figure 1 -  $N_{des}$  Air Void Data Including Outliers



Figure 2 -  $N_{\mbox{\scriptsize ini}}$  Air Void Data Including Outliers



Figure 3 - N<sub>des</sub> Air Void Data Excluding Outliers



Figure 4 - N<sub>ini</sub> Air Void Data Excluding Outliers

APPENDIX

Calculatio	ns for	r Mix ′	176A-9	.5 LR	(Inclue	ding O	utliers)																			
Nmm SSD meth	od						New SSD method							New SSD methor	d						N <sub>ini</sub> - Glass Beads tested b	) v Brian C	awley			
Sample ID	A	В	6	D D	Range		Sample ID	F	F	G	н	Range		Sample ID		, i	K	1	Range		Sample ID			K		
Dry Wt.	4509.1	4499.7	4506.8	4506.5	9.4	-	Dry Wt.	4503.7	4506.5	4501.7	4500.2	6.3	-	Dry Wt.	4510.2	4502.1	4508.0	4516.4	14.3	-	Dry Wt.	4510.2	4502.1	4508.0	4516.4	
Wt. In H <sub>2</sub> O	2499.8	2501.6	2502.7	2459.6			Wt. In H <sub>2</sub> O	2440.4	2446.4	2460.9	2454.2			Wt. In H <sub>2</sub> 0	2380.2	2396.5	2389.7	2392.1			Wt. partial wet	4557.5	4556.5	4565.2	4575.4	
SSD Wt.	4513.2	4502.6	4508.8	4511.6			SSD Wt.	4514.3	4512.3	4508.9	4508.5			SSD Wt.	4679.2	4727.4	4681.1	4733.4			Wt.w/ beads & bkt.(1) kg	32.80	32.70	32.84	32.76	
Volume	2013.4	2001.0	2006.1	2052.0		St. Dev.	Volume	2073.9	2065.9	2048.0	2054.3		St. Dev.	Volume	2299.0	2330.9	2291.4	2341.3		St. Dev.	Wt.w/ beads & bkt.(2) kg	32.80	32.72	32.80	32.74	
G <sub>mb</sub>	2.240	2.249	2.247	2.196	0.053	0.025	G <sub>mb</sub>	2.172	2.181	2.198	2.191	0.026	0.011	Gmb	1.962	1.931	1.967	1.929	0.038	0.020	Wt.w/ beads & bkt.(3) kg	32.80	32.70	32.82	32.68	
Gmm	2.311	2.311	2.311	2.311			Gmm	2.311	2.311	2.311	2.311			Gmm	2.311	2.311	2.311	2.311			Wt.w/ beads & bkt.(avg)	32.80	32.71	32.82	32.73	
Air Voids	3.09	2.69	2.79	4.97	2.3		Air Voids	6.03	5.61	4.89	5.21	1.1		Air Voids	15.11	16.42	14.87	16.53	1.7		Bucket wt.	8.7041	8.7041	8.7041	8.7041	
		Avg air v	/oids	3.39					Avg air v	/oids	5.43					Avg air v	voids	15.73			Wt. of beads, g	19538.4	19446.1	19550.7	19447.2	
N <sub>max</sub> dimension:	al method	ł																			Volume of beads, cm <sup>3</sup>	11805.2	11749.4	11812.6	11750.1	
Ht @ N <sub>max</sub> , mm	115.4	114.4	114.8	117.6			Gmb, Nmax	Dens(pcf)	Ht, Nma	a) Mass	Dens(pcf	)									Pill vol = bkt vol - bead vol	2274.3	2330.1	2266.9	2329.4	Range
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			2.240	139.7	115.4	4509.1	139.7										G <sub>mb</sub> pill	1.983	1.932	1.989	1.939	0.056
Volume, cm <sup>3</sup>	2039.3	2021.6	2028.7	2078.2			2.249	140.3	114.4	4499.7	140.3										G <sub>mm</sub>	2.311	2.311	2.311	2.311	
Dry wt.	4509.1	4499.7	4506.8	4506.5			2.247	140.2	114.8	4506.8	140.2										Air Voids	14.19	16.39	13.95	16.10	2.4
G <sub>mb</sub>	2.211	2.226	2.222	2.169			2.196	137.0	117.6	4506.5	137.0												Avg air v	oids	15.16	
G <sub>mb</sub> corr. fact.	1.013	1.010	1.011	1.013																						
																					Bucket Wt. (Empty)		8.7041	kg		
N <sub>des</sub> dimensiona	al method						Summary, 176A -	9.5 Limer	rock	N <sub>des</sub>		N <sub>ini</sub>									Bucket Volume		14079.5	cm <sup>3</sup>		
Ht @ N <sub>des</sub> , mm	117.6	116.6	117.0	120.0			Average air voids,	back calc	ulated	5.23	16.28	16.28									Beads and Bucket		1	2	3	
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			Average air voids a	actual, SS	D	5.43	15.73	NA											32.02	32.02	31.98	kg
Volume, cm <sup>3</sup>	2078.2	2060.5	2067.6	2120.6			Average air voids a	actual, be	ads	NA	NA	15.16														
Dry wt.	4509.1	4499.7	4506.8	4506.5			Difference (back c	alculated-	actual)	-0.20	0.54	1.12									Avg. (beads and bucket)		32.01	kg		
G <sub>mb</sub>	2.170	2.184	2.180	2.125	Range																Avg. minus bucket wt.		23.30	kg		
G <sub>mb</sub> * CF	2.198	2.206	2.204	2.152	0.054																G <sub>mb</sub> of beads		1.655			
G <sub>mm</sub>	2.311	2.311	2.311	2.311																						
Air Voids (corr)	4.90	4.53	4.62	6.87	2.3																					
		Avg air v	/oids, corr	5.23																						
N <sub>ini</sub> dimensional	method																									
Ht @ Nini, mm	133.1	131.4	132.4	136.5																		-				
Area cm <sup>2</sup>	176.7	176.7	176.7	176.7																				-		
Volume, cm <sup>3</sup>	2352.1	2322.0	2339.7	2412.2																						
Dry wt.	4509.1	4499.7	4506.8	4506.5																						
G <sub>mb</sub>	1.917	1.938	1.926	1.868	Range																					
G <sub>mb</sub> * CF	1.942	1.958	1.948	1.892	0.066																					
Gmm	2.311	2.311	2.311	2.311																						
Air Voids (corr)	15.98	15.28	15.71	18.13	2.8																					
		Ava air v	, oids corr.	16.28	1																					

Calculatio	ns for	Mix 1	177A-1	2.5 LF	(Inclu	iding C	Outliers)																			
N SSD meth	od						N. SSD methor	ч						N - SSD metho	4						N Glass Beads tested b	v Bryon Cou	dev			
Somple ID		в	C	D	Pango		Sample ID		F	G	н	Pongo		Sample ID	-		K		Pango		Sample ID	y Diyan Can	10 1	K		-
Dry Wt	4538.5	v	4549.7	4546.1	11.2		Dry Wt	4554.7	4554.0	4546.5	4540.5	14.2	-	Dry Wt	4550.0	4545.8	4555.2	4547.7	9.4		Dample ID Dry Wt	4550.0	4545.8	4555.2	4547.7	-
W/t_In H <sub>2</sub> D	2544.9	0	2547.6	2537.4	11.2		Voit In Hall	2480.0	2531.8	2458.3	2470.9	14.4		W/t In H <sub>2</sub> D	2459.4	2456.9	2452.1	2452.3	0.4		W/t_nartial.wet	4594.8	4593.1	4601.1	4587.5	-
SSD W/t	4543.5	ī	4553.7	4551.1	1		SSD W/t	4570 Z	4558.8	4565.7	4553.4			SSD W/t	4736.3	4752.4	4735.4	4748.8			W/t w/ heads & hkt (1) kn	32.77	32.66	32.72	32.74	
Volume	1998.6	d	2006.1	2013.7	1	St. Dev.	Volume	2090.7	2027.0	2107.4	2082.5		St. Dev.	Volume	2276.9	2295.5	2283.3	2296.5		St. Dev.	Wt.w/ beads & bkt.(2) kg	32.74	32.69	32.74	32.70	
Gmb	2.271		2.268	2.258	0.013	0.007	Gmb	2.179	2.247	2.157	2.180	0.089	0.039	Gmb	1.998	1.980	1.995	1.980	0.018	0.010	Wt.w/ beads & bkt.(3) kg	32.77	32.68	32.73	32.71	
Gmm	2.322		2.322	2 322	1		Gmm	2.322	2.322	2.322	2.322			Gmm	2 322	2 322	2,322	2 322			Wt w/ heads & hkt (avo)	32.76	32.68	32.73	32.72	-
Air Voids	2.20		2.33	2.77	0.6		Air Voids	6.18	3.24	7.09	6.10	38		Air Voids	13.94	14.72	14.08	14.72	0.8		Bucket wt.	8.7041	8,7041	8.7041	8,7041	
		Ava air v	roids	2.44	1				Avg air v	roids	5.65					Avg air v	oids	14.36			Wt. of beads, q	19461.1	19379.5	19424.8	19425.1	
N <sub>max</sub> dimension	al method								Ŭ												Volume of beads, cm <sup>3</sup>	11810.8	11761.3	11788.8	11789.0	-
Ht @ N <sub>max</sub> , mm	114.8	v	115.2	115.9			Gmb, Nmax	Dens(pcf	) Ht, Nma	n Mass	Dens(pcf)										Pill vol = bkt vol - bead vol	2268.7	2318.2	2290.7	2290.5	Range
Area, cm <sup>2</sup>	176.7	0	176.7	176.7			2.271	141.7	114.8	4538.5	141.7										G <sub>mb</sub> pill	2.006	1.961	1.989	1.985	0.045
Volume, cm <sup>3</sup>	2028.7	1	2035.8	2048.1	1																Gmm	2.322	2.322	2.322	2.322	
Dry wt.	4538.5	d	4549.7	4546.1			2.268	141.5	115.2	4549.7	141.5										Air Voids	13.63	15.55	14.36	14.49	1.9
Gmb	2.237		2.235	2.220			2.258	140.9	115.9	4546.1	140.9												Avg air voids	3	14.51	1
Gmb corr. fact.	1.015		1.015	1.017																						
																					Bucket Wt. (Empty)		8.7041	kg		
N <sub>des</sub> dimensiona	al method						Summary, 177A	- 12.5 Lim	erock	Ndes		Vini	1								Bucket Volume		14079.5	cm <sup>3</sup>		
Ht @ Ndes, mm	117.2	v	117.5	118.2	1		Average air voids	, back cale	culated	4.37	15.65	15.65									Beads and Bucket		1	2	3	
Area, cm <sup>2</sup>	176.7	0	176.7	176.7			Average air voids	actual, SS	SD	5.65	14.36	NA											31.89	31.93	31.89	kg
Volume, cm <sup>3</sup>	2071.1	1	2076.4	2088.8	1		Average air voids	actual, be	ads	NA	NA	14.51														
Dry wt.	4538.5	d	4549.7	4546.1			Difference (back	calculated	-actual)	-1.28	1.29	1.14									Avg. (beads and bucket)		31.90	kg		
Gmb	2.191		2.191	2.176	Range																Avg. minus bucket wt.		23.20	kg		
Gmb * CF	2.224		2.224	2.214	0.011																G <sub>mb</sub> of beads		1.648			
Gmm	2.322		2.322	2.322																						
Air Voids (corr)	4.21		4.24	4.67	0.5																					
		Avg air v	oids, corr	4.37																						
																										_
								_		-							-									-
N <sub>ext</sub> dimensional	method																									
Ht @ N. mm	132.8	×.	133.6	133.7	1																					
Area cm <sup>2</sup>	176.7		176.7	176.7																						
Volume cm <sup>3</sup>	2346.8	i i	2360.9	2362.7	1																					
Dry wt.	4538.5	d	4549.7	4546.1																						
Gmb	1.934		1.927	1.924	Range																					
Gmh * CF	1.963		1.956	1.957	0.007																					
Gmm	2.322		2.322	2.322													-									
Air Voids (corr)	15.46		15.78	15.72	0.3																					-
		Avg air v	oids corr.	15.65																						

Calculatio	ons for	Mix '	178A-1	9.0 LF	t (inclu	uding C	Outliers)																			
N SSD moth	l .						N SSD mathed							N. SSD mathe							N Class Reads tosted b		nulou.			
Nmax 000 metr	100	0	-	0	Denne		Ndes 330 method	-	-	0		Dente		Nini SSD metric	10			-	Danas		Nini - Glass Deads tested b	y Dryan Ca	awiey	IZ.		
Dry Wt	A579.6	4572.1	4578.7	J681.6	Range	-	Dry Wit	4580.2	Г 4599.9	4583.1	4586.7	Range	-	Dry Wt	4598.3	J 4588.2	1591 /	1 1689.9	Range	-	Dry Wt	4588.3	4588.2	1591 A	1599.9	
Vit In H-0	2554.2	2531.0	2517.7	2532.8	0.0		With H-0	2/93.6	2624.6	2622.6	2615.9	0.0		With H-0	2/07/	2512.2	2504.1	1 2511.8	3.2		Wt. nortial wat	4500.5	4560.8	4652.0	4505.5	
SSD WA	2334.2 AEQN 7	4585.2	A595.0	AE07 E			SSD WA	4609.7	4609.7	4601.3	4610.5			SSD WA	1700 E	4837.2	4815.1	2311.0			Wt w/ hoode 8 bkt (1) kg	32.76	32.68	4032.0	32.70	
Volume	2036.5	2054.2	2077.3	2064.7		St. Dev.	Volume	2116.1	2085.1	2078.7	2094.6		St. Dev.	Volume	2293.1	2325.0	2311.1	1 2303.0		St. Dev.	Wt.w/ beads & bkt.(1) kg	32.70	32.68	32.72	32.70	
Gmb	2.249	2.226	2.204	2.219	0.045	0.019	Gmb	2.164	2.201	2.205	2.190	0.040	0.018	Gmb	2.001	1.973	1.987	1.993	0.027	0.012	Wt.w/ heads & bkt (3) kg	32.78	32.68	32.74	32.70	
Gee	2 341	2 341	2 341	2.341			Gene	2 341	2.341	2.341	2.341			Gen	2 341	2.341	2.341	2 341			Wt w/ heads & hkt (avo)	32.79	32.68	32.73	32.71	
Air Voids	3.94	4.92	5.85	5.21	1.9		Air Voids	7.54	5.99	5.82	6.46	1.7		Air Voids	14.53	15.70	15.14	14.87	1.2		Bucket wt.	8,7041	8,7041	8,7041	8,7041	
		Avg air	voids	4.98					Avg air v	oids	6.45					Avg air v	/oids	15.06			Wt. of beads, g	19437.3	19315.1	19370.6	19348.6	
N <sub>max</sub> dimension	al method	, Č														Ŭ					Volume of beads, cm <sup>3</sup>	11794.7	11720.6	11754.2	11740.9	
Ht @ N <sub>max</sub> , mm	117.0	118.1	119.6	119.2			Gmb, Nmax	Dens(pcf	) Ht, Nma	) Mass	Dens(pcf	)			_			_			Pill vol = bkt vol - bead vol	2284.8	2358.9	2325.3	2338.6	Range
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			2.249	140.3	117.0	4579.5	140.3										G <sub>mb</sub> pill	2.008	1.945	1.975	1.963	0.063
Volume, cm <sup>3</sup>	2067.6	2087.0	2113.5	2106.4			2.226	138.9	118.1	4572.1	138.9										Gmm	2.341	2.341	2.341	2.341	
Dry wt.	4579.5	4572.1	4578.7	4581.6			2.204	137.5	119.6	4578.7	137.5										Air Voids	14.22	16.91	15.65	16.16	2.7
Gmb	2.215	2.191	2.166	2.175			2.219	138.5	119.2	4581.6	138.5												Avg air voic	İs	15.74	
G <sub>mb</sub> corr. fact.	1.015	1.016	1.017	1.020																						
																					Bucket Wt. (Empty)		8.7041	kg		
N <sub>des</sub> dimension	al method						Summary, 178A -	19.0 Lim	erock	Ndes		Nini									Bucket Volume		14079.5	cm <sup>3</sup>		
Ht @ N <sub>des</sub> , mm	119.4	120.5	122.1	121.6			Average air voids,	back calo	culated	6.89	17.75	17.75									Beads and Bucket		1	2	3	
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			Average air voids	actual, SS	SD	6.45	15.06	NA											31.84	31.92	31.96	kg
Volume, cm <sup>3</sup>	2110.0	2129.4	2157.7	2148.8			Average air voids	actual, be	ads	NA	NA	15.74														
Dry wt.	4579.5	4572.1	4578.7	4581.6			Difference (back c	alculated-	-actual)	0.43	2.69	2.01									Avg. (beads and bucket)		31.91	kg		
Gmb	2.170	2.147	2.122	2.132	Range																Avg. minus bucket wt.		23.20	kg		
Gmb * CF	2.204	2.181	2.159	2.175	0.044																G <sub>mb</sub> of beads		1.648			
Gmm	2.341	2.341	2.341	2.341																						
Air Voids (corr)	5.87	6.82	7.77	7.08	1.9																					
		Avg air	voids, corr	6.89																						
			-						-											-						
			-																			-				
N <sub>ini</sub> dimensiona	l method																									
Ht @ N <sub>ini</sub> , mm	134.7	135.9	138.9	138.0																						
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7																						
Volume, cm <sup>3</sup>	2380.3	2401.6	2454.6	2438.7																						
Dry wt.	4579.5	4572.1	4578.7	4581.6																						
G <sub>mb</sub>	1.924	1.904	1.865	1.879	Range																					
G <sub>mb</sub> * CF	1.953	1.934	1.898	1.917	0.055																					
Gmm	2.341	2.341	2.341	2.341																						
Air Voids (corr)	16.56	17.38	18.93	18.12	2.4				-																1	
		Ave air	roids corr	17 75	1																					

Calculatio	ons for	Mix '	108A-9	.5 GR	(inclu	iding O	utliers)																			
N SSD moth	l .		-				N. COD mothod							N. COD mothe							N Class Reads tosted b	L. Cross Ch.	alar			-
Nmax 000 metr		0	-	D.	Denne		Ndes 330 method	-	5	0		Denes		Nini SSD metho			1/		Danas		Nini - Glass Deads tested b	y oney and	Jiar	IZ.	<u> </u>	-
Dry Wt	A 4993 5	E001.3	1007 A	1981.6	Range 19.8	-	Dry Wt	1978 G	Г /070 1	4975.1	1976 3	Range 4.0	-	Dry Wt	/078 Q	J 4977.4	1976 7	7 4976 3	Range	-	Dry Wt	/078 Q	J 4977.4	1976 7	1976 3	-
With In H-0	2938.4	2960.2	2958.1	4001.0 2054 6	15.0		W/t In H-0	1497 0.9	1497 3.1 10007 A	4970.1 2928.0	2930.5	4.0		With H-0	2808.5	2806.1	4570.7	7 2901.7	2.0		Wt. partial wat	4970.9	6030.7	4970.7	6005.4	
SCD 100	2530.4 4000.0	2900.2	4000.0	4002.0	-		PSD 184	4001.2	40921.4	4079.0	4070 E			SSD 116	2000.0	2000.1	2022.7 Engo r	2001.7			Wit. partial wet	2029.1	22.14	3020.0	0000.4 00 nc	
Volume	2058.2	2043.0	2041.7	2029.3		St. Dev	Volume	2053.1	2054.8	2050.2	2049.0		St. Dev	Volume	2254.2	2262.6	2216.2	2 2228.3		St. Dev	W/t w/ heads & hkt (2) kg	33.24	33.26	33.30	33.26	
G_s	2 426	2 448	2 448	2 455	0.029	0.012	G_k	2 425	2.423	2 427	2 429	0.005	0.002	G_b	2 209	2 200	2 246	2 233	0.046	0.021	W/t w/ heads & hkt (3) kg	33.26	33.24	33.32	33.20	
 	2.515	2.515	2.515	2.515			G	2.515	2.515	2.515	2.515			G	2.515	2.515	2.515	2.515			W/t w/ heads & hkt (avn)	33.25	33.25	33 31	33.24	-
 Air Voids	3.53	2.66	2.68	2.39	11		Air Voids	3.58	3.65	3.51	3.43	0.2		Air Voids	12.010	12.53	10.71	11.20	18		Bucket wt	8 7041	8 7041	8 7041	8 7041	
1 11 10100	0.00	Avg air	voids	2.82			THI TOIGO	0.00	Avg air y	roids	3.54	0.1		1 11 10100	12.10	Avg air y	roids	11.66	1.0		Wt. of beads. g	19520.1	19511.9	19576.1	19530.5	-
Nmax dimension	al method	1																			Volume of beads, cm <sup>3</sup>	11841.6	11836.6	11875.5	11847.9	
Ht @ Nmax, mm	118.0	117.1	117.1	116.4			Gmb, Nmax	Dens(pcf	) Ht. Nma	n Mass	Dens(pcf	)									Pill vol = bkt vol - bead vol	2237.9	2242.9	2204.0	2231.6	Range
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			2.426	151.4	118.0	4993.5	151.4										G <sub>mb</sub> pill	2.225	2.219	2.258	2.230	0.039
Volume, cm <sup>3</sup>	2085.2	2069.3	2069.3	2057.0			2.448	152.8	117.1	5001.3	152.8										Gmm	2.515	2.515	2.515	2.515	
Dry wt.	4993.5	5001.3	4997.4	4981.5			2.448	152.7	117.1	4997.4	152.7										Air Voids	11.54	11.76	10.22	11.34	1.5
G <sub>mb</sub>	2.395	2.417	2.415	2.422			2.455	153.2	116.4	4981.5	153.2												Avg air voic	ls	11.21	
Gmb corr. fact.	1.013	1.013	1.014	1.014																						1
																									-	
																					Bucket Wt. (Empty)		8.7041	kg		
N <sub>des</sub> dimension	al method						Summary, 108A -	9.5 Grani	ite	Ndes		Nini									Bucket Volume		14079.5	cm <sup>3</sup>		
Ht @ N <sub>des</sub> , mm	119.7	118.7	118.6	117.9			Average air voids,	back calo	culated	4.11	13.26	13.26									Beads and Bucket		1	2	3	
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			Average air voids	actual, SS	SD	3.54	11.66	NA											31.86	31.94	31.94	kg
Volume, cm <sup>3</sup>	2115.3	2097.6	2095.8	2083.5			Average air voids	actual, be	ads	NA	NA	11.21														
Dry wt.	4993.5	5001.3	4997.4	4981.5			Difference (back c	alculated-	actual)	0.56	1.60	2.04									Avg. (beads and bucket)		31.91	kg		
Gmb	2.361	2.384	2.384	2.391	Range																Avg. minus bucket wt.		23.21	kg		
G <sub>mb</sub> * CF	2.392	2.415	2.417	2.424	0.032																G <sub>mb</sub> of beads		1.648			
Gmm	2.515	2.515	2.515	2.515																						
Air Voids (corr)	4.90	3.98	3.91	3.64	1.3																					
		Avg air	voids, corr	4.11																						
N <sub>ini</sub> dimensiona	l method																								-	-
Ht @ Ne: mm	132.3	131.3	131.1	130.3																					-	
Area cm <sup>2</sup>	176.7	176.7	176.7	176.7											-											
Volume cm <sup>3</sup>	2337.9	2320.3	2316.7	2302.6																						
Dry wt.	4993.5	5001.3	4997.4	4981.5																					-	
Gmb	2.136	2.155	2.157	2.163	Range																					
Gmb * CF	2.164	2.183	2.186	2.193	0.029																					
Gmm	2.515	2.515	2.515	2.515	1			-	-						-		-			-						
Air Voids (corr)	13.96	13.19	13.07	12.81	1.2																				-	-
		Avg air	voids corr	13.26						-												(	-		+	+

Calculatio	ons for	r Mix 7	71A-12	2.5 GR	(inclu	ding O	utliers)																			
Nmax SSD meth	ax SSD method Ness SSD method Sample ID											Nini SSD metho	ıd						Nini - Glass Beads tested b	v Mike Ber	kowitz					
Sample ID	A	В	C	D	Range		Sample ID	F	F	G	н	Range		Sample ID		1	K		Range		Sample ID			K		1
Dry Wt.	5004.7	4998.0	5002.6	5009.6	11.6		Dry Wt.	5005.7	5009.5	5010.0	5003.8	6.2		Dry Wt.	5006.7	5011.4	5010.6	5 5005.8	5.6		Dry Wt.	5006.7	5011.4	5010.6	5005.8	-
Wt. In H <sub>2</sub> O	2978.2	2934.4	2967.3	2976.8			Wt. In H <sub>2</sub> 0	2907.8	2962.8	2958.0	2925.1			Wt. In H <sub>2</sub> O	2921.6	2916.9	2918.3	7 2923.6			Wt. partial wet	5062.8	5069.4	5065.0	5072.4	
SSD Wt.	5011.8	5008.3	5010.1	5017.1			SSD Wt.	5029.8	5022.2	5022.3	5018.6			SSD Wt.	5172.1	5165.3	5165.1	5192.8			Wt.w/ beads & bkt.(1) kg	33.18	33.24	33.22	33.24	
Volume	2033.6	2073.9	2042.8	2040.3		St. Dev.	Volume	2122.0	2059.4	2064.3	2093.5		St. Dev.	Volume	2250.5	2248.4	2246.4	1 2269.2		St. Dev.	Wt.w/ beads & bkt.(2) kg	33.26	33.26	33.22	33.24	
G <sub>mb</sub>	2.461	2.410	2.449	2.455	0.051	0.023	Gmb	2.359	2.433	2.427	2.390	0.074	0.034	Gmb	2.225	2.229	2.231	2.206	0.025	0.011	Wt.w/ beads & bkt.(3) kg	33.26	33.24	33.20	33.24	
Gmm	2.549	2.549	2.549	2.549			Gmm	2.549	2.549	2.549	2.549			Gmm	2.549	2.549	2.549	2.549			Wt.w/ beads & bkt.(avg)	33.23	33.25	33.21	33.24	
Air Voids	3.45	5.45	3.93	3.67	2.0		Air Voids	7.46	4.57	4.79	6.23	2.9		Air Voids	12.72	12.56	12.50	13.46	1.0		Bucket wt.	8.7041	8.7041	8.7041	8.7041	
		Avg air v	/oids	4.13					Avg air v	oids	5.76					Avg air v	/oids	12.81			Wt. of beads, g	19466.4	19473.2	19444.2	19463.5	
N <sub>max</sub> dimension	al method	1																			Volume of beads, cm <sup>3</sup>	11819.2	11823.3	11805.7	11817.4	
Ht @ N <sub>max</sub> , mm	117.8	120.1	118.4	118.1			Gmb, Nmax	Dens(pcf	) Ht, Nma	Mass	Dens(pcf)										Pill vol = bkt vol - bead vol	2260.3	2256.2	2273.8	2262.1	Range
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			2.461	153.6	117.8	5004.7	153.6										G <sub>mb</sub> pill	2.215	2.221	2.204	2.213	0.018
Volume, cm <sup>3</sup>	2081.7	2122.3	2092.3	2087.0			2.410	150.4	120.1	4998.0	150.4										Gmm	2.549	2.549	2.549	2.549	
Dry wt.	5004.7	4998.0	5002.6	5009.6			2.449	152.8	118.4	5002.6	152.8										Air Voids	13.10	12.86	13.55	13.19	0.7
Gmh	2.404	2.355	2.391	2.400			2.455	153.2	118.1	5009.6	153.2												Avg air void	s	13.17	1
Gmb corr. fact.	1.024	1.023	1.024	1.023																			5			
- 110	1.021	1.020	1.021	1.020																						
																					Bucket Wt. (Empty)		8.7041	kg		
N <sub>des</sub> dimensiona	al method						Summary, 71A - 1	12.5 Grani	ite	Ndes	1	Vini									Bucket Volume		14079.5	cm <sup>3</sup>		
Ht @ Ndeg, mm	119.6	121.9	120.3	119.9			Average air voids.	back calo	culated	5.58	15.37	15.37									Beads and Bucket		1	2	3	
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			Average air voids	actual, SS	SD	5.76	12.81	NA											31.88	31.90	31.90	kq
Volume, cm <sup>3</sup>	2113.5	2154.2	2125.9	2118.8			Average air voids	actual, be	ads	NA	NA	13.17														- C
Dry wt.	5004.7	4998.0	5002.6	5009.6			Difference (back o	alculated-	actual)	-0.18	2.56	2.19									Avg. (beads and bucket)		31.89	kg		
Gmh	2.368	2.320	2.353	2.364	Range																Avg. minus bucket wt.		23.19	kq		
Gmb * CF	2.424	2.374	2.410	2.418	0.050																Gmb of beads		1.647	Ů		
Gmm	2.549	2.549	2.549	2.549																						
Air Voids (corr)	4.91	6.85	5.44	5.12	1.9																					
		Avg air v	/oids, com	5.58	1																					
		, in the second																								
N. disconsistent	l un adde a d																									
IN <sub>ini</sub> dimensional	i metnoa		-																							
Ht @ N <sub>ini</sub> , mm	133.3	135.7	134.4	134.0																						
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7																						
Volume, cm <sup>3</sup>	2355.6	2398.0	2375.0	2368.0																						
Ury wt.	5004.7	4998.0	5002.6	5009.6	_													_								
Gmb	2.125	2.084	2.106	2.116	Range	-			-	-					_			_	-							
G <sub>mb</sub> * CF	2.175	2.133	2.157	2.164	0.042																					
G <sub>mm</sub>	2.549	2.549	2.549	2.549																						
Air Voids (corr)	14.68	16.32	15.36	15.10	1.6					ļ																
		Avg air v	/oids, corr	15.37	1																					

Calculatio	ns for	Mix 1	17B-19	.0 GR	(Inclu	ding O	utliers)																			
N SSD meth	od						New SSD method							Net SSD method							No Glass Beads tested k	w Bryan (	owley			
Sample ID	Δ	в	L C	D	Range		Sample ID	E	F	G	н	Range		Sample ID			K	1	Range		Samula ID		1	ĸ	1	(
Dry Wt	4868.9	4861.8	4885.6	4880.3	23.8		Dry Wit	4886.1	4888.6	4874.3	4878.3	14.3		Dry Wt	4869.2	4885.0	4891.3	4878.8	22.1		Dry W/t	4869.2	4885.0	4891.3	4878.8	L
Wt In H <sub>2</sub> O	2897.3	2881.5	2901.1	2896.1	20.0		Wt In H₀0	2871.7	2895.3	2877.6	2875.3	1		Wt In H <sub>2</sub> 0	2831.9	2828.7	2835.6	2833.9			Wt_partial wet	4886.5	4899.0	4905.8	4891.3	
SSD Wt	4875.6	4868.9	4895.4	4891.6	1		SSD Wr	4902.0	4901.5	4887.9	4893.6			SSD W/t	4961.2	4965.9	4976.8	4963.4			W/t w/ heads & hkt (1) kg	33.26	33.30	33.30	33.24	
Volume	1978.3	1987.4	1994.3	1995.5		St. Dev.	Volume	2030.3	2006.2	2010.3	2018.3		St. Dev.	Volume	2129.3	2137.2	2141.2	2129.5		St. Dev.	Wt.w/ beads & bkt.(2) kg	33.26	33.28	33.28	33.18	
Gmb	2.461	2.446	2.450	2.446	0.016	0.007	Gmb	2.407	2.437	2.425	2.417	0.030	0.013	Gmb	2.287	2.286	2.284	2.291	0.007	0.003	Wt.w/ beads & bkt.(3) kg	33.22	33.32	33.30	33.24	
Gmm	2.525	2.525	2.525	2.525			Gmm	2.525	2.525	2.525	2.525			Gmm	2.525	2.525	2.525	2.525			Wt.w/ beads & bkt.(avg)	33.25	33.30	33.29	33.22	
Air Voids	2.53	3.12	2.98	3.14	0.6		Air Voids	4.69	3.50	3.97	4.28	1.2		Air Voids	9.44	9.48	9.53	9.27	0.3		Bucket wt.	8.7041	8.7041	8.7041	8.7041	
		Avg air v	oids	2.94					Avg air v	oids	4.11					Avg air v	voids	9.43			Wt. of beads, g	19656.1	19696.9	19683.4	19624.6	
N <sub>max</sub> dimension	al method	Ť																			Volume of beads, cm <sup>3</sup>	11917.2	11941.9	11933.8	11898.1	
Ht @ N <sub>max</sub> , mm	116.7	116.7	118.1	119.3			Gmb, Nmax	Dens(pcf	) Ht, Nma	Mass	Dens(pcf	)									Pill vol = bkt vol - bead vol	2162.3	2137.6	2145.7	2181.4	Range
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			2.461	153.6	116.7	4868.9	153.6										G <sub>mb</sub> pill	2.252	2.285	2.280	2.237	0.049
Volume, cm <sup>3</sup>	2062.3	2062.3	2087.0	2108.2			2.446	152.6	116.7	4861.8	152.6										Gmm	2.525	2.525	2.525	2.525	
Dry wt.	4868.9	4861.8	4885.6	4880.3			2.450	152.9	118.1	4885.6	152.9										Air Voids	10.82	9.49	9.72	11.42	1.9
Gmb	2.361	2.358	2.341	2.315			2.446	152.6	119.3	4880.3	152.6												Ava air v	oids	10.36	
Gmb corr. fact.	1 042	1.038	1.046	1.056	1																		5			
- 110																										
																					Bucket Wt. (Empty)		8.7041	kq		
N <sub>des</sub> dimensiona	l method						Summary, 17B - 1	9.0 Grani	te	Ndes		Nini									Bucket Volume		14079.5	cm <sup>3</sup>		
Ht @ N <sub>des</sub> , mm	118.3	118.4	119.7	120.9			Average air voids,	back calo	ulated	4.26	13.68	13.68									Beads and Bucket		1	2	3	
Area, cm <sup>2</sup>	176.7	176.7	176.7	176.7			Average air voids a	actual, SS	SD	4.11	9.43	NA											31.92	31.94	31.92	kg
Volume, cm <sup>3</sup>	2090.5	2092.3	2115.3	2136.5			Average air voids a	actual, be	ads	NA	NA	10.36														
Dry wt.	4868.9	4861.8	4885.6	4880.3			Difference (back c	alculated-	actual)	0.16	4.26	3.32									Avg. (beads and bucket)		31.93	kg		
G <sub>mb</sub>	2.329	2.324	2.310	2.284	Range																Avg. minus bucket wt.		23.22	kg		
G <sub>mb</sub> * CF	2.428	2.411	2.417	2.413	0.017																G <sub>mb</sub> of beads		1.649			
G <sub>mm</sub>	2.525	2.525	2.525	2.525																						
Air Voids (corr)	3.85	4.51	4.28	4.42	0.7																					
		Avg air v	oids, corr	4.26																						
N <sub>ini</sub> dimensional	method																									
Ht @ N <sub>w</sub> : mm	130.8	132.0	132.6	134.0																						
Area cm <sup>2</sup>	176.7	176.7	176.7	176.7																						
Volume cm <sup>3</sup>	2311.4	2332.6	2343.2	2368.0																						
Dry wt.	4868.9	4861.8	4885.6	4880.3																						
Gmb	2.106	2.084	2.085	2.061	Range																					
Gmb * CF	2.196	2.163	2.182	2.177	0.033	1																				
Gmm	2.525	2.525	2.525	2.525	1												-									
Air Voids (corr)	13.04	14.35	13.59	13.77	1.3																					
		Avg air v	oids corr.	13.68	1																					

Lab         Scorethol         Na         Box         Na         Scorethol         Na         Na <th>Calculatio</th> <th>ons fo</th> <th>r Mix '</th> <th>176A-9</th> <th>.5 LR</th> <th>(Excludi</th> <th>ing Outliers)</th> <th></th>	Calculatio	ons fo	r Mix '	176A-9	.5 LR	(Excludi	ing Outliers)																	
Number of the server	N SSD moth	ad .					N. SSD method						N., SSD mother						N. Close Reade tested I	u Brian C	oulou			
Dr. Yie         Bits         Dr. Yie         Add 2	Nmax 000 metr	100	0	-	0	Danas	Ndes 33D method	-		-		Denne	Nini SSD method			L K		Danas	Nini - Glass Deaus testeu i	J Dhan C	amey			
Nr. 16.9         4806         2001         2002         2005         2007         100         Wh pails wet         4807         5 4805         4807 <td>Sample ID</td> <td>A500.1</td> <td>4400.7</td> <td></td> <td>U</td> <td>Range</td> <td>Sample ID</td> <td>4502.7</td> <td></td> <td>4501.7</td> <td>4500.0</td> <td>Range</td> <td>Sample ID</td> <td>4510.0</td> <td>J 4500.1</td> <td>4500.0</td> <td>451G 4</td> <td>Range</td> <td>Day 184</td> <td>4510.0</td> <td>J 4500.1</td> <td>4509.0</td> <td>AE1G A</td> <td>1</td>	Sample ID	A500.1	4400.7		U	Range	Sample ID	4502.7		4501.7	4500.0	Range	Sample ID	4510.0	J 4500.1	4500.0	451G 4	Range	Day 184	4510.0	J 4500.1	4509.0	AE1G A	1
SSUM         45/3         40/3 <th< td=""><td>Wit In Hall</td><td>2/99.8</td><td>2501.6</td><td>2502.7</td><td></td><td>0.4</td><td>Wt In Hall</td><td>2440.4</td><td>2446.4</td><td>2460.9</td><td>2454.2</td><td>0.5</td><td>Wt In H<sub>2</sub>O</td><td>2380.2</td><td>2396.5</td><td>2389.7</td><td>2392.1</td><td>14.5</td><td>W/t_nartial.wet</td><td>4510.2</td><td>4556.5</td><td>4565.2</td><td>4575.4</td><td></td></th<>	Wit In Hall	2/99.8	2501.6	2502.7		0.4	Wt In Hall	2440.4	2446.4	2460.9	2454.2	0.5	Wt In H <sub>2</sub> O	2380.2	2396.5	2389.7	2392.1	14.5	W/t_nartial.wet	4510.2	4556.5	4565.2	4575.4	
Water         2014         2010         2026 <t< td=""><td>SSD WA</td><td>4513.2</td><td>4502.6</td><td>4508.8</td><td></td><td></td><td>SSD WA</td><td>4514.3</td><td>4512.3</td><td>4508.9</td><td>4508.5</td><td></td><td>SSD W4</td><td>4679.2</td><td>4707 A</td><td>/681.1</td><td>4733.4</td><td></td><td>Wit w/ heads 2 bkt (1) kg</td><td>32.80</td><td>32.70</td><td>32.84</td><td>32.76</td><td></td></t<>	SSD WA	4513.2	4502.6	4508.8			SSD WA	4514.3	4512.3	4508.9	4508.5		SSD W4	4679.2	4707 A	/681.1	4733.4		Wit w/ heads 2 bkt (1) kg	32.80	32.70	32.84	32.76	
Solution	Volume	2013.4	2001.0	2006.0			Volume	2073.9	2065.9	2048.0	2054.3		Volume	2299.0	2330.9	2291.4	2341.3		Wt w/ heads & hkt (2) kg	32.80	32.70	32.80	32.70	
Org         2311	Gmb	2.240	2.249	2.247		0.009	Gmb	2.172	2.181	2.198	2.191	0.026	Gmb	1.962	1.931	1.967	1.929	0.038	Wt.w/ beads & bkt.(3) kg	32.80	32.70	32.82	32.68	
Arr Yords         3.09         2.09         2.79         0.4         Arr Yords         5.01         5.11         Arr Yords         15.2         1.27         Backet weither         1002         1.11         Arr Yords         15.2         1.287         15.2         1.27         Mage arrowsite         1002         1.11         Arr Yords         15.2         1.287         1.11         Arr Yords         15.2         1.27         Mage arrowsite         1.1002         1.11         Arr Yords         15.2         1.27         Mage arrowsite         1002         1.11         Arr Yords         5.21         Arr Yords         15.2         1.27         Normality         1002         1.112         1.11         Arr Yords         1.11         Arr Yords         15.2         1.27         Normality         1002         1.112         1.11         Arr Yords         1.11	Gmm	2.311	2.311	2.311			Gene	2.311	2.311	2.311	2.311		Gam	2.311	2.311	2.311	2.311		Wt w/ heads & hkt (avg)	32.80	32.71	32.82	32.73	-
Areg         Areg <th< td=""><td>Air Voids</td><td>3.09</td><td>2.69</td><td>2.79</td><td></td><td>0.4</td><td>Air Vnids</td><td>6.03</td><td>5.61</td><td>4 89</td><td>5.21</td><td>11</td><td>Air Vnids</td><td>15.11</td><td>16.42</td><td>14.87</td><td>16.53</td><td>17</td><td>Bucket wt</td><td>8 7041</td><td>8 7041</td><td>8 7041</td><td>8 7041</td><td></td></th<>	Air Voids	3.09	2.69	2.79		0.4	Air Vnids	6.03	5.61	4 89	5.21	11	Air Vnids	15.11	16.42	14.87	16.53	17	Bucket wt	8 7041	8 7041	8 7041	8 7041	
Hay demonstrated         Image: Normal Probability         Image: Norm			Avg air v	/oids	2.86				Avg air	voids	5.43				Avg air	voids	15.73		Wt. of beads, g	19538.4	19446.1	19550.7	19447.2	-
If B       If A	N <sub>max</sub> dimension	al metho	d												0				Volume of beads, cm <sup>3</sup>	11805.2	11749.4	11812.6	11750.1	
Average air volds         1397         115.4         1997         140.3         114.4         44997         140.3         140.4         14997         140.3         140.4         14097         140.3         140.4         140.2         140.3         160.6         0.057         0.057         0.057         0.057         0.057         0.057         0.057	Ht @ Nmax, mm	115.4	114.4	114.8			Gmb. Nmax	Dens(pcf)	Ht. Nmax	Mass	Dens(pcf)	1							Pill vol = bkt vol - bead vol	2274.3	2330.1	2266.9	2329.4	Range
Volume         Volume<	Area, cm <sup>2</sup>	176.7	176.7	176.7			2.240	139.7	115.4	4509.1	139.7	<u></u>							G-t pill	1 983	1 932	1 989	1 939	0.056
Dry st.         26901         46907         46903         1419         16.30         1396         1610         24           Own         2111         2120         2220         2220         2220         2220         2220         2220         2220         2220         2220         2200 <t< td=""><td>Volume cm<sup>3</sup></td><td>2039.3</td><td>2021.6</td><td>2028.7</td><td></td><td></td><td>2.2.10</td><td>140.3</td><td>114.4</td><td>1000.1</td><td>1/0.3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>G</td><td>2 311</td><td>2 311</td><td>2 311</td><td>2 311</td><td>0.000</td></t<>	Volume cm <sup>3</sup>	2039.3	2021.6	2028.7			2.2.10	140.3	114.4	1000.1	1/0.3								G	2 311	2 311	2 311	2 311	0.000
Com         Column         Com         Find         Find <th< td=""><td>Dry wt</td><td>4509.1</td><td>4499.7</td><td>4506.8</td><td></td><td></td><td>2.240</td><td>140.0</td><td>114.4</td><td>4506.8</td><td>140.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Air Voids</td><td>14 19</td><td>16 39</td><td>13.95</td><td>16.10</td><td>24</td></th<>	Dry wt	4509.1	4499.7	4506.8			2.240	140.0	114.4	4506.8	140.0								Air Voids	14 19	16 39	13.95	16.10	24
One Conf. Incl.         1.013         1.010         1.011	Gent	2 211	2 226	2 222			2.2.11	140.2	114.0	1000.0	1-10.2									11.10	Avg air y	nide	15.16	2.4
Some         Lord         Lord <thlord< th="">         Lord         Lord         <thl< td=""><td>G : corr. fact</td><td>1.012</td><td>1.010</td><td>1.011</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>/ wg un v</td><td></td><td>10.10</td><td></td></thl<></thlord<>	G : corr. fact	1.012	1.010	1.011																	/ wg un v		10.10	
New dimensional method         Normany, 178A, 95 Line Columber         New dimensional method         Bucket Wolk, (Empty)         B,734         Ng           Area ga invisional method         1767	Omp cont lact.	1.013	1.010	1.011																				
New dimensional method         v         v         Summary, 175A - 9 5 Linerock         New         New         Bucket Volume         Bucket Volume         14079 5 cm <sup>2</sup> v           H® (New, rm)         1767         17																			Bucket Wt. (Empty)		8 7041	ka		
Image: number of the sector of the	New dimension:	al method	1				Summary, 176A -	9.5 Lime	rock	Nder		Net							Bucket Volume		14079.5	cm <sup>3</sup>		-
Mage and	Ht@N. mm	117.6	116.6	117.0			Averane air voide	back cal	hatelus	4.68	15.66	15.66							Beads and Bucket		1	2	3	
Notive         Note         <	Area cm <sup>2</sup>	176.7	176.7	176.7			Average air voids,	actual S9		5.43	15.00	NA							Deads and Dacket		32.02	32.02	31.98	ka
Abs://       Abs:// <th< td=""><td>Volume cm<sup>3</sup></td><td>2078.2</td><td>2060.5</td><td>2067.6</td><td></td><td></td><td>Average air voids</td><td>actual, oc actual he</td><td>ohe</td><td>NA</td><td>NA NA</td><td>15.16</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>32.02</td><td>52.02</td><td>51.50</td><td>Ng</td></th<>	Volume cm <sup>3</sup>	2078.2	2060.5	2067.6			Average air voids	actual, oc actual he	ohe	NA	NA NA	15.16									32.02	52.02	51.50	Ng
Ome         2.170         2.184         2.180         Range         Avg. minus bucket wi.         2.330         kg           Gms         2.311	Drv wt.	4509.1	4499.7	4506.8			Difference (back o	alculated	-actual)	-0.75	-0.07	0.50							Avg. (beads and bucket)		32.01	ka		
Image         Image <th< td=""><td>Gmb</td><td>2 170</td><td>2 184</td><td>2 180</td><td></td><td>Range</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Ava minus bucket wt</td><td></td><td>23.30</td><td>ka</td><td></td><td></td></th<>	Gmb	2 170	2 184	2 180		Range													Ava minus bucket wt		23.30	ka		
Origon of Linds       Linds <thlinds< th="">       Linds       <thlinds< th=""></thlinds<></thlinds<>	G_1 * CE	2 198	2 206	2 204		0.009													G_, of heads		1.655			
Arr Voids (corr)       4.501 <td>G</td> <td>2.100</td> <td>2.200</td> <td>2.204</td> <td></td> <td>0.000</td> <td></td> <td>Omp of beddes</td> <td></td> <td>1.000</td> <td></td> <td></td> <td></td>	G	2.100	2.200	2.204		0.000													Omp of beddes		1.000			
Avg air volds, com       4.68       0.01       0	Air Voids (corr)	4 90	4.53	4.62		0.4																		
Null dimensional method       Image: Null dimensional method <t< td=""><td>1 11 10100 (0011)</td><td>1.00</td><td>Avg air y</td><td>/oids.corr</td><td>4.68</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td></t<>	1 11 10100 (0011)	1.00	Avg air y	/oids.corr	4.68																			-
Image: Note of the state o																								
Num       131       131.4       132.4       C <thc< th="">       C       <thc< th="">       C       <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<></thc<></thc<>																								
Nu dimensional method       Nu dimensional me			_						_	_														
Implementation     Implementatio	N. dimensione	Incethod																						
Ht @ Nai. mi     131.4     132.4 <td>N<sub>ini</sub> dimensiona</td> <td>method</td> <td></td> <td>100.1</td> <td></td> <td>-</td> <td></td>	N <sub>ini</sub> dimensiona	method		100.1		-																		
Area cm*       1/b/1	Ht @ Nini, mm	133.1	131.4	132.4																				
Volume_cm*         232.0         2339.7         Composition         Compo	Area, cm*	1/6./	1/6./	1/6./																				
Orgen     1917     1938     1926     Range       Gmb     1917     1938     1926     Range       Gmb     2.311     2.311     2.311       Air Voids (corr)     15.28     15.71     0.7	Volume, cm°	2352.1	2322.0	2539.7																				
Sime         1300 <th< td=""><td>G .</td><td>1 917</td><td>1 939.7</td><td>1 926</td><td></td><td>Range</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>	G .	1 917	1 939.7	1 926		Range																		
Orm         1.342         1.342         1.344         1		1.917	1.050	1.949				-	-	-					-									-
Orm         Z.311         Z.311         Z.311         Common and the state of the state o		1.342	1.500	1.340		0.010														'				
	Air Voide (corr)	2.311	15.29	15.71		0.7																		
	7 si volus (coll)	13.50	Avg air v	/oids corr	15.66	0.7																		

Calculatio	ns foi	r Mix	177A-1	2.5 LF	R (Excludin	ng Outliers)																	
N SSD meth	od					N. SSD method						N., SSD method						N Glace Beade tected I	av Bryan (	`owlov			
Sample ID	00 A	в		D	Panga	Somple ID	E	F	G	н	Pango	Somela ID			K		Pango	Somple ID	Ty Diyan C	amey		$\square$	-
Dry Wt	4538.5	v v	4549.7	4546.1	11.2	Dry Wt	4554.7	<u> </u>	4546.5	4540.5	14.2	Dry Wt	4550.0	4545.8	4555.2	4547.7	G A	Dry Wt	4550.0	4545.8	4555.2	4547.7	
With In H-O	2544.9		2547.6	2537.4	11.2	W/t_In H <sub>2</sub> 0	2480.0		2458.3	2470.9	14.2	W/t_In H <sub>0</sub> 0	2459.4	2456.9	2452.1	2452.3	0.4	Wt nartial wet	4594.8	4593.1	4601.1	4597.5	
SSD Wt	4543.5	Ť	4553.7	4551.1		SSD Wt	4570.7		4565.7	4553.4		SSD W/t	4736.3	4752.4	4735.4	4748.8		W/t w/ heads & hkt (1) kg	32.77	32.66	32.72	32.74	
Volume	1998.6	d	2006.1	2013.7		Volume	2090.7		2107.4	2082.5		Volume	2276.9	2295.5	2283.3	2296.5		Wt.w/ beads & bkt.(2) kg	32.74	32.69	32.74	32.70	
Gmh	2.271		2.268	2.258	0.013	Gmh	2.179		2.157	2.180	0.023	Gmh	1.998	1.980	1.995	1.980	0.018	Wt.w/ beads & bkt.(3) kg	32.77	32.68	32.73	32.71	
Gmm	2.322		2.322	2.322		Gmm	2.322		2.322	2.322		Gmm	2.322	2.322	2.322	2.322		Wt.w/ beads & bkt.(avg)	32.76	32.68	32.73	32.72	
Air Voids	2.20		2.33	2.77	0.6	Air Voids	6.18		7.09	6.10	1.0	Air Voids	13.94	14.72	14.08	14.72	0.8	Bucket wt.	8,7041	8,7041	8,7041	8.7041	
		Avg air	voids	2.44				Avg air	voids	6.46				Avg air v	voids	14.36		Wt. of beads, g	19461.1	19379.5	5 19424.8	19425.1	
N <sub>max</sub> dimension	al method	4																Volume of beads, cm <sup>3</sup>	11810.8	11761.3	11788.8	11789.0	
Ht @ Nmax, mm	114.8	v	115.2	115.9		Gmb. Nmax	Dens(pcf	Ht. Nm	a: Mass	Dens(pct	ĥ							Pill vol = bkt vol - bead vol	2268.7	2318.2	2290.7	2290.5	Range
Area, cm <sup>2</sup>	176.7	0	176.7	176.7		2 271	141.7	114.8	4538.5	141.7								G-s nill	2.006	1 961	1 989	1 985	0.045
Volume cm <sup>3</sup>	2020 2	1	2025.0	20.49.1		2.211	141.1	114.0	4000.0	141.1								Omb pin	2.000	1.001	1.000	1.000	0.045
Dry wt	4538.5	d	4549.7	4546.1		2,268	141.5	115.2	1519.7	141.5								Omm Air Voide	13.63	2.JZZ 15.55	14.36	1/ /9	19
DI WIL	4000.0		1 105	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		2.200	141.0	115.2	4345.7 AEAE 1	141.0								Air voids	13.03	Aug oir u		14.45	1.5
O comp	2.2JI		2.233	2.220		2.200	140.5	110.5	4040.1	140.5									-	Avy all v	Ulus	14.01	1
Gmb corr. tact.	1.015	L	1.015	1.017																			
																		Pueliet )#(t. (Emptu)		0 7041	ka		
NI disconcione	ار معاقد معا					0 477.0	42.511.00		NI									Bucket Wi. (Empty)		0.7041	ry cm <sup>3</sup>		
Ndes dimensiona	ii metriou		_			Summary, 177A -	12.5 LIM	erock	Ndes		Nini							Bucket volume		14079.5	- CIII		
Ht @ N <sub>des</sub> , mm	117.2	V	117.5	118.2		Average air voids,	back calo	culated	4.37	15.65	15.65							Beads and Bucket		1	2	3	
Area, cm <sup>2</sup>	176.7	0	176.7	176.7		Average air voids :	actual, SS	SD	6.46	14.36	NA									31.89	31.93	31.89	kg
Volume, cm <sup>3</sup>	2071.1	1	2076.4	2088.8		Average air voids :	actual, be	ads	NA	NA	14.51												
Dry wt.	4538.5	d	4549.7	4546.1		Difference (back c	alculated	actual)	-2.09	1.29	1.14							Avg. (beads and bucket)		31.90	kg		
Gmb	2.191		2.191	2.176	Range													Avg. minus bucket wt.		23.20	kg		
G <sub>mb</sub> * CF	2.224		2.224	2.214	0.011													G <sub>mb</sub> of beads		1.648			
G <sub>mm</sub>	2.322		2.322	2.322																			
Air Voids (corr)	4.21		4.24	4.67	0.5																		
		Avg air	voids, corr	4.37																			
N <sub>ini</sub> dimensional	method																				-		
Ht @ N mm	132.8		133.6	133.7																	+		
Area are <sup>2</sup>	176.7		176.7	176.7											-				-				
Volumo om <sup>3</sup>	170.7	1	170.7	170.7																			
Drv wt	4538.5	h	4549.7	4546.1																	+	<u> </u>	
Gmb	1.934		1.927	1.924	Range										-						-		
G_1 * CE	1.963	-	1.956	1.957															++		+	<u> </u>	
G	2 322	-	2 332	2 322	0.007														+ +		+		
Air Voide (corr)	2.32Z		15.79	15.72	03																+	<u> </u>	
Al Yolus (COII)	10.40	Ava air	voide corr	15.65	0.3														+		+	<u> </u>	
		p mg an	, siga coll.	L 10.00							1				1								

Number         Number<	Calculatio	ons fo	r Mix 1	78A-1	9.0 LF	(Excludi	ng Outliers)																
Name         Name <th< th=""><th>N SSD meth</th><th>hod</th><th></th><th></th><th></th><th></th><th>New SSD method</th><th></th><th></th><th></th><th></th><th></th><th>Net SSD method</th><th></th><th></th><th></th><th></th><th></th><th>Net - Glass Beads tested by Bryan</th><th>Cawley</th><th></th><th></th><th></th></th<>	N SSD meth	hod					New SSD method						Net SSD method						Net - Glass Beads tested by Bryan	Cawley			
Dry W         6         4521         4532         4532         4532         4532         4532         207         Dry W         4682         4683         4	Sample ID	100 A	в	C .	D	Panga	Sample ID	E	F	G	н	Pango	Sample ID			K	-	Pango	Sample ID		K	1	
With right         2310         2377         2328         2377         2328         2377         2328         2377         2328         2377         2328         2377         2328         2377         2328         2377         2328         2377         2328         2377         2328         2377         2387         2377         2387         2377         2387         2377         2387         2377         2377         2387         2377         2378         2377         2378         2377         2378         2377         2378         2377         2378         2377         2378         2377         2378         2377         2378         2377         2371         2388         2377         2371         2388         2378         2377         2371         2388         2378	Dry Wt	0	4572.1	4578.7	4581.6	95	Dry Wt		4588.8	4583.1	4586.7	5.7	Dry Wt	4588.3	4588.2	4591.4	4589.9	3.2	Dry Wt	4588.2	4591.4	4589.9	L
SSD Vit         4862         6873	Wt In H <sub>2</sub> 0		2531.0	2517.7	2532.8	0.0	Wt In H <sub>2</sub> D		2524.6	2522.6	2515.9	0.1	Wt In H <sub>2</sub> 0	2497.4	2512.2	2504.1	2511.8	0.2	Wt nartial wet	4660.8	4652.0	4654.0	
Volume         20051         2005         20011         20001         20011 <t< td=""><td>SSD Wt.</td><td></td><td>4585.2</td><td>4595.0</td><td>4597.5</td><td></td><td>SSD Wt.</td><td></td><td>4609.7</td><td>4601.3</td><td>4610.5</td><td></td><td>SSD Wt</td><td>4790.5</td><td>4837.2</td><td>4815.2</td><td>4814.8</td><td></td><td>Wt w/ heads &amp; hkt (1) kg</td><td>32.68</td><td>32.72</td><td>32.70</td><td>-</td></t<>	SSD Wt.		4585.2	4595.0	4597.5		SSD Wt.		4609.7	4601.3	4610.5		SSD Wt	4790.5	4837.2	4815.2	4814.8		Wt w/ heads & hkt (1) kg	32.68	32.72	32.70	-
Org         2.20         2.34	Volume		2054.2	2077.3	2064.7		Volume		2085.1	2078.7	2094.6		Volume	2293.1	2325.0	2311.1	2303.0		VVt.w/ beads & bkt.(2) kg	32.68	32.72	32.72	
Om         2 341         3 241         2 341         3 241         2 341         3 241         2 341         3 241         2 341         3 241         3	Gmb		2.226	2.204	2.219	0.022	Gmb		2.201	2.205	2.190	0.015	Gmb	2.001	1.973	1.987	1.993	0.027	Wt.w/ beads & bkt.(3) kg	32.68	32.74	32.70	
Arr Voids       4.92       5.85       5.21       0.9       5.20       5.20       5.20       5.21       0.9       5.20       5.20       5.20       1.20       Bucket vi.       8.70/11       8.70	Gmm		2.341	2.341	2.341		Gmm		2.341	2.341	2.341		Gmm	2.341	2.341	2.341	2.341		VVt.w/ beads & bkt.(avg)	32.68	32.73	32.71	
Arg. ormsise         List         Arg. arrende	Air Voids		4.92	5.85	5.21	0.9	Air Voids		5.99	5.82	6.46	0.6	Air Voids	14.53	15.70	15.14	14.87	1.2	Bucket wt.	8.7041	8.7041	8.7041	
New memory         New mem			Avg air v	oids	5.33				Avg air v	/oids	6.09				Avg air v	/oids	15.06		Wt. of beads, g	19315.1	19370.6	19348.6	
Iff @ Name, ome       111       115	N <sub>max</sub> dimension	al metho	d																Volume of beads, cm <sup>3</sup>	11720.6	6 11754.2	11740.9	
Ave:         Origination         Origin transport         Origination	Ht @ N <sub>max</sub> , mm	n	118.1	119.6	119.2		Gmb, Nmax	Dens(pcf	) Ht, Nma	a) Mass	Dens(pct	)							Pill vol = bkt vol - bead vol	2358.9	2325.3	2338.6	Range
Volume         Open         2341         2344         2341         <	Area, cm <sup>2</sup>		176.7	176.7	176.7		0.000	0.0	0.0	0.0	0.0								G <sub>mb</sub> pill	1.945	1.975	1.963	0.030
Dyst         44721         4573         4516         275         1264         1275         1262         1275         1264         1275 <th< td=""><td>Volume, cm<sup>3</sup></td><td></td><td>2087.0</td><td>2113.5</td><td>2106.4</td><td></td><td>2.226</td><td>138.9</td><td>118.1</td><td>4572.1</td><td>138.9</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Gmm</td><td>2.341</td><td>2.341</td><td>2.341</td><td></td></th<>	Volume, cm <sup>3</sup>		2087.0	2113.5	2106.4		2.226	138.9	118.1	4572.1	138.9								Gmm	2.341	2.341	2.341	
Sol         2 191         2 166         2 176         2 166         2 176         2 166         2 177         2 186         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192         4 80 1         192	Dry wt.		4572.1	4578.7	4581.6		2.204	137.5	119.6	4578.7	137.5								Air Voids	16.91	15.65	16.16	1.3
Gmac carr. fact.         1 016         1 017         1 020         Image: Construction of the construction	G <sub>mb</sub>		2.191	2.166	2.175		2.219	138.5	119.2	4581.6	138.5									Avg air •	voids	16.24	
Number of the second method         Number of the second seco	G <sub>mb</sub> corr. fact.		1.016	1.017	1.020															-			
Name         Name         Name         Name         Bucket Vu (Empty)         8.701         kg         No           Ht @ Neg. mm         120.5         122.1         121.6         Average airvoids, back calculated         7.22         18.14         18.14         8.14																							
New densional web         v         v         v         s         Manage and voltable and vol																			Bucket Wt. (Empty)	8.7041	kg		
He Beads and Bucket       1205       121       121       12       3         Area, cm <sup>2</sup> 1767       1	N <sub>des</sub> dimensiona	al metho	d				Summary, 178A -	19.0 Lim	erock	N <sub>des</sub>		Nini							Bucket Volume	14079.5	5 cm <sup>3</sup>		
Areage air wids actual, SSD         6.09         15.06         NA         Max         Ma	Ht @ N <sub>des</sub> , mm		120.5	122.1	121.6		Average air voids,	back calc	culated	7.22	18.14	18.14							Beads and Bucket	1	2	3	
Volume_cn <sup>3</sup> 21294       2177       2148       Verage air volds actual, bads       NA       NA       16.24         Dry wt.       4572.1       4578.7       4578.6       Difference (back calculate-actual)       1.3       3.09       1.90       Arg. (back and bucket)       31.91       Kg         Gma       2.147       2.122       2.132       Range       NA       NA       16.24         Gma       2.147       2.122       2.132       Range       NA       NA       16.24       NA       NA       16.24         Gma       2.147       2.123       2.132       Range       NA       NA<	Area, cm <sup>2</sup>		176.7	176.7	176.7		Average air voids a	actual, SS	SD	6.09	15.06	NA								31.84	31.92	31.96	kg
Dry wt.       45721       4587.4       4587.6       Mage       Difference (back calculated-sclue)       1.13       3.09       1.90       Arg. (beads and huckel)       31.9       kg.       Kg. <td>Volume, cm<sup>3</sup></td> <td></td> <td>2129.4</td> <td>2157.7</td> <td>2148.8</td> <td></td> <td>Average air voids a</td> <td>actual, be</td> <td>ads</td> <td>NA</td> <td>NA</td> <td>16.24</td> <td></td>	Volume, cm <sup>3</sup>		2129.4	2157.7	2148.8		Average air voids a	actual, be	ads	NA	NA	16.24											
$G_{nb}$ $2.147$ $2.122$ $2.137$ $0.022$ $ang$ <td>Dry wt.</td> <td></td> <td>4572.1</td> <td>4578.7</td> <td>4581.6</td> <td></td> <td>Difference (back c</td> <td>alculated-</td> <td>-actual)</td> <td>1.13</td> <td>3.09</td> <td>1.90</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Avg. (beads and bucket)</td> <td>31.91</td> <td>kg</td> <td></td> <td></td>	Dry wt.		4572.1	4578.7	4581.6		Difference (back c	alculated-	-actual)	1.13	3.09	1.90							Avg. (beads and bucket)	31.91	kg		
Gm* CF       2.181       2.192       2.175       0.022       0.022       0.02 <td>Gmb</td> <td></td> <td>2.147</td> <td>2.122</td> <td>2.132</td> <td>Range</td> <td></td> <td>Avg. minus bucket wt.</td> <td>23.20</td> <td>kg</td> <td></td> <td></td>	Gmb		2.147	2.122	2.132	Range													Avg. minus bucket wt.	23.20	kg		
Gmm       2.341       3.341       3.341       3.341       3	G <sub>mb</sub> * CF		2.181	2.159	2.175	0.022													G <sub>mb</sub> of beads	1.648			
Air Voids (cor)       6.82       7.77       7.08       1.0 </td <td>Gmm</td> <td></td> <td>2.341</td> <td>2.341</td> <td>2.341</td> <td></td>	Gmm		2.341	2.341	2.341																		
Avg air voids, con       7.22       Avg air voids, con       7.22       Image: Constraint of the constraint	Air Voids (corr)	1	6.82	7.77	7.08	1.0														-			
Image: Section of the section of th			Avg air v	oids, corr	7.22																		
Na       Na <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>																							
Null dimensional method       Image: Normal method			_																				
Net dimensional method       Image: Net of the sector of the			_																				
Area, cm <sup>2</sup> 138.9       138.9       138.0       1 <td>N<sub>ini</sub> dimensional</td> <td>I method</td> <td></td>	N <sub>ini</sub> dimensional	I method																					
Area     1050	Ht @ N. mm	1	135.9	138.9	138.0																		
New off       1007	Area am <sup>2</sup>		176.7	176.7	176.7																-		
Volume, Vinit, Vinit	Volumo cm <sup>3</sup>		2/01.6	2454.6	2/38.7																		
Orm         1.904         1.805         1.879         Range           Gmb         1.914         1.805         1.879         Range           Gmb         2.341         2.341         2.341         2.341           Air Voids (corr)         17.38         18.93         18.12         1.6	Drv wt		4572.1	4578.7	4581.6																		
Marcine         1.934         1.898         1.917         0.036           Gma*         2.341         3.341         3.	Gmb		1.904	1.865	1.879	Range														-			
Gmm         2.341         2.341         2.341           Air Voids (corr)         17.38         18.93         18.12         1.6	Gmb * CF		1.934	1.898	1.917	0.036														-			
Air Voids (corr)         17.38         18.93         18.12         1.6           Ava air voids corr         18.14			2 341	2 341	2 341																		
Ava air voids corr. 18.14	Air Voids (corr)	ł	17.38	18.93	18.12	16		-			-									-	-		-
			Avg air v	oids corr.	18.14															-			

Calculatio	ns fo	r Mix 1	08A-9	.5 GR	(Excludin	g Outliers)																	
N SSD meth	od					N. SSD method						N., SSD methor						N Glace Beade tected I	av Grog S	holar			
Remote ID	00 A	в	6	D	Dongo	Remote ID	-	E	C .		Donao	Secola ID			IZ.	-	Denge	Pomple ID	Jy Oleg Ol	liulai	K		
Dry Wt		5001.3	1997 1	1981.5	19.8	Dry Wt	 /078.0	/070.1	1975 1	1976 3	A D	Dry Wt	1978 G	1077 A	1976.7	1976 3	7.6	Dry W4	1978 G	1977 A	n n	1976 3	
Wittin Hall		2960.2	2958.1	2954.6	10.0	Wt In Hall	2929.2	2927.4	2928.0	2930.5	4.0	Wt In H <sub>e</sub> O	2808.5	2806.1	2822.7	2801.7	2.0	W/t_nartial.wet	5029.1	5030 Z		5005.4	
SSD WA		5003.2	4999.8	4983.9		SSD VA	4982.3	4982.2	4978.2	4979.5		SSD W/t	5062.7	5068.7	5038.9	5030.0		Wit w/ beads & bkt (1) kg	33.24	33.24		33.26	
Volume		2043.0	2041.7	2029.3		Volume	2053.1	2054.8	2050.2	2049.0		Volume	2254.2	2262.6	2216.2	2228.3		Wt.w/ beads & bkt.(2) kg	33.26	33.26		33.26	
Gmb		2.448	2.448	2.455	0.007	Gmb	2.425	2,423	2.427	2.429	0.005	Gmb	2.209	2.200	2.246	2.233	0.046	Wt.w/ beads & bkt.(3) kg	33.26	33.24		33.20	
Gee		2 5 1 5	2 5 1 5	2.515		Gee	2 5 1 5	2 5 1 5	2 515	2 515		Gmm	2 515	2 515	2 5 1 5	2 5 1 5		W/t w/ heads & hkt (avg)	33.25	33.25		33.24	
Air Voids		2.66	2.68	2.39	0.3	Air Voids	3.58	3.65	3.51	3.43	0.2	Air Voids	12.18	12.53	10.71	11.20	18	Bucket wt	8 7041	8 7041		8 7041	
		Avg air v	oids	2.58				Avg air 1	/oids	3.54				Avg air v	/oids	11.66		Wt. of beads. α	19520.1	19511.9		19530.5	
Nmax dimension	al metho	d						0						0				Volume of beads, cm <sup>3</sup>	11841.6	11836.6		11847.9	
Ht @ Nmax, mm		117.1	117.1	116.4		Gmb, Nmax	Dens(pcf	) Ht. Nma	n Mass	Dens(pct	3							Pill vol = bkt vol - bead vol	2237.9	2242.9		2231.6	Range
Area, cm <sup>2</sup>		176.7	176.7	176.7		0.000	0.0	0.0	0.0	0.0								Gmb pill	2.225	2.219		2.230	0.011
Volume, cm <sup>3</sup>		2069.3	2069.3	2057.0		2 448	152.8	117.1	5001.3	152.8								Gene	2 5 1 5	2 5 1 5		2 515	
Drv wt		5001.3	4997.4	4981.5		2.448	152.7	117.1	4997.4	152.7								Air Voids	11.54	11.76		11.34	0.4
Gmb		2 417	2 415	2 422		2 455	153.2	116.4	4981.5	153.2										Avg air y	shin	11.55	
G + corr. fact		1.013	1.014	1.014		2.100	100.2		100110	100.2										i ng an i		11.00	
Omp cont fact.		1.013	1.014	1.014																			
																		Bucket W/t (Empty)		8 7041	ka		
N <sub>dec</sub> dimensions	I method	3				Summary, 108A -	9.5 Grani	te	Ndes		Nex							Bucket Volume		14079.5	cm <sup>3</sup>		
Ht@N. mm		118.7	118.6	117.9	1	Averane air voide	hack calc	hotelu	3.84	13.02	13.02							Beads and Bucket		1	2	3	
Area cm <sup>2</sup>		176.7	176.7	176.7		Average air voids,	actual SS		3.64	11.66	NA							Deads and Ducket		31.86	31.94	31.94	ka
Volume cm <sup>3</sup>		2097.6	2095.8	2083.5		Average air voids :	actual, oc actual he	ohe	NA	NA	11.55									51.00	01.04	51.54	кy
Drv wt		5001.3	4997 A	4981.5		Difference (hack c	alculated-	actual)	0.30	1.37	1.48							Ave (heads and hucket)		31.91	ka		
		2 384	2 384	2 391	Range													Ava minus bucket wt		23.21	ka		
G_L * CE		2.004	2.004	2.001														G of heads		1.648	1.9		
G		2.415	2.411	2.424	0.000													Omp of Decids		1.040			
Air Voide (corr)		3.09	3.01	3.64	03																		
		Avg air y	nids corr	3.84	0.5																		
		/ ag an a		0.04																			
N <sub>ini</sub> dimensional	method																						
Ht @ N <sub>ini</sub> , mm		131.3	131.1	130.3																			
Area, cm <sup>2</sup>		176.7	176.7	176.7																			
Volume, cm <sup>3</sup>		2320.3	2316.7	2302.6																			
Dry wt.		5001.3	4997.4	4981.5																			
G <sub>mb</sub>		2.155	2.157	2.163	Range																		
G <sub>mb</sub> * CF		2.183	2.186	2.193	0.010																		
G <sub>mm</sub>		2.515	2.515	2.515																			
Air Voids (corr)		13.19	13.07	12.81	0.4																		
		Avg air v	oids, corr	13.02																			

Num         Story 00	Calculatio	ns for	Mix 7	71A-12	.5 GR	(Excluding	j Outliers)																	
Strange UP         A         B         C         D         Reage Port Wit         Strange UP         Vit         U         J         K         L         Parage Port Wit         Strange UP         J         J         K         L         Parage Port Wit         Strange UP         J         K         L         J         K	N <sub>max</sub> SSD meth	nd					New SSD method						N <sub>ex</sub> SSD methor						Ner - Glass Beads tested k	ny Mike Br	erkowitz			
Dy Wit         5002 f         2002 f         200 f	Sample ID	Δ	в	L C	n	Pange	Sample ID	F	F	G	н	Range	Sample ID			K	1	Pange	Samila ID		1	ĸ	1	
Win Hug         2978 2         2978 3         2978 2         2978 3         2978 2         2978 3         2978 2         2978 3	Dry Wt.	5004.7		5002.6	5009.6	7.0	Dry Wt.	-	5009.5	5010.0	5003.8	6.2	Dry Wt.	5006.7	5011.4	5010.6	-	4.7	Drv Wt.	5006.7	5011.4	5010.6	5005.8	
SSD VM         50118         60101         50171         SSD VM         50223         20235         <	Wt. In H <sub>2</sub> O	2978.2		2967.3	2976.8		Wt. In H <sub>2</sub> O		2962.8	2958.0	2925.1		Wt. In H <sub>2</sub> 0	2921.6	2916.9	2918.7			Wt. partial wet	5062.8	5069.4	5065.0	5072.4	
Volume         2035 f         2042 2003         Vitu Week 3 & Mi C V Mar 2005         2005 K         2005	SSD Wt.	5011.8		5010.1	5017.1		SSD Wt.		5022.2	5022.3	5018.6		SSD Wt.	5172.1	5165.3	5165.1			Wt.w/ beads & bkt.(1) kg	33.18	33.24	33.22	33.24	
Sm         2.481         2.482         2.480         0.48         0.48         0.42         2.28         2.28         2.28         0.00         Mtm baak & bit (b/g)         3.28         3.28         3.28         3.28           Gm         2.284         2.58<	Volume	2033.6		2042.8	2040.3		Volume		2059.4	2064.3	2093.5		Volume	2250.5	2248.4	2246.4			Wt.w/ beads & bkt.(2) kg	33.26	33.26	33.22	33.24	
Gram         2.549	G <sub>mb</sub>	2.461		2.449	2.455	0.012	G <sub>mb</sub>		2.433	2.427	2.390	0.042	Gmb	2.225	2.229	2.231		0.006	Wt.w/ beads & bkt.(3) kg	33.26	33.24	33.20	33.24	
Air Voids         3.45         3.33         3.67         0.5         Air Voids         4.57         4.79         6.20         1.7         Air Voids         1.250         1.024         <	Gmm	2.549		2.549	2.549		G <sub>mm</sub>		2.549	2.549	2.549		Gmm	2.549	2.549	2.549			VVt.w/ beads & bkt.(avg)	33.23	33.25	33.21	33.24	
Mag diarronds         388         Mag diarronds         388         Mag diarronds         1289         Multical set of se	Air Voids	3.45		3.93	3.67	0.5	Air Voids		4.57	4.79	6.23	1.7	Air Voids	12.72	12.56	12.50		0.2	Bucket wt.	8.7041	8.7041	8.7041	8.7041	
New demonsional methods         rel         New demonsional methods         Volume of beads, cm <sup>2</sup> 1119.2         1129.2 </td <td></td> <td></td> <td>Avg air v</td> <td>/oids</td> <td>3.68</td> <td></td> <td></td> <td></td> <td>Avg air 1</td> <td>voids</td> <td>5.20</td> <td></td> <td></td> <td></td> <td>Avg air v</td> <td>/oids</td> <td>12.59</td> <td></td> <td>Wt. of beads, g</td> <td>19466.4</td> <td>19473.2</td> <td>19444.2</td> <td>19463.5</td> <td></td>			Avg air v	/oids	3.68				Avg air 1	voids	5.20				Avg air v	/oids	12.59		Wt. of beads, g	19466.4	19473.2	19444.2	19463.5	
He Q. Max. m1       176.7	N <sub>max</sub> dimension	al method	ł																Volume of beads, cm <sup>3</sup>	11819.2	11823.3	11805.7	11817.4	
Area. cm <sup>3</sup> 176.7         176.7	Ht @ N <sub>max</sub> , mm	117.8		118.4	118.1		Gmb, Nmax	Dens(pcf	) Ht, Nma	a) Mass	Dens(pct	)							Pill vol = bkt vol - bead vol	2260.3	2256.2	2273.8	2262.1	Range
Volume. cm <sup>2</sup> 2817         2822         2870         0.00         0.0	Area, cm <sup>2</sup>	176.7		176.7	176.7		2.461	153.6	117.8	5004.7	153.6								G <sub>mb</sub> pill	2.215	2.221	2.204	2.213	0.018
Dry wt.         5002.6         5009.8         2.449         15.28         18.14         5002.6         15.28         Arr Voids         13.10         12.86         13.57         13.17           Ges         2.404         2.391         4.00         2.455         15.3         118.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         5008.6         15.3.2         18.1         8.0         18.0	Volume, cm <sup>3</sup>	2081.7		2092.3	2087.0		0.000	0.0	0.0	0.0	0.0								Gen	2 549	2 549	2 549	2 549	
Bit Min         Conv	Dry wt	5004.7		5002.6	5009.6		2 449	152.8	118.4	5002.6	152.8								Air Voids	13.10	12.86	13.55	13.19	0.7
Grass Corr         Instruct         Instrut         Instruct         Instruct	Gmb	2 404		2.391	2 400		2.455	153.2	118.1	5009.6	153.2									10.10	Avg air y	oids.	13.17	0.1
Description       Description       Description       Description       Band       Mag       Mag <td>G . corr. fact</td> <td>1.004</td> <td></td> <td>1.004</td> <td>1.002</td> <td></td> <td>2.400</td> <td>100.2</td> <td>110.1</td> <td>0000.0</td> <td>100.2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>r ng un r</td> <td>0103</td> <td>10.11</td> <td></td>	G . corr. fact	1.004		1.004	1.002		2.400	100.2	110.1	0000.0	100.2										r ng un r	0103	10.11	
New dimensional method         New dimethod         New dimensional method	Omb cont. ract.	1.024		1.024	1.023					-														
New dimensional method         Summary, 71A 12.5 Grante         New descensional method         Bucket Volume         Bucket Volume         14079.5 cm³         Image: Constraint of the co																			Bucket W/t (Empty)		8 70/1	ka		
New of the During of the Du	N., dimensions	l method					Summary 71A . 1	2.5 Grani	ito	Nee		NL .							Bucket Volume		1/079.5	cm <sup>3</sup>		
Hi gr Mass, nm       19.6       1.0.3       11.0.3       11.0.3       11.0.4       11.0.4       11.0.4       10.0	INGES GITTERISTOTE	440.0		400.0	440.0		ouninary, riA- i	2.5 Oran	ile i	Tindes	45.05	Nini 45.05									4070.0		-	
Area or       116.7       <	Ht @ Ndes, mm	119.6		120.3	119.9		Average air voids,	раск саю	culated	5.16	15.05	15.05							Beads and Bucket		1	2	3	
Volume.cm       212.9 2       218.8 2       Average arroads actual to eads       NA       NA       NA       13.17         Dry wf. 50047       5002.6 5009.6       Difference (back calculate-actual)       -0.04       2.46       1.87       Average arroads actual to eads       1.84       4       3.19       kg       2.319       kg	Area, cm <sup>4</sup>	1/6./		1/6./	1/6./		Average air voids a	actual, St	<u>sd</u>	5.20	12.59	NA									31.88	31.90	31.90	kg
Difference (back falculated-actual)       -0.04       2.46       1.87       Avg. (beack and bucket)       51.69       kg       6         Gmb       2.368       2.368       2.368       Range       Avg. (beack and bucket)       23.19       kg       6         Gmb       2.368       2.368       2.368       Range       Avg. (beack and bucket)       23.19       kg       6         Gmb       2.364       2.44       2.410       2.418       0.014       Avg. (beack and bucket)       23.19       kg       6         Gmb       2.549       2.549       2.549       2.549       2.549       2.549       0.516       Avg. (beack and bucket)       2.319       kg       6         Avg air voits (corr)       4.91       5.44       5.12       0.5       Avg. (beack and bucket)       2.44       4.4	Volume, cm*	2113.5		2125.9	2118.8		Average air voids a	actual, be	ads	NA 0.01	NA D.45	13.17									24.00	1		
Gmb       2.303       2.304       Range       R	Ury wt.	5004.7		5002.6	5009.6		Difference (back c	alculated	-actual)	-0.04	2.46	1.87							Avg. (beads and bucket)		31.89	кg		
Grow 0.0       2.444       2.410       2.418       0.014	Gmb	2.368		2.353	2.364	Range													Avg. minus bucket wt.		23.19	kg		
0 mm       2.549       2.549       2.549       2.549       2.549       2.549       2.640       6	G <sub>mb</sub> * CF	2.424		2.410	2.418	0.014													G <sub>mb</sub> of beads		1.647			
Air Voids (corr)       4.91       5.44       5.12       0.5<	G <sub>mm</sub>	2.549		2.549	2.549																			
Mag air voids, com       5.16       6	Air Voids (corr)	4.91		5.44	5.12	0.5																		
Image: Market of the state			Avg air v	/olds, corr	5.16																			
Nm dimensional method       133.3       134.4       134.0       134.7       176.																								
Nu dimensional     134.     134.     134.     134.     134.     136																								
Nwidimensional method         Vector         State																								
Ht @ N <sub>ini</sub> , mm 133.3 134.4 134.0 Area cm <sup>2</sup> 176.7 176.7 176.7	N <sub>ini</sub> dimensional	method																						
Area cm <sup>2</sup> 1767 1767 1767	Ht @ Nini, mm	133.3		134.4	134.0																			
	Area cm <sup>2</sup>	176.7		176.7	176.7																			
Volume_ro <sup>3</sup> _2355.6_2375.0_2388.0_	Volume cm <sup>3</sup>	2355.6		2375.0	2368.0																			
Dry wt. 5004.7 5002.6 5009.6	Dry wt.	5004.7		5002.6	5009.6															-				
Gmb. 2.125 2.106 2.116 Range	Gmh	2.125		2.106	2.116	Range																		
Gen*CF 2.175 2.157 2.164 0.017	Gmh * CF	2.175		2.157	2.164	0.017			-															
	6	2.549		2.549	2.549																			
University of the second secon	Air Voids (corr)	14.68		15.36	15 10	07																		
Avg air volds, cord 15.05			Avg air v	/oids, corr.	15.05																			

Calculatio	ns for	Mix 1	7B-19	.0 GR	(Excludin	g Outliers)																	
N SSD mothe	ad be					N. SSD method						NL, SSD method						N., Glace Beade tested k	u Bruon (	Sowlov			
Remain UD	A .		0	D	Banga	Romple ID	E	F	G		Panga	Sample ID	1		- K		Bongo	Romala ID	y Diyan c	Jawiey	IZ.	1	
Dry Wt		4861.8	4885.6	4880.3	23.8	Dry Wit	4886.1	4888.6	4874 3	4878 3	14 3	Dry Wt	4869.2	4885.0	4891.3	4878.8	22.1	Dry Wt	4869.2	4885.0	4891 3	4878.8	•
Vôt In H <sub>2</sub> O		2881.5	2901.1	2896.1	20.0	Wit In Hall	2871.7	2895.3	2877.6	2875.3	14.0	W/t In Hall	2831.9	2828.7	2835.6	2833.9		W/t_nartial wet	4886.5	4899 N	4905.8	4891.3	
SSD Wt		4868.9	4895.4	4891.6		SSD Wt	4902.0	4901.5	4887.9	4893.6		SSD Wt	4961.2	4965.9	4976.8	4963.4		Wt w/ heads & hkt (1) kg	33.26	33.30	33.30	33.24	
Volume		1987.4	1994.3	1995.5		Volume	2030.3	2006.2	2010.3	2018.3		Volume	2129.3	2137.2	2141.2	2129.5		Wt.w/ beads & bkt.(2) kg	33.26	33.28	33.28	33.18	
G <sub>mb</sub>		2.446	2.450	2.446	0.004	Gmb	2.407	2.437	2.425	2.417	0.030	G <sub>mb</sub>	2.287	2.286	2.284	2.291	0.007	Wt.w/ beads & bkt.(3) kg	33.22	33.32	33.30	33.24	
Gmm		2.525	2.525	2.525		Gmm	2.525	2.525	2.525	2.525		Gmm	2.525	2.525	2.525	2.525		Wt.w/ beads & bkt. (avg)	33.25	33.30	33.29	33.22	
Air Voids		3.12	2.98	3.14	0.2	Air Voids	4.69	3.50	3.97	4.28	1.2	Air Voids	9.44	9.48	9.53	9.27	0.3	Bucket wt.	8.7041	8.7041	8.7041	8.7041	
		Avg air v	oids	3.08				Avg air v	oids	4.11				Avg air v	oids	9.43		Wt. of beads, g	19656.1	19696.9	19683.4	19624.6	
N <sub>max</sub> dimensiona	il method	1												_				Volume of beads, cm <sup>3</sup>	11917.2	11941.9	11933.8	11898.1	
Ht @ N <sub>max</sub> , mm		116.7	118.1	119.3		Gmb, Nmax	Dens(pcf	Ht, Nma	Mass	Dens(pcf	)							Pill vol = bkt vol - bead vol	2162.3	2137.6	2145.7	2181.4	Range
Area, cm <sup>2</sup>		176.7	176.7	176.7		0.000	0.0	0.0	0.0	0.0								G <sub>mb</sub> pill	2.252	2.285	2.280	2.237	0.049
Volume, cm <sup>3</sup>		2062.3	2087.0	2108.2		2.446	152.6	116.7	4861.8	152.6								Gmm	2.525	2.525	2.525	2.525	
Dry wt.		4861.8	4885.6	4880.3		2.450	152.9	118.1	4885.6	152.9								Air Voids	10.82	9.49	9.72	11.42	1.9
G <sub>mb</sub>		2.358	2.341	2.315		2.446	152.6	119.3	4880.3	152.6										Avg air v	oids	10.36	
G <sub>mb</sub> corr. fact.		1.038	1.046	1.056																			
																		Bucket Wt. (Empty)		8.7041	kg		
N <sub>des</sub> dimensional	l method					Summary, 17B - 1	9.0 Grani	te	N <sub>des</sub>		Nini							Bucket Volume		14079.5	cm <sup>3</sup>		
Ht @ N <sub>des</sub> , mm		118.4	119.7	120.9		Average air voids,	back calo	ulated	4.40	13.90	13.90							Beads and Bucket		1	2	3	
Area, cm <sup>2</sup>		176.7	176.7	176.7		Average air voids :	actual, SS	SD	4.11	9.43	NA									31.92	31.94	31.92	kg
Volume, cm <sup>3</sup>		2092.3	2115.3	2136.5		Average air voids :	actual, be	ads	NA	NA	10.36												
Dry wt.		4861.8	4885.6	4880.3		Difference (back c	alculated-	actual)	0.29	4.47	3.54							Avg. (beads and bucket)		31.93	kg		
G <sub>mb</sub>		2.324	2.310	2.284	Range													Avg. minus bucket wt.		23.22	kg		
G <sub>mb</sub> * CF		2.411	2.417	2.413	0.006	0.006												G <sub>mb</sub> of beads		1.649			
Gmm		2.525	2.525	2.525																			
Air Voids (corr)		4.51	4.28	4.42	0.2																		
		Avg air v	oids, corr	4.40																			
																							L
																			L				
N <sub>ini</sub> dimensional	method																						
Ht @ Nee, mm		132.0	132.6	134.0																			
Area cm <sup>2</sup>		176.7	176.7	176.7																			
Volume cm <sup>3</sup>		2332.6	2343.2	2368.0																			
Dry wt.		4861.8	4885.6	4880.3																			
G <sub>mb</sub>		2.084	2.085	2.061	Range																		
G <sub>mb</sub> * CF		2.163	2.182	2.177	0.019																		
Gmm		2.525	2.525	2.525																			
Air Voids (corr)		14.35	13.59	13.77	0.8																		
		Avg air v	oids corr.	13.90																			

		Gmb @	2 Nmax							
 Mix ID	А	В	С	D	Avg.	Range	Avg + R/2	Avg - R/2	Outlier	
176A-9.5 LR	2.240	2.249	2.247	2.196	2.233	0.053	2.259	2.206	D	
177A-12.5 LR	2.271		2.268	2.258	2.265	0.013	2.272	2.259	None	
178A-19.0 LR	2.249	2.226	2.204	2.219	2.224	0.045	2.247	2.202	А	
108A-9.5 GR	2.426	2.448	2.448	2.455	2.444	0.029	2.458	2.430	А	
71A-12.5 GR	2.461	2.410	2.449	2.455	2.444	0.051	2.469	2.418	В	
17B-19.0 GR	2.461	2.446	2.450	2.446	2.451	0.016	2.458	2.443	А	

Outlier Determination; FDOT method

		Gmb @	Ndes														
Mix ID	E	F	G	Н	Avg.	Range	Avg + R/2	Avg - R/2	Outlier								
176A-9.5 LR	2.172	2.181	2.198	2.191	2.185	0.026	2.199	2.172	None								
177A-12.5 LR	2.179	2.247	2.157	2.180	2.191	0.089	2.235	2.146	F								
178A-19.0 LR	2.164	2.201	2.205	2.190	2.190	0.040	2.210	2.170	E								
108A-9.5 GR	2.425	2.423	2.427	2.429	2.426	0.005	2.429	2.423	None								
71A-12.5 GR	2.359	2.433	2.427	7 2.390 2.402 0.074 2.439 2.365 E													
17B-19.0 GR	2.407	2.437	2.437 2.425 2.417 2.421 0.030 2.436 2.406 None* *Include 2.437 even though 0.001 high														

	Gm	b@Nini(	SSD met	hod)					
Mix ID	I	J	K	L	Avg.	Range	Avg + R/2	Avg - R/2	Outlier
176A-9.5 LR	1.962	1.931	1.967	1.929	1.947	0.038	1.967	1.928	None
177A-12.5 LR	1.998	1.980	1.995	1.980	1.988	0.018	1.998	1.979	None
178A-19.0 LR	2.001	1.973	1.987	1.993	1.989	0.027	2.002	1.975	None
108A-9.5 GR	2.209	2.200	2.246	2.233	2.222	0.046	2.245	2.199	None
71A-12.5 GR	2.225	2.229	2.231	2.206	2.223	0.025	2.235	2.210	L
17B-19.0 GR	2.287	2.286	2.284	2.291	2.287	0.007	2.290	2.284	None

		Gmb @	Nini (Glas	ss Beads	method)						
	Mix ID	I.	J	K	L	Avg.	Range	Avg + R/2	Avg - R/2	Outlier	
-	176A-9.5 LR	1.983	1.932	1.989	1.939	1.961	0.056	1.989	1.932	None	
	177A-12.5 LR	2.006	1.961	1.989	1.985	1.985	0.045	2.007	1.963	None	
	178A-19.0 LR	2.008	1.945	1.975	1.963	1.973	0.063	2.004	1.941	I	
	108A-9.5 GR	2.225	2.219	2.258	2.230	2.233	0.039	2.252	2.214	к	
	71A-12.5 GR	2.215	2.221	2.204	2.213	2.213	0.018	2.222	2.204	None	
	17B-19.0 GR	2.252	2.285	2.280	2.237	2.263	0.049	2.288	2.239	None	