COBITCO INC
EMULSIFIED ASPHALT

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April 14, 2016

Foothills Paving Company
5040 Tabor
Wheat Ridge, CO 80033
Attn: Heath Russo

Subject: Type II Slurry Seal Mix Design, 2016
Aggregate Source: Asphalt Paving Co., Golden, CO.
Emulsion: COBITCO, Inc., CQS-l h + 3% SBR Latex ("CQS-1h1L")

A job mix recommendation was prepared using a Type II aggregate from Asphalt Paving Co., Golden, CO and COBITCO, Inc. CQS-l h1L. The job mix recommendation was determined using ISSA and ASTM accepted testing procedures.

This report outlines the tests performed. The accompanying data and graphs are the results of these tests.

The aggregate provided met ISSA and Asphalt Paving Co. (APC) specifications for Type II slurry aggregate. The aggregate is within tolerance of ISSA specifications for Type II slurry aggregate. The aggregate was used "as is" for this mix recommendation. See attached tables and graphs. This mix recommendation is valid only for aggregate gradations within the stockpile tolerance of this gradation per ISSA A105 section 4.2.3.

Emulsion content of the mix was determined by evaluating 6 Day Soak Wet Track Abrasion (ISSA TB 100) and Sand Adhesion Mix Procedure (ISSA TB 109) tests. Water and additive quantities were determined by Trial Mix Procedure (ISSA TB 113). Hydrated Lime provided the best overall mix characteristics. Refer to Mix and Compatibility Test charts enclosed.

Compilation of the enclosed data was used to determine the optimum emulsion/bitumen content of the slurry mix. Unknown factors of weather, water content of the aggregate stockpiles, aggregate reactivity, etc., will affect the liquid content of the mix. As is common practice, the actual mix applied at any one time will be adjusted, within certain tolerances, and approved by the project managers as may be required.

**COBITCO, Inc.**

Mix recommendation, based on dry aggregate weight:

| | | |
|---|---|---|
| 1. | Emulsion Content Range: | 12.75% ± 0.5% |
| 2. | Pre-Wet Water: | 9.0%-10.0% (laboratory mix water)<br>Field adjust as required. |
| 3. | Filler: Hydrated Lime | 0.25%-0.50%<br>Usage should not exceed 1%. |
| 4. | Liquid Additive: SRC-1 | 0.09 %- 0.15% (optimum = 0.1%) |

The aggregate sample provided was covered with a fine clay-like material. This covering may have the tendency to inhibit proper adhesion of the emulsion to the aggregate.

The Sand Equivalent Value for the sample provided was 56.15 Dry (Method A) and 62.9

Wet (Method B). The Minimum Requirement is 45.(Page 5)

The ability to mix, mix times and traffic times are dependent on the Sand Equivalent Value. There is a low point of S.E. Value that will cause this system to be unusable. At this low point value, there is nothing that can be done with/to the emulsion to correct the situation.

Test results summarized in this report represent laboratory conditions only with the specified aggregate and emulsion. This mix design is not valid for materials supplied by any other supplier than those specified. Extrapolation of test results beyond the emulsion usage limits is not valid. The tests were performed using accepted laboratory procedures. No opinion is expressed as to the uniformity of the material that may be produced by the field crews or any differences in materials delivered to the job site. Conditions during actual fieldwork may affect the laboratory mix recommendations, and some adjustments for field conditions may be required. This mix design is provided for information only. No guarantees or warranty of the field crew's work, other laboratory results, materials supplied other than by COBITCO, Inc. or product produced is made or implied.

Should you have any questions regarding these tests and reports, please contact our office at (303) 296-8575.

Sincerely,

Thomas G. Morgan,

President

**COBITCO,Inc. Laboratory**

**Aggregate:** APC, Type II
APC, Ralston Quarry

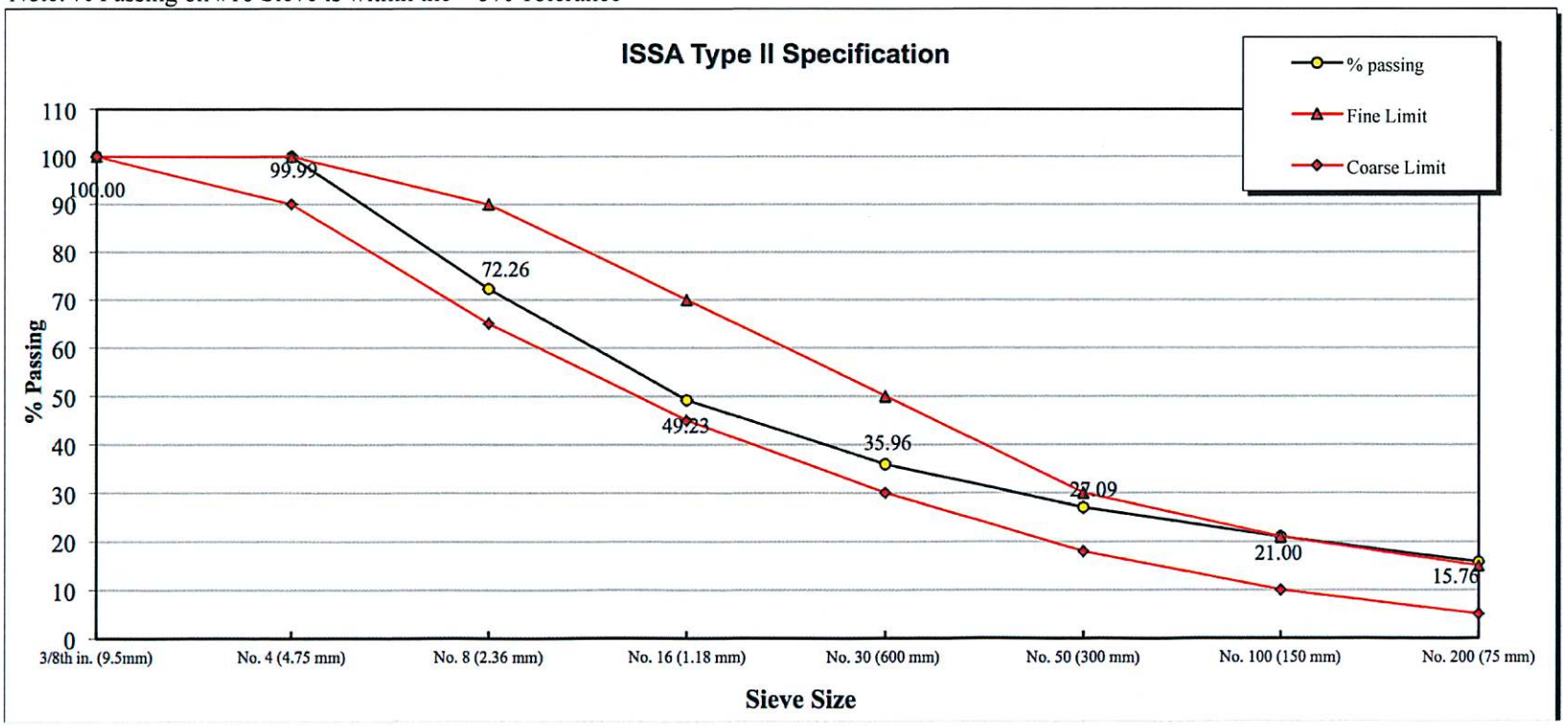
**ISSA** **AASHT O T27 / AST M C136**

**Date:** 4/14/16
Sample Date: 1/27/15

| Sieve Size | Grams of Ag. | % Passing | ISSA Type II | Spec. | Stockpile Tolerance |
|---|---|---|---|---|---|
| 3/8th in. (9.5mm) | 0.00 | **100.00%** | 100 | 100 | ±5% |
| No. 4 (4.75 mm) | 0.110 | **99.99%** | 90 | 100 | ±5% |
| No. 8 (2.36 mm) | 213.00 | **72.26%** | 65 | 90 | ±5% |
| No. 16 (1.18 mm) | 389.77 | **49.23%** | 45 | 70 | ±5% |
| No. 30 (600 µm) | 491.64 | **35.96%** | 30 | 50 | ±5% |
| No. 50 (300 µm) | 559.73 | **27.09%** | 18 | 30 | ±4% |
| No. 100 (150 µm) | 606.54 | **21.00%** | 10 | 21 | ±3% |
| No. 200 (75 µm) | 646.73 | **15.76%** | 5 | 15 | ±2% |

Sample Weight: 767.73

Note: % Passing on #16 Sieve is within the ± 5% Tolerance



**Aggregate** **Date:** 4/14/16

Source & Type: APC, Type II
Supplied by: Delivered to COBITCO,Inc. on : 2/12/16

| | | | Specification | |
|---|---|---|---|---|
| Gradation by ASTM C136 & ASTM C117: | | Lab Results: | Min. | Max. |
| | This Aggregate meets ISSA & APC gradation specification for Type II Slurry aggregate. See attached gradations. | Pass | | |
| Sand Equivalent Value ASTM D2419: | Dry (Reference, Method A) | 56.15 | 45 | |
| | *Wet (2% moisture,24 Hrs.) * COBITCO, Inc. modified method | 62.9 | 45 | |
| | I.S.S.A. specs.: 45 Min for Standard Slurry and 65 Min for Micro Surfacing | | | |
| L.A. Abrasion ASTM C131 | (Note: Independent Lab Test), %: (I.S.S.A. Max = 35%) | 20 | | 35 |
| Soundness $Na_2SO_4$, 5 Cycles ASTM C88 | Weighted Loss, % : (Note: Aggregate Supplier Data) | 3.1 | | 9.0 |

**For Information Only:**

| | |
|---|---|
| Max. size of aggregate retained on #4 seive, inches : | 0.2047 |
| Min. thicknesss of slurry, calculated, pounds/ sq. yd. : | 17.81 |

**Emulsion: CQS-1h+ 3% L**

| | | | Specification | |
|---|---|---|---|---|
| **Test Method** | **Tests on Emulsion:** | Lab Results | Min. | Max. |
| ASTM D244 | Residue by Oven Evaporation @ 325 Deg. F., % | 65.59 | 60% | |
| ASTM D244 | Sieve 20 mesh, % | 0.026 | | 0.10% |
| ASTM D244 | Particle Charge | Positive | Positive | |
| ASTM D244 | Saybolt-Furol Viscosity, 77deg. F. | 37.2 | 20 sec. | 100 sec. |
| ASTM D244 | Storage Stability, 24 Hours | 0.41 | | 1.0 |
| | **Tests on Residue:** (Oven Evaporation @ 325 deg. F.): | | | |
| ASTM D 5 | Penetration, 77deg. F, 100 g, 5 sec., dmm | 77 | 40 | 90 |
| ASTM D 113 | Ductility, 77deg. F, 5 cm/min, cm. | 65 | 40 | |
| ASTM D 2040 | Solubility in Trichloroethylene, % | 98.5 | 97.5 | |
| ASTM D36 | Softening Point, Ring and Ball, Deg. F.,% | 145 | | |
| ASTM D5976/6.2 | Elastic Recovery, 10cm 1hr @ 77 Deg.F.,% | 62 | | |
| COBITCO, Inc | Certified Polymer Content by Weight AC, % | 3.0 | | |

**COBITCO,Inc. Laboratory**

**Aggregate:** APC, Type II (% water in aggregate=1.00) **Date:** 4/14/16
**Emulsion:** CQS-1h+ 3% L

**Mix and Compatibility Tests at 77F. (ISSA TB113, TB114 & TB 115)**

| **Trial Mixes:** | #1 | #2 | #3 | #4 | |
|---|---|---|---|---|---|
| Temperature,degrees F. : | 77 | 77 | 77 | 77 | |
| % Aggregate: | 100 | 100 | 100 | 100 | |
| % Filler ( Type): HL / PC ** | 0 | 0.25HL | .50HL | 1.00 PC | |
| % Water: plus SRC-1 | 12 | 9+.1SR | 10.00+.1SR | 10 | |
| % Total Water in mix: | 10 | 10 | 11 | 11 | |
| % Emulsion: | 12 | 12 | 12 | 12 | |
| Visual mix consistency @ 30 seconds mix time: | broke | stiff/dry | good | dry | |
| Mix Time,Seconds: | 22 | 94 | 235 | 55 | |
| (180 sec. Minimum required) | Fail | fail | pass | FAIL | |
| Set Time, displacement,min.: | nftp | n/a | 2 | nftp | |
| Set Time, clear blot, min.: | nftp | n/a | 3 | nftp | |
| **Examination and evaluation of Cured Mixes ( cured at 77 F.,1** | nftp | | | | |
| Surface(normal/shiny/tacky) | nftp | n/a | normal | nftp | |
| Color:(brown/black/grey) | nftp | n/a | black | nftp | |
| Fines flotation(report): | nftp | n/a | pass | nftp | |
| Internal Adhesion (report): | nftp | n/a | pass | nftp | |
| Wet Stripping, % coating: (10 min. boiling water) | nftp | n/a | 98 | nftp | |
| | | n/a | solid/sat. | nftp | |

>90%=satisfactory
75-90%=marginal
<75%=unsatisfactory

**Legend: HL = Hydrated Lime Type N or S / PC = Portland Cement, Type I / nftp=no further tests performed
**Legend: SRC-1=Slurry Retarder,Cationic- version 1

**Determination of Slurry System Compatibility**

| | | |
|---|---|---|
| Surface: | Pass | Pass=Surface as satisfactory / Fail=Surface as tacky |
| Split Consistency Test: | Pass | Pass=Uniform consistency / Fail= Not uniform consistency |
| Refree Split Consistency Test: (Required only if /4.2 Fails) | Not required | |
| a) %AC Upper Half: | % | |
| %AC Lower Half: | % | |
| b) % retained on #16 Sieve, Upper Half: | % | |
| % retained on #16 Sieve, Lower Half: | % | |
| Wet Stripping Test(See TB114): | Pass | |
| Mix Workability (from TB113): | Pass, mixes 2&3 | Pass=Controllable to 180 secs. Fail=Controllable to less than 180 secs. |
| Slurry Seal Formulation: | Compatible | Compatible if reports 4.1 - 4.5 Pass |

**Classification of Emulsion/Aggregate Mixture System:**

| **Cohesion, Kg-Cm @ 77°F.** | **Torque Kg-Cm** | | **Mode** |
|---|---|---|---|
| 30 min. / Mode: | 18 | ECV=23 | Spin |
| 60 min. / Mode: | 18.5 | ECV=26 | Solid Spin |
| 90 min. / Mode: | 22 | ECV=26 | Solid Spin |
| 150 min. / Mode: | 26 | ECV=26 | Solid Spin |
| 210 min. / Mode: | 26 | ECV=26 | Solid Spin |
| 270 min. / Mode: | 26 | ECV=26 | Solid Spin |

**Mix Percent:**

| | |
|---|---|
| % Dry Aggregate: | 100 |
| % Total Water: | 8 |
| % Filler/Type: HL / PC: | .5 HL |
| % Liquid Additive / Type: | .1/SCR-1 |
| % Emulsion: | 12 |

**Classification:**

Quick Set:(>12 kg-cm @ 30 min.) = Yes

Quick Traffic:(>20 kg-cm @ 60 min.) = No

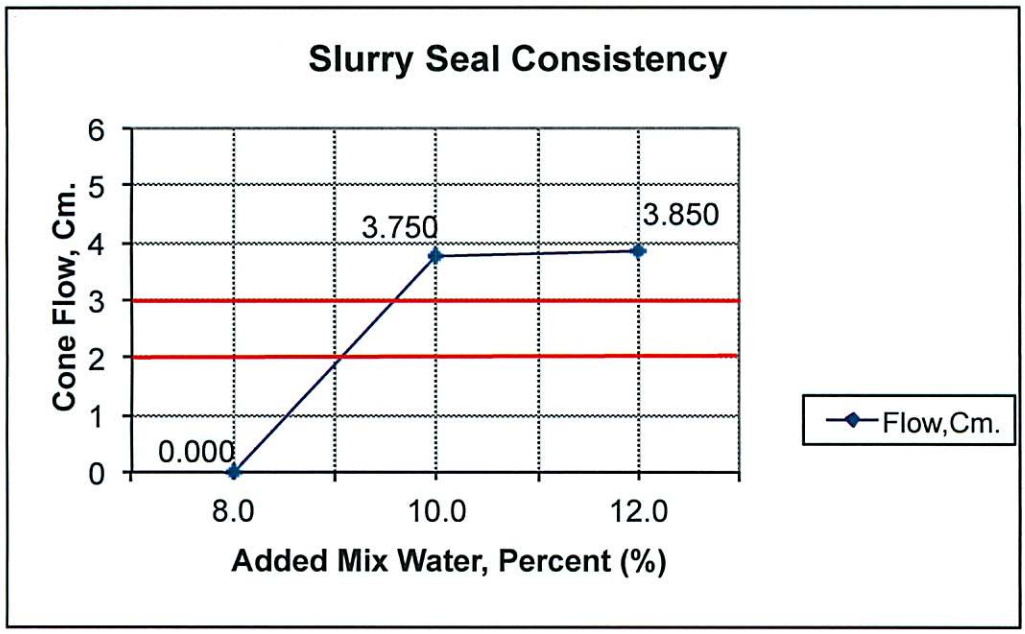
**COBITCO, Inc.Laboratory**

**Aggregate:** APC, Type II
**Emulsion:** CQS-1h+ 3% L **Date:** 4/14/16

**ISSA Method** **TB 106 Slurry Seal Consistency**

| | | | | | |
|---|---|---|---|---|---|
| **Mix #1:** | Report: | **0.00** | Cm. flow @ | **8.0** | % mix water |
| **Mix #2:** | Report: | **3.75** | Cm. flow @ | **10.0** | % mix water |
| **Mix #3:** | Report: | **3.85** | Cm. flow @ | **12.0** | % mix water |

| | Mix #1 | MIX #2 | Mix #3 |
|---|---|---|---|
| **Flow, CM.:** | 0.000 | 3.750 | 3.850 |
| **Water, %:** | 8.0 | 10.0 | 12.0 |




**Cone Flow, Cm. Limits:** 2 min - 3 max.

**Results from graph:** Optimum Water, %: 9.50 Approx.
Maximum Water, %: 9.60 Approx.

NOTE: Actual mixes showed 9%-11% water was optimum. Emulsion=12%

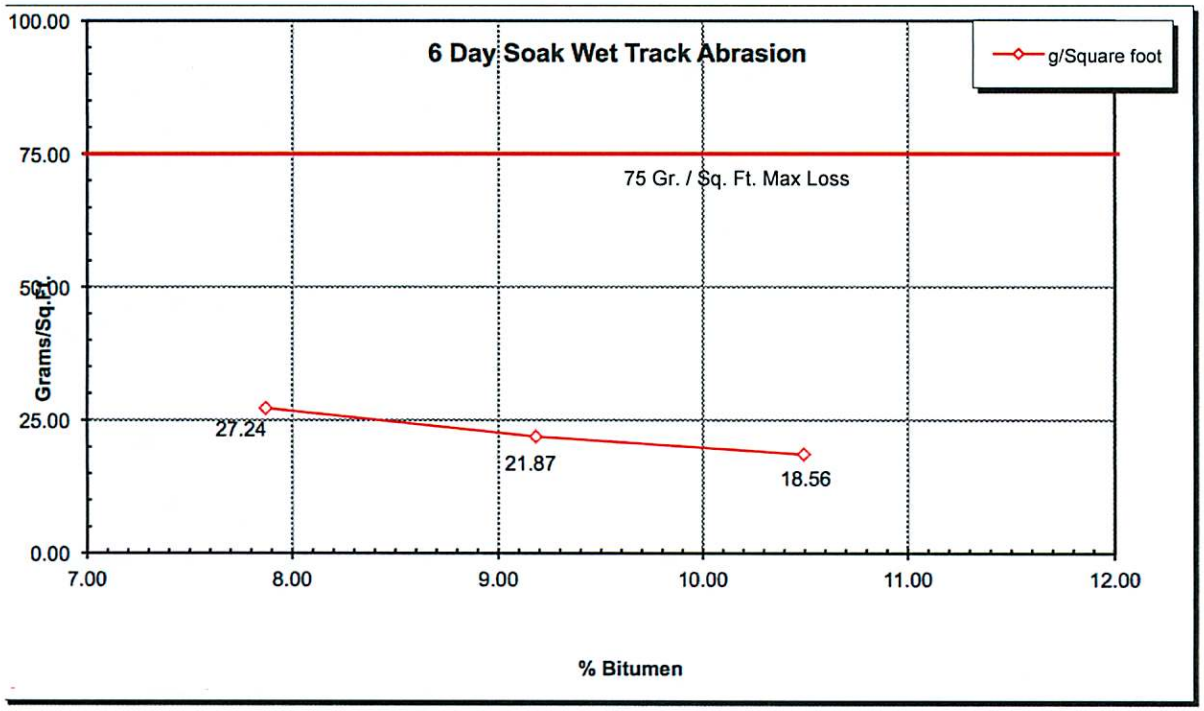
Note: From ISSA Technical Bulletin 106, " This test may not be applicable to certain Quick-Set and Quick-Traffic Systems because of erratic results due to their setting characteristics."
This has been found to be correct. The slurry mixes are too wet with the 14% - 14.5% water called for in the Consistency Test. 9% -11% water was used in the slurry mixes. See Mix-Compatibility Page 7 of mix design.

## Wet Track Abrasion Test - 6 Day Soak(ISSA TB-100)

**Date:** 4/14/16

**Aggregate:** APC, Type II
**Emulsion:** CQS-1h+ 3% L
**Residue, % :** 65.59

| % Emulsion: | 12.0% | 14.0% | 16.0% |
|---|---|---|---|
| | Mix 1 | Mix 2 | Mix 3 |
| Aggregate gms (dry).: | 700.00 | 700.00 | 700.00 |
| Water gms.: | 63.00 | 56.00 | 52.50 |
| Retarder, gms., SRC-1: | 0.70 | 0.70 | 0.70 |
| Emulsion gms.: | 84.00 | 98.00 | 112.00 |
| Mineral Filler, gms.:Hydrated Lime | 3.50 | 3.50 | 3.50 |
| **AC in Mix, %:** | 7.87 | 9.18 | 10.49 |
| **Wet Track Abrasion Test** | | | |
| **Start Weight:** | 812.00 | 830.83 | 823.91 |
| **Finish Weight:** | 801.95 | 822.76 | 817.06 |
| **Loss, gms.:** | 10.05 | 8.07 | 6.85 |
| **Loss, g/sq.ft.** | **27.24** | **21.87** | **18.56** |
| **Loss, g/sq.m.** | **293.96** | **236.05** | **200.36** |

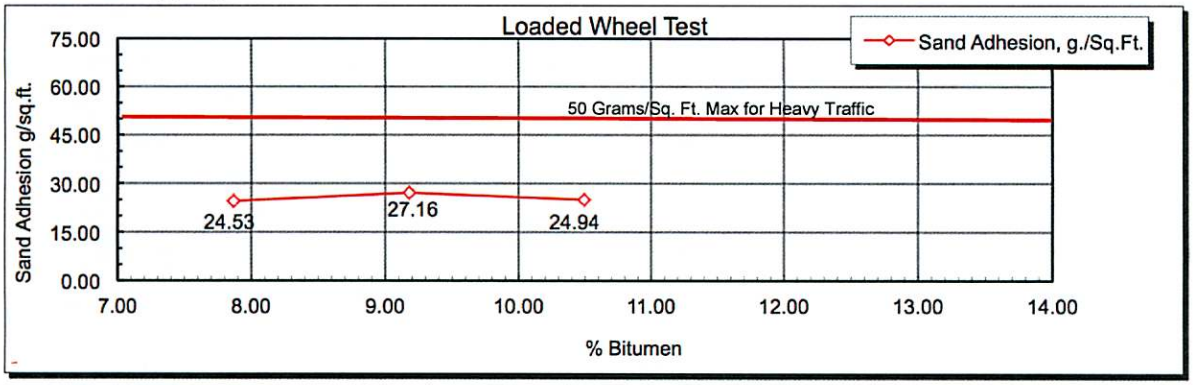


## Excess Asphalt By Loaded Wheel Tester (ISSA TB-109)

**Date:** 4/14/16

**Aggregate:** APC, Type II
**Emulsion: CQS-1h+ 3% L**
**Residue,%:** 65.59

| **% Emulsion:** | **12.0%** | **14.0%** | **16.0%** |
|---|---|---|---|
| | **Mix 1** | **Mix 2** | **Mix 3** |
| Aggregate gms. (dry): | 400.00 | 400.00 | 400.00 |
| Water gms.: | 36.00 | 32.00 | 30.00 |
| Retarder, gms., SRC-1 | 0.40 | 0.40 | 0.40 |
| Emulsion gms.: | 48.00 | 56.00 | 64.00 |
| Mineral Filler, gms.:Hydrated Lime | 2.00 | 2.00 | 2.00 |
| **AC in Mix, %:** | **7.87** | **9.18** | **10.49** |
| **Tack /Shine Point, cycles at 125 pounds** | | | |
| | 778 | 756 | 620 |
| **Sand Adhesion, 100 cycles, 125 pounds, 180 F.** | | | |
| Original weight, g. | 422.20 | 461.18 | 396.77 |
| Adhered weight, g. | 425.18 | 464.48 | 399.80 |
| **Sand Adhesion, g.** | **2.98** | **3.30** | **3.03** |
| **Sand Adhesion, g./Sq.Ft.** | **24.53** | **27.16** | **24.94** |
| % AC in Mix: | 7.87 | 9.18 | 10.49 |
| Sand Adhesion, g./Sq.Ft. | 24.53 | 27.16 | 24.94 |



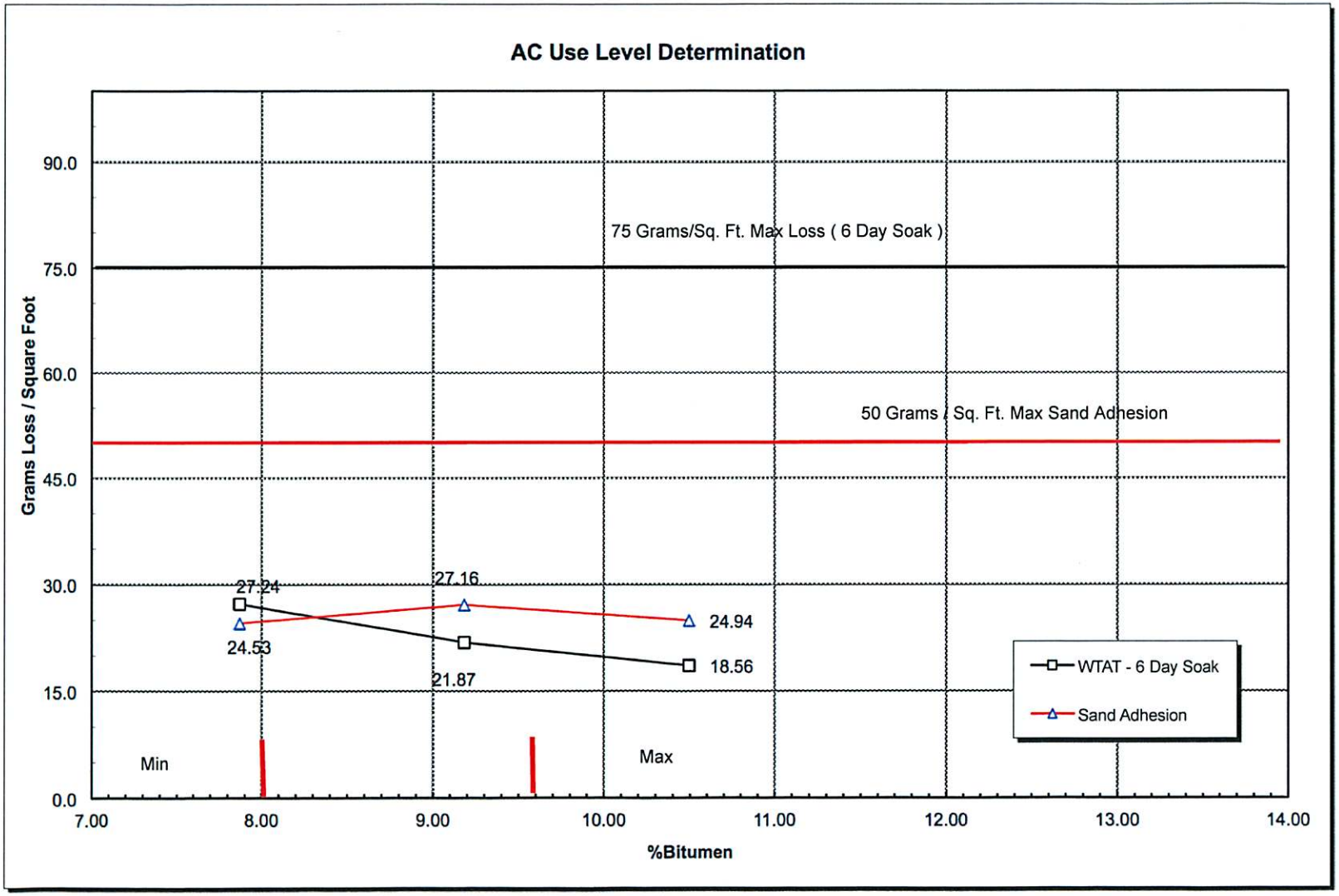

**Reports:**

| | | |
|---|---|---|
| Tack/Shine Point(Avg. of 3): | **718** | cycles of 125 pound load @ 77 F. |
| Sand Adhesion (Avg. of 3): | **25.54** | Grams/ sq.yd. adhered after 100 cycles of 125 pound load @ 77 F. |

| | | | |
|---|---|---|---|
| % Bitumen | 7.87 | 9.18 | 10.49 |
| % Emulsified Asphalt | 12.00 | 14.00 | 16.00 |
| WTAT - 6 Day Soak | 27.24 | 21.87 | 18.56 |
| Sand Adhesion | 24.53 | 27.16 | 24.94 |

**Date:** 4/14/16

**Aggregate:** APC, Type II
**Emulsion:** CQS-1h+ 3% L



**COBITCO,Inc Laboratory**

**Slurry Thickness Chart, calculated** Date: 4/14/16

**Aggregate:** APC, Type II

**Formula:**
Lbs./Sq. Yd. = (( thickness x 9)/12) x Dry Aggr. Wt .per Cubic Foot
Where:
Dry Wt./Cu.Ft.,pounds = 116.02 ( Page 4 of Mix Design)
From the sample submitted, the maximum thickness stone retained on the #4 Sieve was:
0.205 inches. (From p.5)

Therefore, to imbed a stone 0.205 inches thick, a minimum of **17.81** Lbs per Sq. Yd. would be required.

***Approximate***

| Pounds per Sq.Yd. | Thickness inches |
|---|---|
| 8.70 | 0.10 |
| 10.44 | 0.12 |
| 12.18 | 0.14 |
| 13.92 | 0.16 |
| 15.66 | 0.18 |
| 17.40 | 0.20 |
| 18.27 | 0.21 |
| 19.14 | 0.22 |
| 20.88 | 0.24 |
| 22.62 | 0.26 |
| 24.36 | 0.28 |
| 26.11 | 0.30 |
| 27.85 | 0.32 |
| 29.59 | 0.34 |
| 31.33 | 0.36 |
| 33.07 | 0.38 |

## Loose Aggregate Bulking Test *

**Date:** 4/14/16
**Sample:** APC, Type II

| % Moisture | Pounds of Moist Aggregate in Container: (0.1cu ft) | per Cubic Foot: | Dry Aggregate in one cubic foot of moist aggregate (pounds): |
|---|---|---|---|
| 0 | 11.5327 | 116.02 | 116.02 |
| 1 | 11.4798 | 115.49 | 114.35 |
| 2 | 10.9208 | 109.87 | 107.71 |
| 3 | 10.3684 | 104.31 | 101.27 |
| 4 | 10.4474 | 105.10 | 101.06 |
| 5 | 9.6632 | 97.22 | 92.59 |

* Method: Dry Rodded