# Implementation of Low-Temperature Cracking Criteria in Iowa

Final Report April 2021



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Thermal stress buildup in pavements due to low temperatures—and often large, sudden drops in temperatures—result in excessive thermal cracking that requires frequent maintenance work. This increases maintenance costs for pavements and reduc pavement service life, adding an extra cost to departments of transportation (DOTs) budgets. To prevent this distress from occurring too soon in new pavements, there are specifications to guide engineers in designing asphalt pavement mixes. Generall it is expected that field-produced mixes will have higher variance within their results when compared to laboratory-produced mixes. However, when the variance is too high, mix performance becomes compromised, thus leading to more excessive thermatic fracture at low temperatures.						
This study evaluated the current performance of field-produced mixtures using various low-temperature cracking methods and recommends necessary adjustments to the limiting criteria for laboratory-produced mixes to enable asphalt pavements to perform better and last longer under low-temperature cracking. Ten different field-produced asphalt mixtures were obtained from paving projects paved within the past seven years. These mixtures were reheated and laboratory-compacted using a gyratory compactor to produce 6 in. (150 mm) diameter specimens with a height of approximately 2 in. (50 mm). To determine the fracture energies of the compacted sample, disk-shaped compact tension (DCT) and semi-circular bend (SCB) tests were carried out as specified by ASTM D7313-13 and AASHTO TP 105-13, respectively. Air voids were determined prior to testing to ensure that specimens used met the air void requirement of 7% for testing. Illinois Flexibility Index Test (I-FIT) Procedure 405 was used for testing at intermediate warmer temperatures to get the flexibility index (FI) as well.						
The 10 mixtures evaluated had an average fracture energy ranging from 265–470 J/m <sup>2</sup> and 485–905 J/m <sup>2</sup> for DCT and SCB, respectively. The FI obtained for the mixtures ranged from 8.36 to 23.32. The DCT fracture energies did not meet the DCT specifications contained in IM510 for the average minimum fracture energies, and the DCT and SCB fracture energies are lower than those produced for approval to pave. A performance criteria adjustment is recommended to ensure that field-produced mixtures meet design specifications from the laboratory to the field.						
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## IMPLEMENTATION OF LOW-TEMPERATURE CRACKING CRITERIA IN IOWA

#### Final Report April 2021

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#### **EXECUTIVE SUMMARY**

#### Goals

The goals of this project were to assess the low-temperature cracking resistance of asphalt mixtures used by the Iowa Department of Transportation (DOT), correlate the laboratory results with field performance, and use those correlations to propose additional performance criteria.

#### **Problem Statement**

Thermal stress buildup in pavements due to low temperatures—and often large, sudden drops in temperatures—result in excessive thermal cracking that requires frequent maintenance work. This increases maintenance costs for pavements and reduces pavement service life.

#### Background

Iowa is among the northern US states that experience fluctuating low temperatures that cause low-temperature thermal cracking. To prevent this distress from occurring too soon in new pavements, engineers use specifications to guide them in designing asphalt pavement mixes.

Current Superpave specifications address thermal cracking at low temperatures based on creep and strength testing of asphalt binders and mixtures, but the specifications only have limiting criteria set forth in the asphalt binder specifications. In addition, these low-temperature characterization methods do not take into account the effect from the aggregate part of the mixture.

Mix test specifications consider the effect from both binder and aggregate. However, mix test specifications do not have clearly set national limits in Superpave; they are set by individual state agencies. Researchers and state DOTs within the Midwestern US have used the disk-shaped compact tension (DCT) test, the semi-circular bend (SCB) test, and the Illinois Flexibility Index Test (I-FIT) to assess low-temperature cracking/fracture in mixtures.

To avoid thermal cracking in the field, characterization of mechanical fracture of the asphalt mixture is important in predicting the pavement performance and assists the design engineer in establishing a mix design that can withstand the cold climate for the design period.

#### **Project Description**

Ten field-produced asphalt mixtures were obtained from projects that represented typical asphalt mixtures used in Iowa. The mixtures were from Fayette, Hamilton, Harrison, Johnson, Lyon, Marshall, Polk, and Union counties.

Five mixtures were from the old design, and the other five mixtures were from the new design. The mixtures had different binder grades and aggregate gradation, voids in mineral aggregate (VMA), voids filled with asphalt (VFA), binder content, and varying percentage of the recycled material. These mixtures were reheated and laboratory-compacted using a gyratory compactor to produce 6 in. (150 mm) diameter specimens with a height of approximately 2 in. (50 mm).

To determine the fracture energies of the compacted samples, DCT and SCB tests were carried out as specified by ASTM D7313-13 and AASHTO TP 105-13, respectively. Air voids were determined prior to testing to ensure that the specimens used met the air void requirement of 7% for testing. I-FIT Procedure 405 was used for testing at intermediate warmer temperatures to get the flexibility index (FI) as well.

## **Key Findings**

- The 10 mixtures evaluated had an average fracture energy ranging from 265–470 J/m<sup>2</sup> and 485–905 J/m<sup>2</sup> for DCT and SCB, respectively.
- The DCT fracture energies did not meet the DCT specifications contained in Instructional Memorandum 510 for the average minimum fracture energies.
- The DCT and SCB fracture energies are lower than those produced for approval to pave.
- The FI obtained for the mixtures ranged from 8.36 to 23.32.

## **Implementation Readiness and Benefits**

This project assessed 10 field-produced asphalt mixtures used in Iowa to determine their lowtemperature cracking resistance and recommends performance criteria adjustments to state specifications based on the results.

These recommended performance criteria adjustments to the state specifications will ultimately reduce maintenance costs and improve the service life of Iowa pavements.

## **Conclusions and Recommendations**

Performance criteria adjustments and a pavement distress survey are recommended to ensure that field-produced mixtures meet design specifications from the laboratory to the field.

- The specification on the need for a DCT test should be revised to state that the test is required when the asphalt binder replacement exceeds 15% for mixtures with recycled asphalt pavement (RAP) and reclaimed asphalt shingles (RAS), rather than the current value of 30% and 25% binder replacement, respectively.
- Since most of the pavements have shown that cracking resistance is low during service life, there is a need for revising the specification or improving the quality-control process, just as the Minnesota DOT (MnDOT) has allowed a 50 J/m<sup>2</sup> range for quality assurance.

• A pavement distress survey is recommended that focuses more on the intensity of thermaland transverse-cracking distress over the years to assess the field performance of the pavements used in this study in relation to the DCT testing results.

#### **CHAPTER 1. INTRODUCTION**

#### **Background Information**

In cold regions of North America (northern US and Canada), the main distress observed in asphalt pavements is low-temperature cracking or thermal cracking. At very low temperatures, the top layer of asphalt concrete undergoes shrinking. However, the top layer is constrained because of friction occurring between itself and an underlying layer of asphalt concrete. This is the action by which thermal-induced tensile stresses are produced. As the temperature decreases, the thermal-induced tensile stress increases, and once it exceeds the pavement tensile strength, the asphalt concrete pavement cracks.

Current Superpave specifications address thermal cracking at low temperatures based on creep and strength testing of asphalt binders and mixtures, but it only has limiting criteria set forth in the asphalt binder specifications like the bending beam rheometer (BBR) test. In addition, these low-temperature characterization methods do not take into account the effect from the aggregate phase of the mixture. Mix test specifications consider the effect from both binder and aggregate. However, mix test specifications do not have clearly set national limits in Superpave; they are set by individual state agencies. The aggregate phase makes up 90% to 95% of the total weight of a typical asphalt concrete mixture. To address the impact of the aggregate phase on lowtemperature cracking in asphalt mixtures, a fracture mechanics-based approach is necessary. The following low-temperature cracking/fracture mix tests have been used by researchers and state departments of transportation (DOTs) within the Midwestern US:

- Semi-circular bend (SCB)
- Illinois Flexibility Index Test (I-FIT)
- Disk-shaped compact tension (DCT)

The SCB test has become favored by industry due to the ease of fabrication and that it is reproducible. Two specimens can be obtained from one field core, reducing the number of cores to be obtained from the field (Wagoner et al. 2005a). The I-FIT has been found to be more effective at differentiating effects due to design factors and mixture aging than fracture energy (G<sub>f</sub>) by itself. The flexibility index (FI) is calculated using G<sub>f</sub> and post-peak slope (Rivera-Perez et al. 2018). The DCT test can be used with field cores that have already undergone dynamic modulus and creep compliance testing. Additionally, the geometry maximizes the potential fracture area, which reduces statistical variability of the data obtained (Wagoner et al. 2005a).

#### **Research Objective**

Durability and performance of pavements is one of the important aspects of design, and they are achieved by understanding the design product. For low-temperature cracking, characterizing asphalt mixes helps to understand the pavement performance by understanding the fracture strength of different materials. Previously, binder characterization has been used; however, asphalt mixes are composed of approximately 95% other materials than the asphalt binder. To

avoid thermal cracking in the field, characterization of mechanical fracture of the asphalt mixture is important in predicting the pavement performance and assists the design engineer in establishing a mix design that can withstand the cold climate for the design period.

The objective of this study was to assess the low-temperature cracking resistance of asphalt mixtures used by the Iowa DOT and correlate the laboratory results with field performance. Based on the developed correlations, performance criteria for the DCT and SCB tests were proposed. The results were compared with what other states in the Midwest are doing.

#### **Overall Report Experimental Plan**

A technical advisory committee (TAC) was formed that consisted of representatives from Iowa DOT, local agencies, and industry professionals. A set of projects that represent typical mixtures and materials used by the Iowa DOT was identified for use in this study. DCT and SCB tests were used to evaluate the low-temperature cracking resistance of these mixtures.

#### **Contents of this Report**

Chapter 1 introduces background information and the objectives of this study. Chapter 2 contains the literature review on low-temperature cracking,  $G_f$ , and the DCT, SCB, and I-FIT tests and their specifications, as well as what other states are doing. It also includes future recommended work. Experimental methods are covered in Chapter 3, while Chapter 4 presents the results and their analysis. Chapter 5 contains conclusions and recommendations on asphalt mix  $G_f$  characterization for design.

#### **CHAPTER 2. LITERATURE REVIEW**

#### **Low-Temperature Cracking**

Low-temperature cracking occurs when stress buildup from thermal contraction surpasses pavement tensile strength due to sudden temperature drop and/or repeated temperature fluctuation. The crack typically forms in a transverse direction on the pavement surface. Lowtemperature cracking is affected by material, environment, and pavement-structure geometry (Kliewer et al. 1996). Thermal cracking is a distress that can compromise the structural integrity of the pavement (Behnia et al. 2018), and the primary concern about this distress is the infiltration of water into the pavement structure, which from a durability standpoint increases the rate of moisture and leads to earlier asphalt concrete deterioration. More so, water infiltration promotes pumping of the underlying unbound material, causing depression at the thermal cracks. Ice lenses could also form beneath a thermal crack and in turn would cause tenting of the crack edge (Marasteanu 2007).

Thermal cracks are categorized into two types of events: (1) single-event thermal cracks that occur due to fast cooling, e.g., a drop in temperature from -10°C to -40°C in a span of 24 hours, and (2) thermal-fatigue cracking that can develop due to several cooling cycles and daily temperature fluctuation. There have been great research efforts directed toward characterization and prevention of thermal cracks in pavement, and this has led to the development of mixture-based thermal-cracking performance evaluation tools such as the DCT test, SCB test, and the use of the combination of stiffness and relaxation properties of asphalt mixtures in black space to limit thermal stresses (Oshone et al. 2018).

 $G_f$  is an asphalt mixture fracture parameter that recent studies have identified to have a correlation with thermal-cracking resistance. It is defined as the work that is required to cause a unit square (m<sup>2</sup>) crack to form in a laboratory test specimen. The  $G_f$  is affected by aggregate type, test temperature, the addition of recycled material, and air voids of the mix (Wagoner et al. 2005b, Li et al. 2010). High  $G_f$  indicates that the pavement has high tensile strength and thus can dissipate tensile stress buildup more easily in the pavement at low temperatures when the pavement is under loading.

Oshone et al. (2018) reported a positive correlation between  $G_f$  and properties that include effective binder content, asphalt film thickness, voids in mineral aggregate (VMA), performancegrade high temperature, and performance-grade spread. A good gradation of material ensures adequate VMA and thus sufficient binder. The voids filled with asphalt (VFA) and VMA are critical in mixture crack resistance and durability. Lowering VMA lowers the binder content for that specific air void content and leads to a more economical mixture but less durability.

Fracture temperature, or the critical cracking temperature, is an important aspect of thermalcrack resistance of a pavement. It is a function of the cooling rate and the temperature at which cooling starts and is affected by asphalt type and degree of aging. Warmer starting temperatures shift the cracking temperature (Mensching et al. 2014). The most frequent actual cooling rate in the field is 1°C to 2°C per hour. An increase in cooling rate results in an increase in the fracture temperature. The cooling rate is the temperature drop per unit of time. Most tests have been conducted at a cooling rate of 10°C per hour by investigators; however, field cooling rates are slower than 10°C (Jung and Vinson 1994). Faster cooling rates cause quicker thermal stress buildup and material cracking at a warmer temperature due to the material lacking time to relax (Mensching et al. 2014).

Hot-mix asphalt (HMA) is designed to resist deterioration due to exposure to traffic and environmental loads. Different HMAs are chosen depending on traffic level and geological location, which influence the variability of mixture components such as binder grade and aggregate. Sustainability is one concern of engineers, and this has led to the use of recycled material as a part of pavement construction, as the milled material is reused as 30% of the asphalt components. This, in turn, has an impact on pavement performance, particularly on distress resistance. An asphalt mixture's fracture and viscoelastic properties play a significant role in controlling the ability of the mixture to limit thermal stress and maintain material integrity as the stress approaches the material stress capacity (Oshone et al. 2018).

Dave et al. (2016) recommended the critical selection of asphalt binder for use and argued that the use of asphalt binder with a low-temperature limit warmer than the required grade can shorten the pavement life significantly. They further strongly recommended the use of performance-based specifications that apply laboratory-mix performance tests. Additionally, the oxidative aging effects of the asphalt binder should be considered while determining asphalt crack resistance.

Hoare and Hesp (2000) state that for a pavement to fail at low temperatures, there has to be either poor material selection or an inadequate testing procedure. An understanding of the fundamental failure mechanisms and other material properties that facilitate crack growth at low temperatures is important.

Behnia et al. (2011) observed that the  $G_f$  of an asphalt mixture containing a virgin binder (PG 58-28) was drastically reduced when the recycled asphalt pavement (RAP) amount within the mix gradation exceeded 10%. While the  $G_f$  of mixtures containing virgin binder PG 64-22 initially increased with an increase in RAP amount up to 30%, any increase in RAP amount over 30% decreased the  $G_f$ . Using a different aging procedure, the study also indicated that the fracture energies of the asphalt mixtures increase with aging levels to a peak level where the fracture energies dropped with further aging. Behnia et al. pointed out that this trend will vary from mixture to mixture, between RAP sources, and from varying binder sources.

Marasteanu (2007) in the first phase of a national pooled fund study recommended the critical need for an asphalt mixture specification. Further, it was pointed out that the  $G_f$  of the asphalt mixture is a better parameter to identify an asphalt mixture's low-temperature cracking susceptibility compared to the  $K_{IC}$ . The reason for this being that  $G_f$  depends less on the conditions of linear elasticity and homogeneity of the tested materials.

In the second phase of the low-temperature cracking national pooled fund study, Mihai et al. (2012) proposed a thermal-cracking specification for asphalt mixtures; based on DCT results, a

minimum  $G_f$  of 400 J/m<sup>2</sup> was suggested for protection against thermal cracking. Additionally, based on SCB results, a testing value of 400 J/m<sup>2</sup> was suggested too. These suggested values were determined through a correlation of the fracture data and field thermal cracking. The DCT test was recommended to be included as a requirement in the low-temperature thermal-cracking mix performance-based specification.

The outcome of the studies that determined the correlation has been that many agencies have identified 400 J/m<sup>2</sup> as the passing criteria for mixes tested at the low-temperature grade of the asphalt binder for the DCT test (Mihai et al. 2012). In Iowa, the DCT test is the method used for low-temperature cracking performance of asphalt mix. The criteria established by the Iowa DOT is 400 J/m<sup>2</sup>, 460 J/m<sup>2</sup>, and 690 J/m<sup>2</sup> for traffic levels of standard traffic, heavy traffic, and very heavy traffic, respectively. Dave et al. (2016) concluded that a variation of 25 J/m<sup>2</sup> G<sub>f</sub> is enough to show a difference in cracking performance.

In a study by West et al. (2018), Iowa was among the states that use the balanced mix design approach, one which is Volumetric Design with Performance Verification. At the time of study, only Iowa, Minnesota, and Missouri required a thermal-cracking test in their mix design specifications, and they used the DCT. In the study, it was noted that lowering the number of design gyrations ( $N_{design}$ ) will result in an increase in the optimum asphalt content if aggregate gradation is fixed. Their recommendation was to reduce the  $N_{design}$  level by 20% to 25% depending on the design traffic (West et al. 2018).

The Minnesota DOT (MnDOT) has implemented DCT testing as a requirement to ensure the thermal-cracking resistance of asphalt mixtures at design and production. Additionally, a  $G_f$  limit has been established in its specification. The minimum  $G_f$  during mix design is 450 J/m<sup>2</sup> for traffic levels 1, 2, and 3 and 500 J/m<sup>2</sup> for traffic levels 4 and 5. For quality assurance, the  $G_f$  is reduced by 50 J/m<sup>2</sup> to values of 400 J/m<sup>2</sup> for traffic levels 1, 2, and 3 and 450 J/m<sup>2</sup> for traffic levels 4 and 5 (Oshone et al. 2018).

The SCB test has been used to evaluate the factors that affect  $G_f$ , and these factors were identified to be aggregate type, air voids content, modifier type, and the binder type (Li et al. 2010). Different aggregate requires different amounts of energy for them to crack, and this compounds the total mixture crack resistance. More energy is needed to break a denser asphalt mixture. Li et al. in their research indicated that asphalt modified with different modifiers had different  $G_f$  for the same type of mixture. SCB has also been used to determine the effect of testing configuration on semi-circular bending fracture of asphalt mixture (Nsengiyumva and Kim 2019).

Rivera-Perez et al. (2018) in a study indicated that the FI is an indicator of ductility of the mixture but should be balanced with the stiffness and strength of the mixture. An increase in FI is associated with additional inelastic mechanisms (i.e., plasticity and viscoelasticity) of energy dissipation away from the crack front, which may delay fracture initiation and propagation. The results considered for correlations were those with 8% air void content and below; at 10% air void, the fracture test specimen experiences a high level of non-fracture-related energy

dissipation. However, correction factors proposed by Barry (2016) could be used to correct for the air void content variation.

#### **SCB Test and I-FIT**

The SCB test is an HMA fracture test used at low temperatures. Recently, the SCB test has become favored among researchers, because specimen fabrication is simple and easily reproducible using both standard laboratory-compacted or field-cored asphalt concrete samples. Within this test, two fracture modes can be studied: Mode I or Mode II. The fracture mode depends on the initial notch orientation. For low-temperature tests, such as the Illinois Test Procedure 405 (I-FIT) developed by researchers from the University of Minnesota–Twin Cities and the University of Illinois–Urbana-Champaign and the SCB test according to AASHTO TP 105-13 (both shown in Figure 1), Mode I fracture is used for specimen preparation, testing, and analysis.



Figure 1. I-FIT SCB test, left, and AASHTO TP 105-13 SCB test, right

 $G_f$ , fracture toughness (K<sub>IC</sub>), and stiffness (S) are the parameters determined using the SCB test results according to AASHTO TP 105-13, while the parameters determined using the I-FIT protocol are  $G_f$  and FI (Test- 2007, Li et al. 2010, Marasteanu et al. 2012, Hill et al. 2013, Illinois Test Procedure 405 2016).

The SCB test method for low-temperature cracking was developed due to specifications utilizing only binder tests such as the BBR and direct tension tester (DTT) for characterization of low-temperature performance. These test methods do not include the response from the aggregate phase, even though the aggregate phase makes up 90% to 95% of the total weight of a typical asphalt concrete mixture. To address the impact of the aggregate phase on low-temperature cracking in asphalt mixtures, AASHTO TP 10-13 was developed. Testing takes place at both 10°C above the low-temperature binder grade and 2°C below the low-temperature binder grade. A vertical compressive load is applied at the top of each specimen, so a constant crack mouth opening displacement (CMOD) of 0.00002 in./s (0.0005 mm/s) is achieved. The parameter  $G_f$  is determined as the area under load-CMOD curve, while toughness and stiffness are determined using load and load line displacement (LLD) results recorded for each tested specimen.

The I-FIT was developed to screen out potentially poor-performing mixtures with high amounts of RAP and reclaimed asphalt shingles (RAS) and correlates well to field results and other cracking tests, while still being practical and easily repeatable (Ozer et al. 2016, Rivera-Perez et al. 2018). In contrast to other SCB tests done at low temperatures, the I-FIT includes G<sub>f</sub> and post-peak behavior in the determination of the FI, which has been found to be more effective at differentiating effects due to design factors and mixture aging than G<sub>f</sub> by itself (Barry 2016).

Testing takes place at 25°C with a loading rate of 2 in./min (50 mm/min). Currently, the Illinois DOT has set the minimum criteria for FI at 8, but the I-FIT and FI parameter need to be further calibrated to different traffic levels, climates, mix types, and applications. Further, there are concerns that with the 25°C test temperature for the I-FIT that this does not comply with the principles of fracture mechanics. This is because the test specimens undergo deformation on the millimeter to centimeter scale prior to completion of cracking, and thus the test violates the small-scale yielding condition, so the samples would need to be much larger, e.g., on the scale of meters in diameter.

## **DCT Test**

To examine the fracture mechanics of asphalt concrete at low temperatures, the DCT test is of key interest. The DCT test has received favorable reviews because of its many advantages; the test can be used with field cores that have already undergone dynamic modulus and creep compliance testing, and specimens can be reproduced consistently for use in Mode I fracture testing (Wagoner et al. 2005c, T 322 2007, Test- 2007, Hill et al. 2012, 2013). This test is used to determine the  $G_f$  (Wagoner et al. 2005a, Zofka and Braham 2009, Hill et al. 2013).

For the DCT test, a circular specimen with a single edge notch is subjected to tension as shown on the left in Figure 2.



Figure 2. Schematic of DCT test, left, and clip gauge attached to buttons, right

In this setup, a tensile load is applied at the top and bottom of each specimen to produce a constant CMOD with a constant rate of 0.0007 in./s (0.017 mm/s). An epsilon clip gauge as shown on the right in Figure 2 is used to measure the CMOD. The clip gauge is placed between two buttons that are glued to the flat face of the specimen. The  $G_f$  is determined through load and fitted CMOD results.

The outcomes of the two-phase national pooled fund study on low-temperature cracking (Mihai et al. 2012) identified the relationship between the amount of transverse cracking of field pavements and the  $G_f$  of cores from these pavements (Figure 3).



Figure 3. Relationship between transverse cracking and DCT G<sub>f</sub>

## CHAPTER 3. EXPERIMENTAL METHODS AND MATERIALS

#### Materials

Ten field-produced asphalt mixtures were obtained from projects located in Iowa that represented typical asphalt mixtures used in Iowa. The mixtures were from Fayette, Hamilton, Harrison, Johnson, Lyon, Marshall, Polk, and Union counties. Figure 4 shows the mixture locations, representing five of the six Iowa DOT districts.



#### Figure 4. Mixture locations and regional recommended Project I type binder grade in Iowa

Note that Project I types are full depth hot-mix asphalt, HMA + cold in-place recycling, HMA + rubblization, HMA + crack and seat HMA overlay >4 in., and HMA + full-depth reclamation (FDR).

Five mixtures were from the old design, and the other five mixtures were from the new design. The mixtures had different binder grades and aggregate gradation, VMA, VFA, binder content, and varying percentage of the recycled material as shown in Table 1.

## Table 1. Mixture properties

			Binder				<b>Recycled material %</b>	Traffic	
Mix	Year	Binder type	content	VMA	VFA	AFT	in mix	level	District
1	2013	PG58-28	5.33	16.7	76.1	10.84	11% RAP, 4% RAS	High	3
2	2014	PG64-22w/hG	5.28	16.8	76.1	10.22	9.5% RAP, 5% RAS	High	1
3	2013	PG58-28	5.33	16.7	76.1	10.84	5% RAP, 4% RAS	High	3
4	2013	PG64-28	4.49	13.2	69.7	8.43	12% slag, 34% RAP	High	6
5	2014	PG58-28	5.48	16.8	76.1	10.22	9.5% RAP, 5% RAS	High	1
6	2018	PG58-28V	4.75	13.9	71.2	9.3	19% RAP	Very high	1
7	2018	PG58-34H	5.34	14.4	72.3	9.85	15% RAP	High	2
8	2018	PG58-28S	5.89	14.7	72.7	8.71	-	Standard	4
9	2018	PG58-28H	5.36	15.3	73.8	14.45	15% RAP	High	4
10	2018	PG58-28S	5.02	14	71.3	8.74	17% RAP	Standard	1

Note: AFT = Asphalt film thickness





Figure 5. Old Ndesign aggregate mix gradations



Figure 6. New Ndesign aggregate mix gradations

For the aggregate gradations, most of the aggregate sizes are in the range of 0.04 in. (1 mm) to 0.5 in. (12.5 mm). Although the Ndesign involves lowering the number of design gyrations, this was not evident between the old and new Ndesign gradation as there were not significant differences between asphalt content when lowering gyration levels based on traffic level design.

#### Methods

The overall test plan is shown in Figure 7.



Theoretical maximum specific gravity ( $G_{mm}$ ) was determined using AASHTO T 209-12. The loose mixtures were heated to 90°C, the conglomerates were separated to form fine particles of 0.25 in. (6 mm,) and the process was carefully done to prevent fracture of the aggregate. After cooling, 2,500 grams from the mixtures were measured per mix. Using the  $G_{mm}$  test container, the weight of the sample and container were recorded, as well as the weight of the container immersed in a water bath. Water was added to cover the sample in the vacuum equipment; a vacuum between 1 in. (25.5 mm) and 1.2 in. (30 mm) of mercury was applied. During the vacuum period, the container and the contents were agitated using a mechanical vibratory device. After 15 minutes, the sample was immersed in a water bath for 5 minutes, and the weight was recorded; the  $G_{mm}$  was then calculated.

The samples were cut to achieve the configuration specified for each test. Water was used while cutting to cool the saw and to wash away small particles to prevent smearing. A bulk specific gravity ( $G_{mb}$ ) test of the specimen was carried out following ASTM D2726. The samples were left to dry after cutting, and their dry weights were recorded. Each sample was then immersed in water for 5 minutes, and the immersed weight was recorded; the sample was then removed from

the water, and the surface wiped with a damp towel to achieve saturated surface dry condition. They were then weighed, and the weight recorded. The  $G_{mb}$  was then calculated.

The specimen air voids were calculated using the obtained  $G_{mm}$  and  $G_{mb}$  to identify the specimen that met the required air void criteria of 7%  $\pm$  0.5% to be used for DCT, SCB, and I-FIT tests. To determine the fracture energies of the compacted sample, specimen preparation was done following ASTM and AASHTO specifications for the respective tests. They were a conditioned for minimum of two hours at the test temperature, and then DCT, SCB, and I-FIT were carried out, and four replicates were used per mix per test.

## DCT

The DCT tests were carried out in accordance with ASTM D7313-13. The different mixture specimens were tested at 10°C higher than the lower limit temperature of the performance grade, i.e., for PG 64-22, the samples were tested at -12°C, and most of the samples were tested at -18°C. A 0.04 in./min (1.0 mm/min) rate of CMOD was used. Continuous load and CMOD were measured and recorded using the test computer, and a plot of load-CMOD was also obtained. G<sub>f</sub> is computed as the area under the load-CMOD curve; the equipment used calculated the G<sub>f</sub> value immediately when the specimen fails under loading.

#### SCB

Following AASHTO TP 105-13 (2015), the SCB tests were carried out with a constant CMOD of 0.00002 in. (0.0005 mm) to ensure the crack growth condition is stable at 10°C higher than the PG lower limit. LLD was measured and recorded using universal testing machine (UTM) equipment. MATLAB was used to plot load and LLD, and  $G_f$  was calculated as the area under load-LLD curve.

Table 2 shows a sample of the raw data obtained from an SCB test of one of the mixtures.

Time	CMOD	Load	Stroke	LLD	Ext	Temp
(seconds)	(mm)	(KN)	(mm)	(mm)	(mm)	(°C)
0	4.3736	-0.005	-18.419	9.554	0.005	-18
0.1	4.3742	-0.011	-18.424	9.56	0.006	-18
0.2	4.3738	-0.005	-18.417	9.562	0.005	-18
0.3	4.3731	-0.002	-18.409	9.557	0.004	-18
0.4	4.3736	-0.003	-18.412	9.564	0.005	-18
0.5	4.3736	0.001	-18.406	9.566	0.005	-18
0.6	4.374	0.006	-18.398	9.575	0.005	-18
0.7	4.3741	0.013	-18.391	9.585	0.005	-18
0.8	4.3739	0.019	-18.386	9.588	0.005	-18
0.9	4.3738	0.026	-18.383	9.59	0.004	-18
1.0	4.3744	0.039	-18.377	9.598	0.005	-18
1.1	4.3748	0.059	-18.373	9.603	0.006	-18
1.2	4.3743	0.05	-18.369	9.599	0.005	-18
1.3	4.3757	0.061	-18.367	9.609	0.007	-18
1.4	4.3741	0.058	-18.351	9.592	0.004	-18
1.5	4.374	0.044	-18.35	9.592	0.004	-18

Table 2. Sample of SCB raw data of one sample as obtained during the test

#### I-FIT

The I-FIT was used for the intermediate warmer temperatures and was carried out as per Illinois Test Procedure 405 (2016). The specimens were conditioned at 25°C. A loading rate of 2 in./min (50 mm/min) was applied constantly for the duration of test. Similar to SCB testing, the load and LLD were measured, and the  $G_f$  was calculated as the area under load-LLD curve, and this value was further used to calculate the FI.

Table 3 shows a sample of the raw data obtained from an I-FIT of one of the mixtures.

			Displacement	Displacement
	Time	Load	Channel 1	Channel 2
Point	<b>(s)</b>	(KN)	( <b>mm</b> )	( <b>mm</b> )
1	0.000	0.08	0.000	0.000
2	0.025	0.11	0.008	0.010
3	0.050	0.27	0.029	0.036
4	0.075	0.47	0.050	0.060
5	0.100	0.68	0.070	0.084
6	0.125	0.89	0.090	0.105
7	0.150	1.11	0.110	0.129
8	0.175	1.33	0.131	0.152
9	0.200	1.55	0.150	0.176
10	0.225	1.78	0.170	0.198
11	0.250	2.02	0.191	0.223
12	0.275	2.25	0.213	0.248
13	0.300	2.46	0.232	0.270
14	0.325	2.67	0.252	0.295

 Table 3. Sample of I-FIT raw data of one sample as obtained during the test

#### **CHAPTER 4. TEST RESULTS**

#### **DCT Results**



The average  $G_f$  value ranged from 265.25 J/m<sup>2</sup> to 470.00 J/m<sup>2</sup> as shown in Figure 8.

Figure 8. Average DCT fracture energies for the mixtures

Mixture 1 is the only mixture that met the  $G_f$  value of the criteria it was designed for, having a  $G_f$  value of 470 J/m<sup>2</sup>, and it was designed for a minimum value of 460 J/m<sup>2</sup>. Mixtures 8 and 10 were designed for standard traffic, and they do not meet the specification of 400 J/m<sup>2</sup>, as they have  $G_f$  values of 381.25 J/m<sup>2</sup> and 330.50 J/m<sup>2</sup>, respectively. Mixtures 3 and 6 have  $G_f$  values that meet the criteria for standard traffic; however, they do not satisfy the specification for high traffic value of 460 J/m<sup>2</sup> as shown in Figure 9.



Figure 9. Comparison of DCT G<sub>f</sub> obtained to the expected minimum values as per the specification

Mixtures 2, 4, 5, 7, and 9 did not meet their designed traffic specification minimum values nor the standard traffic specification value. Mixture 4 had the lowest fracture resistance, and the highest percentage of recycled material using slag; however, this does not mean the recycled material caused the low  $G_f$ , as other mixtures with no or little percentage of recycled material also did not have  $G_f$  values for the standard traffic specification. Mixtures 2 and 4 have 64°C as the upper temperature limit, and the  $G_f$  values obtained were lower than the other mixtures with a lower value of upper performance-grade temperature limit.

Mixture 3 had the lowest variance in the results followed by Mixture 10 and Mixture 4. Mixtures 2, 6, and 8 had the highest variance followed by Mixture 1, while Mixtures 5, 7, and 9 had variances between Mixture 4 and Mixure 7. The Ndesign for Mixtures 6 to 10 had DCT G<sub>f</sub> mean values that were within a small range.

Figure 10 shows a box plot of the DCT test results for all 10 mixtures.





An increase in RAP caused a reduction in the DCT test fracture energies. This can be attributed to the fact that the RAP had binder that is old, and hence it's stiff and cannot resist fracture. As the binder ages, it exhibits less ductility and thus requires a small amount of energy to fracture.

Figure 11 shows the effect of RAP on the  $G_f$  from the DCT results.



Figure 11. RAP effect on DCT G<sub>f</sub>

A high film thickness of the binder causes an increase in DCT fracture resistance up to an optimum value, after which the DCT  $G_f$  value decreases with an increase in film thickness. A sufficient asphalt content is required, just enough to coat the aggregates and bond them together. From the trend line shown in Figure 12, it is apparent that as film thickness increases, the  $G_f$  will increase, thus improving mix performance against low-temperature fracture.



Figure 12. Effect of film thickness on DCT G<sub>f</sub>

However, when the film thickness became greater than 12  $\mu$ m, as shown in the figure, performance decreased.

#### **SCB Results**

The average  $G_f$  values from the SCB results ranged from 485 J/m<sup>2</sup> to 1,102 J/m<sup>2</sup>, as shown in Figure 13.



Figure 13. Graph of average SCB Gf of the mixtures

Mixture 2 had the highest SCB  $G_f$ , while it was among the low DCT  $G_f$  values. Mixture 1 had higher values for both DCT and SCB tests compared to the other mixtures. There was no trend noticed between SCB and DCT  $G_f$  values of the mixtures. This could be attributed to the differences in testing configurations of the specimens and the loading rate.

Mixture 10 had the lowest variance for SCB testing, of which this was also observed in the DCT results. Mixture 6 had the second lowest variance while Mixtures 7, 8, and 9 had the highest variance of the five mixtures. Mixtures 7 and 9 had outlier results, which were not used in calculating those mixtures' average mean fracture energies.

Figure 14 shows a box plot of the SCB test results for all 10 mixtures.



## Figure 14. Box plot of SCB G<sub>f</sub>

An increase in RAP caused a decrease in the SCB  $G_f$  as shown in Figure 15. This was also observed from the fracture energies of the DCT tests.





An increase in film thickness caused a decrease in SCB fracture energies (Figure 16).



Figure 16. Effect of film thickness on SCB Gf

If asphalt is concentrated in the same point of the mixture, it gives a weak point for fracture and especially in low temperatures, as it becomes plastic; hence, low energy is needed to cause a crack.

#### **I-FIT Results**

The FI was calculated from the  $G_f$  obtained during I-FIT testing (Illinois Test Procedure 405 2016). All FI values are about 8.0, which is the minimum recommended value for both HMA and stone-matrix asphalt (SMA) asphalt mixtures (Figure 17).


Figure 17. Graph of average FI of the mixtures

Mixture 7 had the lowest value of FI, and this could be related to the performance-grade lower limit temperature, which was lower than the other mixtures' performance-grade lower limit temperatures.

Generally, the mixtures had low variance as shown in the box plot in Figure 18.



Figure 18. Box plot of FI

Mixture 4 had an outlier, which was not used when calculating the mean FI. Mixtures 1 and 2 had the highest variance as compared to the other mixtures.



Figure 19 shows the effect of RAP on the G<sub>f</sub> from the I-FIT results.



An increase in film thickness caused an increase in FI (Figure 20), of which this trend was also observed in the fracture energies of the SCB tests.



Figure 20. Effect of film thickness on FI

### **Test Temperatures and Coefficients of Variation**

All the mixtures have coefficients of variation (COV) below the recommend 25% for SCB and DCT tests, as shown in Table 4.

	Test		DC	T	SCI	3
	temperature					
Mixture	(°C)	Reps	Mean	COV	Mean	COV
1	-18	4	470.00	13.53	907.20	15.23
2	-12	4	308.25	23.23	1102.00	17.52
3	-18	4	436.00	2.61	584.00	20.34
4	-18	4	265.25	13.37	670.00	18.68
5	-18	4	347.00	15.46	514.00	13.56
6	-18	4	412.75	18.16	609.75	17.39
7	-24	4	391.75	14.30	650.80	23.20
8	-18	4	381.25	21.79	905.75	21.49
9	-18	4	287.50	17.45	548.25	23.56
10	-18	4	330.5	6.57	485.17	13.52

Table 4. Test temperatures	and COV for SCB and DCT
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Mixture 2 had the highest COV for the DCT test, at 23.23%, and Mixture 9 had the highest COV for SCB, at 23.56%, and the rest of the COV values were in the range of 2.61% to 21.79%.

Mixture 8 had COV values that were similar to one another based on results from both tests. This is an indicator that Mixture 8 met the required COV.

Table 5 shows the test temperatures and COV results from the I-FIT testing.

	Test		I-F	TT
	temperature			
Mixture	(°C)	Reps	Mean	COV
1	25	4	14.93	33.71
2	25	4	17.57	35.56
3	25	4	18.29	13.95
4	25	4	23.32	32.21
5	25	4	17.93	0.44
6	25	4	15.28	16.03
7	25	4	8.36	7.52
8	25	4	15.05	7.79
9	25	4	14.47	4.60
10	25	4	12.65	15.09

Table 5. Test temperatures and COV for I-FIT

### **Overall Analysis**

A JMP analysis of the  $G_f$  indicated: (1) based on the DCT and SCB results, Mixture 1 was significantly different from Mixtures 2, 4, 5, 9, and 10, while Mixture 2 was significantly different from Mixtures 1, 3, 6, and 7; (2) Mixtures 4, 5, 9, and 10 were not significantly different; and (3) RAP content was observed to be the factor that most affected  $G_f$  for the mixtures used in this study.

### **CHAPTER 5. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS**

The mixtures'  $G_f$  values of the DCT tests did not meet the design criteria for the traffic level, meaning that the fracture energies of the field-produced mixtures were lower than the value they were designed for demonstrated by the sample mixtures used in this study. It should be noted that the mixtures may have had low fracture energies because they had undergone more aging after mixing; during the laboratory tests, the mixtures were heated before compaction and before the  $G_{mm}$  tests.

DCT tests were not required for the laboratory-produced mixtures during construction since the binder replacement was less than 30% for mixtures with RAP and 25% for RAS. Additionally, the majority of mixtures studied in this work did not meet the requirement for DCT testing for their laboratory-designed mixtures and yet did not achieve  $G_f$  for their designed traffic volumes. The specification on the need for a DCT test should be revised to state that the test is required when the asphalt binder replacement exceeds 15% for mixtures with RAP and RAS, rather than the current value of 30% and 25% binder replacement, respectively.

The pavements that are still in use and have not had any major rehabilitation or maintenance activities show that these pavements have an adequate amount of cracking resistance as they have been able to carry the loads they were designed for. However, the laboratory tests on the mixtures show low cracking resistance and therefore a need for revising the specification or improving the quality-control process, just as MnDOT has allowed a 50 J/m<sup>2</sup> range for quality assurance.

A pavement distress survey is recommended that focuses more on the intensity of thermal- and transverse-cracking distress over the years to assess the field performance of the pavements used in this study in relation to the DCT testing results.

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Gradation					Mix	tures				
(mm)	1	2	3	4	5	6	7	8	9	10
25	100	100	100	100	100	100	100	100	100	100
19	100	100	100	100	100	100	100	100	100	99
12.5	97	97	97	94	97	96	98	97	95	90
9.5	88	90	88	86	90	89	89	88	90	79
4.76	69	64	69	59	64	62	63	70	77	59
2.36	43	47	43	40	47	45	46	50	41	40
1.18	26	33	26	28	33	30	34	34	23	30
0.85	15	19	15	17	19	19	24	23	15	24
0.3	9.2	8.3	9.2	8.9	8.3	9.4	12	7.7	6.4	11
0.15	5.6	5.1	5.6	4.8	5.1	5.2	4.8	3.8	3.4	5.5
0.075	3.9	3.9	3.9	4.2	3.9	3.9	2.9	3	2.6	4.3

### Table 6. Mixture aggregate gradation

	. 1	- 47 pr	4 . X			•			Ari	SC	5	-2	CO.	g - 1	4						
4/25/13	ver.9.05	10/8/2014	Ser.	•			1 23	0		SPHALT PAL	ING DAL	V PLANT	PEPOPI	-	l			•			
Activ	e Project No.	MP-017-1(7	05)076-7	7			ALC: NO	Contractor	IN DOT A	DM	AD	LT FLANT	REFOR	_		~		10/	6/14 3:59	PM	
	Contract ID:	77-0171-70	5 - 1	25		-		County:		Po	lk		_ /	Active Placement:	21	Surface (T	ravel Lane		_	Report	No.: 3
Mi	x Design No.:	1BD14-065	- ····································				RAP	Stockpile ID	7.8% (ABC9-	-100) ABC14-00	80 (7.4% A	.C)	-	Active Bid Item	2303-0041	Surface	f 1/2 L-2 (HI	(HMA)	- La	b Voids Ta	arget: 4.0
		UNCOMPACT	ED MIXTUR	E S			-	CO	MPACTED JOI	INT			-		2000 00 1	COMPACT	ED MAT	(TIVA)	E De	sign Gyrat	ions: 86
Hot Box I.D.	HB-A	HB-P	1 .	1	T		Core		T	T			1	1	1	T	LOMAT	Cores hay	e been wa	T	×.
(Theoretical %AC)	(5.01%)	(4.99%)		1.			,#	Station	Joint ID	G <sub>mb</sub>	Core	Placement	Station	CL Reference	W1	W2 in H20	W3 Wet	Gmb	% of	P. (%)	Thickness (in.)
Date Sampled	10/8/14	10/8/14		1			. 1	1					1.0		019 (9)	(9)	(9)		Grann		e.
Time	1:55 PM	2:00 PM		84			2						+				-			1	
Station	+367+00	1					3						+								
Side 🐁	2L-SB\WE	3	1	-			4										-				
Sample (Tons)	459.54	523.44					5														-
G <sub>mb</sub>	2.383	2.384	×		-		6						+								2.00
Gmb (DOT)		1					7		10				-					-	3		**
G <sub>mm</sub>	2.474	2.475			-					1							-	1	-	1.	
Gmm (DOT)					1		9		1		8						-	1997 P. 1. 1.	-		~
P. (%)	3.7	3.7					10				1					-		1	1.10		
P. (%) (DOT)				1	1		11		he in										· · · · · ·		E.
				Avg Gmh	Avg G <sub>mm</sub>	Avg Pa (%)	12														
				2.384	2.475	3.7	-	Average	G_s					Curfage (Terry		1			· •/		
					1		L		- 110	1	1	Cours	se Placed:	Sunace (Trave	ei Lane)			. Thi	ckness QI:		
	1	GRADAT	ION (%Pass	ing)		Use DOT	-	USE	0.0.T. RESI	ILTS *	7	Intended Lift	Thickness:	2.00	) ,			Avg. Ma	at Density:	1.	
Sieve	Specs	CFA 10-08-			Avg	District		*	(Enter an 'X')			Tas	t Data/Ru	10/08/	14			Avg.	% of Gmb:		
1 in.	100	100.0			100.0							165	a Date/By:					Avg. % F	eld Voids:	with	
3/4 in.	100	100.0			100.0																
1/2 in.	90-100(97)	99.0		1	99.0		-		EST STRIP		<b>1</b> Q.	l. (lower) =					=		$\rightarrow$	PWL (lov	wer)
3/8 in.	83-97(90)	92.0			92.0		1.	2.0	Enter an "X")						2					=	
- #4	57-71(64)	66.0			66.0					-											
* Dev	± 7.0	2.0			2.0		111	1			a Q.I	. (upper) =					=		$\rightarrow$	PWL (up	per)
•#8	42-52(47)	46.0	1.1		46.0			FILM THIC	KNESS (FT) (	8.0-15.01	7									-	
*Dev	± 5.0	-1.0			-1.0			FT .		10.0	PV	VL (total) =			+		-	-	100.0	=	ļ
#16		31.0			31.0		-	Price Adiu	Istment	10.9	Carina										
-#20	15-23(19)	18.0			18.0	-	L	indo i taja	ounen	30.00		may be warved	per Enginee	r approval (2303.0	3, D, 4, a, 3).				Pav	actor -	
#30	+40	10			10.0														rayi	actor -	1
#EO	± 4.0	-1.0			-1.0			Gyrato	ry VMA [15.8-1	17.8]	Tons	of Mix for PWL	Field Void	s Analysis (00.00	205	C.4			and the second second		
#100		0.5			8.5			VMA,	%	15.5				deducted)=	300	.01	Field Void	as Price Adji	ustment =		
#100	1050.00	4.8			4.8																
#200	1.9-5.9(3.9)	3.8			3.8			QUANT	ITY FOR PAYN	MENT					TEMP	ERATURE.	F				
Cradation O	± 2.0	-0.1			-0.1		1	Mix Unit Pric	e (\$/ton)	\$€0.00		Time	7:00	9:00	11:00	1:00	3:00	5:00	7:00	Snec	Comph/2
Gradation Co	mpliance?	Yes			Yes		Bi	nder Unit Pri	ice (\$/ton)	\$550.00	A	Air Temp	46	50	61	67	71	71		opeo	Gompiy
DBR	0.6 - 1.4	0.78			0.78		-	Tons of Mix o	on Road	385.61	Bir	nder Temp			306	308				260-330	°E Var
% +4 Type 4	80	#DIV/0!	0.8	N61	#DIV/0!		To	ns to Other B	Bid Item(s)		PI	ant Temp			328	330				225-330	°E Vac
% +4 Type 3		#DIV/0!		1	#DIV/0!			Tons of B	inder	20.37	N	lat Temp			305	300	205			225-330	e ve
(+4/-4) Type 2	25/0	#DIV/0! -	14		#DIV/0!		4	Tons of V	Vaste				-		000	500	235			220-000	F tes
		#	DIV/01				Т	ons of Binde	er to Date	1		Break Dow	Wix Chang	e Information (whi	tdown	are made to	tart the day	identify the		iouo daula	
-						2		Tons of Mix	to Date			Rain Out		Old Target				, identity the	in on piev	ious days	report):
		BINDER	2					PLACE	MENT RECOR	RD /	L	1	<b></b>	Old Target	New Target	ions	Agg	Initial %	New %	Agg I	nitia New %
		Target	Actual	Spec	Comply?	From S	tation	Tos	tation	Lane	Midth (6)										
% Added 8	Binder	4.20	4.44	N/A		- Toni G		100		Lane	ν ποιο (π)										
% Total B	inder	5.30	5.28	5.00-5.60	Yes			Station de la company													
% RA	P	9.50	7.81%	≤100%	Yes		-														
% R4	s	5.00	4 11%	< 5%	Yes								L								
% Binder Rep	lacement	19.33%	15.91%	\$ 30%	Yes								Comment								
PG Gra	de	64-2	2	58-28	No	Contification	Taak						1st sample	e was a road box	k at 459.54	tons, 2nd sa	ample was	from the pl	ant at 52	3.44 tons	
Binder replaceme	int exceeded	Binder grade de	es not como	NAC > 0 20	different the	Certified	Tech:		Ryan Horr	1	Cert. No. C	21316									
Gb:	1.03193 I	Gsb:	2.652	Phe (%):	4.87	Distrik	-	D 11	Den Glawio		Cert. No. 5										
Contraction of the second					4.07	Usinbution	h	uist. Materials	Proj. E	=ngineer	Contractor	-									

Form 955 ver. 10.16

#### **Iowa Department of Transportation** Highway Division-Office of Materials Proportion & Production Limits For Aggregates

	FOIK		Project No.: MP-	017 <b>-1(7</b> 05)076-	.77		Date:	04/01/14	
Project Location:	From Iowa	141 to NV	V 158th Avenue		M	ix Design l	No.:	1BD14-0	65
Contract Mix Tonn	age:	1,597	Course:	Surface		Mix Si	ize (in.):	1/2	
Contractor:	DMAP		Mix Type	: HMA 3M		Design Li	ife ESAL's:	3,000,000	)
Material	Ident #	% in Mix	Producer & Lo	cation	Type (A or B)	Friction Type	Beds	Gsb	%Abs
3/4 Chips	A85006	5.5%	Martin Marietta/Ames Mi	ne	А	5	47	2.655	0.88
1/2 Add Rock-Quartzit	ASD002	9.0%	Lg Everist Inc/Dell Rapid:	s E. Minnehaha (	А	2		2.652	0.42
3/8" Washed Chips L4	A85006	21.5%	Martin Marietta/Ames Mi	ne	Α	4	49	2.652	0.78
Manufactured Sand	A85006	32.5%	Martin Marietta/Ames Mi	ne	А	5	47	2.666	0.71
Asphalt Sand	A77504	17.0%	Hallett Materials Co/Denr	y-Johnston	Α	4		2.648	0.69
RAP/RAS	ABC9-100	14.5%	9.5% RAP/5% RAS (7.8%	AC)	А	2	BC14-008	2.606	1.80
Type and Source of A	Asphalt Bin	der:	St. F	aul Park Refiner	y Co. LLC	(St. Paul F	>		
		Indi	vidual Aggregates Sieve	Analysis - % Pa	ssing (Ta	irget)			

		Indi	vidual Agg	gregates S	ieve Anal	ysis - % Pa	ussing (Ta	rget)			
Material	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
3/4 Chips	100	100	60	31	5.0	2.5	2.0	1.7	1.5	1.2	1.0
1/2 Add Rock-Quartzite	100	100	99	81	10	1.5	1.0	1.0	1.0	1.0	1.0
3/8" Washed Chips L4	100	100	100	86	18	2.5	2.0	1.8	1.7	1.3	1.0
Manufactured Sand	100	100	100	100	97	68	39	20	8.0	5.0	3.5
Asphalt Sand	100	100	100	100	95	88	76	41	8.0	1.0	0.8
RAP/RAS	100	100	98	93	80	65	50	38	30	23	18

Preliminary Job Mix Formula Target Gradation

Upper Tolerance	100	100	100	97	71	52		23			5.9
Comb Grading	100	100	97	90	64	47	33	19	8.3	5.1	3.9
Lower Tolerance	100	100	90	83	57	42		15			1.9
S.A.sq. m/kg	Total	4.56		+0.41	0.26	0.38	0.54	0.55	0.51	0.63	1.26

Production Limits for Aggregates Approved by the Contractor & Producer.

Sieve	5.5%	of mix	9.0%	of mix	21.5%	of mix	32.5%	of mix	17.0%	of mix	14.5%	of mix
Size	3/4 C	Chips	1/2 Add Ro	ck-Quartzite	3/8" Washe	ed Chips L4	Manufact	ured Sand	Aspha	lt Sand	RAP	/RAS
in.	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
3/4"	98.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
1/2"	53.0	67.0	95.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
3/8"	24.0	38.0	74.0	88.0	79.0	93.0	100.0	100.0	100.0	100.0		
#4	0.0	12.0	3.0	17.0	11.0	25.0	90.0	100.0	88.0	100.0		
#8	0.0	6.0	0.0	6.0	0.0	6.0	63.0	73.0	83.0	93.0		
#30	0.0	4.0	0.0	4.0	0.0	4.0	16.0	24.0	37.0	45.0		
#200	0.0	1.5	0.0	1.5	0.0	1.5	0.0	5.0	0.0	1.5		

 Comments:
 Signatures on file in District 1 Materials Office

 Copies to:
 DMAP
 Rex Kinkade
 Cheryl Barton
 Rita Eichhorst

 Vicky Rink
 Jefferson RCE
 Mark Trueblood
 Central Materials

The above target gradations and production limits have been discussed with and agreed to by an authorized representative of the aggregate producer.

Signed:

Producer

Signed:

Contractor

1B1 5-2-4 DCT

Ec	m	036	Ver	10.16
-ro	um	930	vei.	10.10

# Iowa Department of Transportation Highway Division - Office of Materials HMA Gyratory Mix Design

N.I.				I LUIL I	o ji ucor ji inina	Design	L	ting Data			
Nmax Country 1		Dalle		Designed	MD 017 1/	70510 76 77	Ľ	May No. 4	101	14.065	
County : Min Circ Cr. X.		FOIK	T	Project :	DMAD	105,010-11		MIX NO. :	77.0	171 705	
Mix Size (in.):		1/2	Type A	Desire Life		2 000 000		Contract #:	,,,,	/01/14	
Mix Type:		HMA 3M	L - 2	Design Lite	ESALS:	3,000,000	E I 10	Date:	04	/01/14	
Intended Use :		Surface		Location :	MP 0 - 7		From Iowa 141	to NW 158th AV	enue		<b>F</b> 1 1
Aggregate		% in Mix	Source ID		Source Locat	ion	Beds	Gsb	%Abs	FAA	Friction
3/4 Chips		5.5%	A85006	Martin Mai	rietta/Ames I	Mine	47	2.655	0.88	46.0	5
1/2 Add Rock-Qu	artzite	9.0%	ASD002	Lg Everist l	inc/Dell Rap	ids E. Minnel	h	2.652	0.42	47.0	2
3/8" Washed Chi	ps L4	21.5%	A85006	Martin Mar	rietta/Ames I	Mine	49	2.652	0.78	46.0	4
Manufactured S	anđ	32.5%	A85006	Martin Mar	rietta/Ames I	Mine	47	2.666	0.71	47.0	5
Asphalt Sand	1	17.0%	A77504	Hallett Mat	erials Co/De	nny-Johnstor	n	2.648	0.69	40.0	4
RAP/RAS		14.5%	ABC9-100	9.5% RAP/	5% RAS (7.	8% AC)	ABC14-0080	2.606	1.80	43.9	2
					0.1.	0.1.: (					
			Job	Mix Formula	- Combined	Gradation (S	sieve Size in.)				
1" 3/	4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	# <b>2</b> 00	
					Upper Tol	erance					
100 10	0	100	97	71	52		23			5.9	
100 10	0	97	90	64	47	33	19	8.3	5.1	3.9	
100 10	0	90	83	57	42		15			1.9	
					Lower To	lerance					
Asphalt Binder S	ource	and Grade:	St. Paul Park Refi	nery Co. LLC (St	. Paul Park, MN					·	
Adjust grade	to PG	58-28		· · · ·	Gvratory Da	ta					
% Aspha	lt Bind	ler	4.75	5.25	5.48	5.75			Number	of Gyrations	
Corrected G	nh @]	N-Des	2 342	2 363	2.369	2 376	1		N-	Initial	
May Sn (	10 (Gr	nm)	2.184	2.505	2 468	2.67				7	
Max. opA	N L		2.404	00 2	2.400	2.405			N.	Design	
% Ginin (e	g ix- m	11181	01.1	00.2	00.7	69.2			14-1	96	
%Gmm (	@ N-M	lax	94.5	95.9	96.3	90.7			N	00 Maria	
% A1r	Voids		5.7	4.4	4.0	3.5			IN	-Max	
% V	MA		17.1	16.8	16.8	16.8				134	
% N	/FA		66.5	73.7	76.1	78.9			<u>Gsb for</u>	Angularity	
Film Tl	nicknes	s	9.01	9.89	10.22	10.66			Me	<u>thod A</u>	
Filler B	it. Rati	0	0.95	0.86	0.84	0.80			2	.651	
G	se		2.693	2.701	2.707	2.713			<u>Pba / %</u>	Abs Ratio	
Р	be		4.11	4.51	4.66	4.86			(	0.52	
Р	ba		0.62	0.73	0.82	0.90			Slope of	Compaction	
% New Ast	halt B	inder	77.2	79.5	80.4	81.3				Curve	
Combined	Gh @	25°C	1.0300	1.0300	1.0300	1 0300				16.9	
	00 (6)		110000	1.0000	1.0000		Contribution		Mix	Check	
Aggregate Type Lice	аl	٨	I			Combined	Erom RAM			Poor	
Aggregate Type Ose	u	2650		0 Chinter	T 1 (1 1)	55.2	2.5		Dh Day	noe Cheels	
G <sub>sb</sub>		2.030		% Friction	1 Type 4 (+4)	55.2	2.5		1 00	ige Check	
$G_{sa}$		2.712			Or Better	80.4	4.0		1.00		
% Water Abs		0.86		% Friction	1 Type 3 (+4)	0.0	0.0		RAN	<u>A Check</u>	
S.A. m <sup>2</sup> / Kg.		4.56			Or Better	25.2	2.1			OK	
Angularity-metho	d A	43		% Friction	a Type 2 (+4)	25.2	2.1				
% Flat & Elonga	ted	1.0		% Friction	n Type 2 (-4)	1.4	0.0		Specific	ation Check	
Sand Equivaler	t I	93		Type 2 Finer	ness Modulus	0.9	0.4		C	omply	
Virgin G. @ 25	°C	1.03			% Crushed	81.0	10.8		Moisture Se	nsitivity Check	
Anti-Strip Dose (	~ %)	0.00						s	IP (0% AS)=14 187		
Stringing Infloation	Doint	14 197									
Suppling Inflection	rona	14,107	alt contont of	5 50/		I dad to start :	this project	P	lease choose AS Do	sage if feq.	
Disp		i. Allaspi	an content of	<u>3.376</u>	is recommen	ided to start	inis project.				
Data show	vn in	<u>5,48%</u>	column is inf	terpolated fro	om test data.						
TI	ne % A	ADD AC to s	start project is	4.4%							
Comm	ente '	Final approx	al based upo	n plant produ	ced mix						
Comm	- ints .	т пагарргоу	a vaseu upo	a plant produ	ieed mix						
Copie	s to :	DMAP		Rex Kinkad	le	Cheryl Barto	n	Rita Eichhor:	st	Vicky Rink	
		Jefferson RC	Œ		Mark Trueh	lood		Central Mate	rials	*	
				01.01.0			<u> </u>				
Mix Designer & Ce	rt.# :	Thu	isman	CI-515		Signed :	Cheryl L. Ba	rton, District	1 Materials		

4/25/13	ver 11 07	10/3/2018					4	2 ION														
Activ	re Project No	IMX-035-5	(108)131(	02-40			123	Contractor	IN DOT A	MANATTO	AVIN	GDA	ALY PLAN	REPORT								
	Contract ID	85-0355-10	09			_		County.		HAM	ILTON	AME	5		Active Placement		Surface (T	ravel Lan	e)		Repo	rt No. 15
M	ix Design No.	1BD18-011				_	RAP	Stockpile ID		1RAP15-02	21 (4.9	% AC)			MIX Type Active Bid Iten	2303.105	Surface L	- 2 1/2 (H	MA)		ab Voids	Target 4.0
Samples from m	ultiple days	UNCOMPAC	TED MIXTUR	E				COMP			- 1					2000-100	3302 11 30	RF 1/2IN L		D	esign Gyra	ations 95
Hot Box I D	D1-		D1-	D1-				COMP)	ACTED JOI								COMPACT	ED MAT				
(Theoretical	006891	D1-006893	006894	006890			Core	Station	laint (D	~			Date of			1 144			1	7		
%AC)	(5.02%)	(4.97%)	(4.94%)	(5.02%)			#	Station	JOINT (D	Gmb		Core	Placement	Station	CL Reference		W2 in H20	W3 Wet	Gmb	% of	P. (%)	Thickness (i
Date Sampled	10/3/18	10/3/18	10/3/18	10/2/18			1				-11	1	10/4/201	8 272+2	2 8 0 0000	5.7 (9)	(9)	(9)		Gmm		
Time	8:30 AM	11:00 AM	1:50 PM	1:20 PM			2					2	10/4/201	8 205+8	5 6.0 SWV Pas	s						
Station	382+55	345+00	306+00	410+00			3					2	10/4/201	8 217+1	0.0 SW Pas	s						
Bar Code ID	D1-00689	1 D1-006893	D1-00689	4D1-00689	hd							4	10/4/201	8 331+6	4.0 SIV Pas	S	+					
Sample (Tons)	195.00	661.00	1,250.00	1,250.00				Averag	e Joint Gash			5	10/4/2011	9 252 5	2 0.0 SWV Pas	5						
G <sub>mb</sub>	2.399	2.400	2.381	2.391				Avera	ge Mat G_h		-1	6	10/4/2010	0 377+40	3.0 SIVV Pas	5						
Gmb (DOT)								% ]	Mat Density		-11	7	10/3/2010	20510	3.0 Siv Pase	5						
Gmm	2.482	2.485	2.487	2.482				For info	rmation On	dv.			10/3/2010	0 393+04	9.0 SWV Pass	<u>s</u>						
Gmm (DOT)								Join	nt Length ft	••9		0	10/3/2010	400+55	7.0 SW Pass	\$						
P <sub>a</sub> (%)	3.3	3.4	4.3	3.7				Unit Price Adjus	tment (\$/#)													
P <sub>a</sub> (%) (DOT)								o ne ne ne negas	kinen: (enti							+						
				Avg G <sub>mb</sub>	Avg G <sub>mm</sub>	Avg Pa (%)						-+		+								1
				2.393	2.484	3.7		Joint Price Ar	fiuetmont -												1	
							L	Source Those Ac	justnerk -	and the second data of the second d	_ 1		С	ourse Placed	Surface (Trav	el Lane)			Th	ickness QI		
		CRADAT							and the second second				Intended	Lift Thickness	2.0	0			A			
Sieve	Spece	GRADA	ION (%Pass	ing)		Use DOT		USE D.O	.T. RESU	LTS				Date Placed	10/03	/18			AVg. N	tat Density		
1 in	100	100 0			Avg	District		(Ent	ter an 'X')					Test Date/By:	10/04	/18	Donnia A	akamaa	Avg.	% of Gmb		
3/4 in	100	100.0			100.0		L								10/04	10	Dennis A	ckennan	Avg. % P	-ield Voids		
1/2 in	80.400(00)	100.0			100.0						- 1											
3/8 in	89-100(96)	97.0			97.0			TES	TSTRIP			Q.I	(lower) =					=		$\rightarrow$	PWL (Io	wer)
* #4	55-60(69)	89.0			89.0			(Ente	er an "X")											-	=	
* Day	+ 7.0	2.0			60.0							~	la companya da ser									
+#9	40.50(45)	-2.0			-2.0							Q.I	(upper) =					=		$\rightarrow$	PWL (up	oper)
#0	40-50(45)	41.0			41.0		-	FILM THICKNE	ESS (FT) [8.	.0-15.0]											=	
*Dev	± 5.0	-4.0			-4.0		é	FT, µm		9.5		PW	L (total) =			+		-	_	100.0	=	
#16		28.0			28.0			Price Adjustm	nent	S0.00											_	
*#30	15-23(19)	17.0			17.0					1100												
* Dev	± 4.0	-2.0			20		1			South State	S.L	1950								Pay	Factor =	
#50		92			-2.0			Gyrat	tory VMA			Ton	ns of Mix for P	WL Field Void	Is Analysis (00.00							
#100		5.6			9.2			VMA, %		14.0	JL				deducted)=	1,83	9.00	Field Void	is Price Adj	justment =		
*#200	1 9.5 9/3 9	4.6			0.6		1		A 1998 - 1	all how										and in the second s		
*Dev	+ 2.0	4.0			4.5		-	QUANTITY I	FOR PAYM	ENT	ЛГ					TEMPE	RATI IRE *F					-
Gradation Co	moliopeel	V.0			0.6		્ય	Vix Unit Price (S	(ton)	\$45.5			Time	7:00	9:00	11:00	1:00	0.00				
	Suma D.S. 1.4	res			Yes		Bi	nder Unit Price (	S/ton)	\$440.0		Ali	r Temp	69	73	77	0.1	3:00	5:00	7:00	Spec	Comply
DBR	ougg U.6 - 1.4	1.01			1.01		1	Tons of Mix on R	load	1,839.0		Bind	ier Temo	315	315	215	01					
% +4 Type 4		89.1			89.1		Tor	ns to Other Bid I	tem(s)	,		Pier	ot Temp	319	222	315	315				260-330	)°F Yes
% +4 Type 3					0.0			Tons of Binde	r i	917	ⅎ⊢	, na Ma	t Temp	313	322	321	318				225-330	)°F Yes
(+4/-4) Type 2		28.6/27.1			28.6/27.1			Tons of Wast	e	76.0		1410	anip								225-330	)°F
							T	ons of Binder to	Date	75.0	4	Br	eak Down	Re-start afte	mandatory shutdow	n.						
			و الليس المعهور					Tops of Mix to D	ato			E Ra	ain Out	Mix Change I	tornation (when	changes are	made to start	the day, ide	ntify them	on previou	s day's rep	oort):
		BINDER	1		1	1	IL.		are	100	1			A Real Property and the second second	Old Target	New Target	Tons	Agg	Initial %	New %	Agg	nitia New %
		Target	Actual	Spec	Comple	- C		PLACEME	NT RECORD	0				Pb Added	4.21	4.11	1,096			1	T	
% Added 8	Binder	4.21	4.12	N/A	South NY .	From St	ation	i o Static	n	Lane	Width	) (ft)		Pb Total	5.10	5	1,096					
% Total B	inder	5.10	4 99	4 80-5 40	Vec																	
% RA	P	19.00	18.61%	\$100%	Ves								1									
% RA	s		10.0170	-10076	res																	
% Binder Ren	acement	17 49%	17 52%	< 200/	Van								6	Comments:					A second second			
PG Cm	da	50.00	17.52%	≥ 30%	Yes	L								-								
FGGa	40	56-28	v	58-28V	Yes	Certified T	ech:	CINDY	DELA RO	DSA	Cert	No CI	722									
Gh	02246	0.1	1040 T			Certified T	ech				Cert	No										
L GD.	1.03340	GSD: 2		Pbe (%)	4.45	Distribution		Dist Materials	Proj Eng	ineer	Contract	ta+	-									
													-									

Star or a

Form 956 ver. 11.05

#### lowa Department of Transportation Highway Division - Office of Construction & Materials HMA Gyratory Mix Design

Ndesign							Latting Data	17	1/17/2017	
County :	Story		Project :	IMX-035-	5(109)11202	-85	Mix No.	10	2018.011	
Mix Size (in.):	1/2	Type A	Contractor	MANATT	SINC - AME	S	Contract #	10	0255 100	
Mix Type:	VT	L - 2	Design Tr	affic	Very High T	raffic	Contract #:	65	-0333-109	
Intended Use :	Surface		Location :	MP 111.78 -	116.74	I-35 - US 30	INTERCHANGE	TO THE CO E	00/22/16	
Aggregate	% in Mix	Source ID		Source Loca	tion	Beds	Geh	0/ A be	EAA	Entertion
1/2 CRUSHED L-4	21.0%	A85006	Martin Ma	arietta Aggreg	rates/Ames M	i 49-50	2 651	0.91	17AA	Prictic
1/2 QUARTZITE	12.0%	ASD002	L G Everis	st Inc/Dell Ra	mids-East	n 49-50	2.641	0.01	47.0	4
3/8 CL CHIP L-4	8.0%	A85006	Martin Ma	arietta Agoreg	ates/Ames Mi	i 40.50	2.041	0.14	47.5	2
MANF SAND	15.0%	A85006	Martin Ma	rietta Aggreg	ates/Ames Mi	i 49-50	2.072	0.55	47.0	4
QUARTZ M SAND	15.0%	ASD002	L G Everis	st Inc/Dell Ra	nids-Fast	u -47	2.075	0.00	45.0	5
SAND	10.0%	A85510	Hallett Ma	terials Co/Ar	nes South		2.039	0.25	49.0	2
Classified RAP	19.0%	I-35	19% IRAI	P15-021 (4.9	% AC)		2.613	1.05	40.0	4
		Ioh	Mix Formul	a Combina	Cradation (8			1.05	42.7	4
1" 3/4"	1/2"	3/8"	#4	40 - COMUNIC		leve Size in.	)			
	1120	5/6	11-4	#6	#10	#30	#50	#100	#200	
100 100	100	06	60	Opper 10	lerance					
100 100	96	80	63	30 AE	70	23	0.1		5.9	
100 100	89	82	55	45	30	19	9.4	5.2	3.9	
100	02	04	22	40 Lower To	lerance	15			1.9	
Asphalt Binder Source	e and Grade:	BITUMINOL	S MATERIAL	S TAMA, IA	PG 58-28V		1			
				Gyratory Da	ta					
% Asphalt Bi	nder	4.25	4.70	4.75	5.25			Number	of Gyrations	
Gmb @ N-D	les.	2.353	2.388	2.391	2.401			N	-Initial	
Max. Sp.Gr. (C	3mm)	2.503	2.487	2.486	2.466				9	
% Gmm @ N-	Initial	86.8	88.6	88.8	89.8			N.	Design	
%Gmm @ N-	Max								05	
% Air Void	ls	6.0	4.0	3.8	2.6			N	J-May	
% VMA		14.7	13.9	13.8	13.9			1.	-wax	
% VFA		59.4	71.2	72.4	81.0			Geb for	Angularity	
Film Thickne	ess	8.36	9.30	9.39	10.53			030 101 M	athod A	
Filler Bit. Ra	tio	1.02	0.92	0.91	0.81			IVIC	0.629	
Gse		2.674	2.676	2.676	2 675			Pha / 9	Abs Datio	
Pbe		3.81	4.24	4.28	4.80		1	rba/ 7	0.62	
Pba	1	0.46	0.49	0.49	0.48		1	01	0.62	
% New Asphalt I	Binder	78.8	81.0	81.2	83.0		1	Slope of	Compaction	
Combined Gb @	25°C	1.0237	1.0235	1.0235	1.0233			7	Jurve	
					110,000	Contribution	-	Mi	c Check	
ggregate Type Used	A				Combined	From RAM		Ex	cellent	
G <sub>sb</sub>	2.642		% Friction	Type 4 (+4)	64	12	1	PhRa	nge Check	
G <sub>sa</sub>	2.697			Or Better	94	13		1.00	inge Check	
% Water Abs	0.77		% Friction	Type 3 (+4)	0	0		PAN	A Chaok	
S.A. m <sup>2</sup> / Kg.	4.56			Or Better	30	1	1	MAN	OV	
Angularity-method A	45		% Friction	Type 2 (+4)	30	1			OK	
% Flat & Elongated	2.0		% Friction	Type 2 (-4)	26	0		D		
Sand Equivalent	96	1	vpe 2 Finen	ess Modulue	10	07		Specifica	ation Check	
Virgin G <sub>b</sub> @ 25°C	1.022		, , men	% Crushed	88.0	16.8		Co	omply	
Anti-Strip Dose (%)	0.00				00.0	10.0	-	Hambi	ing Check	
ipping Inflection Point	20,000.0						SIP	(0% AS)=20,000	-	
Dispositio	on : An aspha	lt content of	4.7%	is recommend	led to start this	s project	J Plea	ise choose AS Dose	e/Type if req.	
Data shown in	4.70% c	olumn is inter	polated from	n test data.		- projoot.				
	ADD AC to st	art project is	3.8%				0.0	00	0/ of hinder	
The %	ADD AC IO SI	ar project is	5.070				0.0	10	70 OI DIDNET	

Mix Designer & Cert.# : CINDY DELA ROSA CI 722

Signed : Shane Fetters(District 1 Materials)

Form 955 ver. 11.05

County :

Contract Mix Tonnage:

Story

#### Iowa Department of Transportation Highway Division-Office of Materials Proportion & Production Limits For Aggregates

#### Project No.: IMX-035-5(109)112--02-85 Date: 05/22/18 Project Location: 1-35 - US 30 INTERCHANGE TO THE CO RD E-29 NB Mix Design No.: 18,627 Course: Surface Mix Size (in.):

Contractor:	MANAT	TS INC -	AMES Mix Type: VT		Design	Traffic:	Very Hig	h Traffic
Material	Ident #	% in Mix	Producer & Location	Type (A or B)	Friction Type	Beds	Gsb	%Abs
1/2 CRUSHED L-4	A85006	21.0%	Martin Marietta Aggregates/Ames Mine	A	4	49-50	2.651	0.81
1/2 QUARTZITE	ASD002	12.0%	L G Everist Inc/Dell Rapids-East	A	2		2.641	0.14
3/8 CL CHIP L-4	A85006	8.0%	Martin Marietta Aggregates/Ames Mine	A	4	49-50	2.672	0.55
MANF SAND	A85006	15.0%	Martin Marietta Aggregates/Ames Mine	A	5	47	2.673	0.60
QUARTZ M SAND	ASD002	15.0%	L G Everist Inc/Dell Rapids-East	A	2		2.639	0.25
SAND	A85510	10.0%	Hallett Materials Co/Ames South	A	4		2.617	1.03
Classified RAP	I-35	19.0%	19% 1RAP15-021 (4.9 % AC)	А	2		2.613	1.65
Type and Source of A	l Asphalt Bin	der:	PG 58-28V BITUMINOUS MAT	 FERIALS T	AMA, IA			

		Indi	vidual Age	gregates S	lieve Anal	ysis - % P	assing (T	arget)			
Material	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
1/2 CRUSHED L-4	100	100	92	77	38	25	17	13	11	8.5	7.0
1/2 QUARTZITE	100	100	99	81	10	1.1	0.6	0.5	0.4	0.3	0.2
3/8 CL CHIP L-4	100	100	100	92	22	3.5	2.5	1.8	1.7	1.6	1.5
MANF SAND	100	100	100	100	96	68	38	20	7.5	3.5	2.5
QUARTZ M SAND	100	100	100	100	99	74	47	30	12	2.8	0.9
SAND	100	100	100	100	98	87	69	40	8.0	0.6	0.2
Classified RAP	100	99	90	82	65	47	36	26	17	12	9.3

#### Preliminary Job Mix Formula Target Gradation

	- 1.00 1.00.		····								
Upper Tolerance	100	100	100	96	69	50		23			5.9
Comb Grading	100	100	96	89	62	45	30	19	9.4	5.2	3.9
Lower Tolerance	100	100	89	82	55	40		15			1.9
S.A.sq. m/kg	Total	4.56		+0.41	0.26	0.37	0.50	0.55	0.58	0.64	1.27

Production Limits for Aggregates Approved by the Contractor & Producer.

Sieve	21.0%	of mix	12.0%	of mix	8.0%	of mix	15.0%	of mix	15.0%	of mix	10.0%	of mix
Size	1/2 CRU	SHED L-4	1/2 QUA	RTZITE	3/8 CL 0	CHIP L-4	MANF	SAND	QUARTZ	M SAND	SA	ND
in.	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
3/4"	98.0	100.0	98.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1/2"	85.0	99.0	92.0	100.0	98.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
3/8"	70.0	84.0	74.0	88.0	85.0	99.0	98.0	100.0	98.0	100.0	98.0	100.0
#4	31.0	45.0	3.0	17.0	15.0	29.0	89.0	100.0	92.0	100.0	91.0	100.0
#8	20.0	30.0	0.0	6.1	0.0	8.5	63.0	73.0	69.0	79.0	82.0	92.0
#30	9.0	17.0	0.0	4.5	0.0	5.8	16.0	24.0	26.0	34.0	36.0	44.0
#200	5.0	9.0	0.0	2.2	0.0	3.5	0.5	4.5	0.0	2.9	0.0	2.2
Com	nents					Addition and some second second						_,

Copies to: MANATTS INC - AMES

The above target gradations and production limits have been discussed with and agreed to by an authorized representative of the aggregate producer.

Signed:

Producer

Signed:

Contractor

1BD18-011

1/2

Form 956 ver. 11.08

#### Iowa Department of Transportation Highway Division - Office of Construction & Materials HMA Gyratory Mix Design

Ndesign			1	0		Leuis Der		10010	
County :	Marshall		Project : FM-CO6	64(127)55-64		Mix No. :	4/17 1BD	//2018 16-065	
Mix Size (in.):	3/4	Type A	Contractor : Manatt's	Inc.		Contract #:	64-C(	064-127	
Mix Type:	ST	No Frictn	Design Traffic :	Standard Traf	fic	Date:	08/	16/18	
Intended Use :	Surface		Location :		E41/235th S	St, from ECL of State	Center E 9 Mile	s to IA 330	
Aggregate	% in Mix	Source ID	Source Lo	cation	Beds	Gsb	%Abs	FAA	Friction
3/4" Clean	34.0%	A64002	Martin Marietta Aggi	regates/Ferguson	10-17	2.630	1.78	46.0	A
3/8" Chips	5.0%	A64002	Martin Marietta Aggr	regates/Ferguson	10-17	2.628	1.85	47.0	4
Manufactured Sand	24.0%	A64002	Martin Marietta Aggr	egates/Ferguson	10-17	2.646	1.75	47.0	4
Screened	20.0%	A64002	Martin Marietta Aggr	egates/Ferguson		2,630	0.55	30.5	4
Classified RAP	17.0%	IRAP18-020	17% ABC18-0068 (5	.97 % AC)		2.585	1.63	41.6	4

			Job	Mix Formula	a - Combined	Gradation (S	ieve Size in.)			
1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
					Upper To	lerance				1200
100	100	97	85	66	45		28			6.2
100	99	90	78	59	40	30	24	11	55	4.3
100	92	83	71	52	35		20	**	Sec.	4.3
					Lower To	erance				2.5
sphalt Bi	nder Source	and Grade:	BITUMINOU	S MATERIALS	STAMA, IA	PG 58-28S				
					Gyratory Da	ta				

% Asphalt Binder       4.60       5.00       5.02       5.50       6.00       Number of Gyrations         Gmb @ N-Des.       2.365       2.378       2.379       2.402       2.409       N-Initial         Max. Sp.Gr. (Gmm)       2.494       2.479       2.478       2.461       2.453       7         % Gmm @ N-Initial       89.6       90.5       90.6       92.1       92.5       N-Design         % Gmm @ N-Max       9       90.6       92.1       92.5       N-Design       50         % Air Voids       5.2       4.1       4.0       2.4       1.8       N-Max         % VFA       63.3       70.8       71.3       82.3       87.0       Gsb for Angularity         Film Thickness       7.87       8.68       8.74       9.70       10.37       Method A         Gse       2.679       2.679       2.679       2.692       Pba /%Abs Ratio       0.55         Pba       0.77       0.77       0.76       0.77       0.96       Slope of Compaction         % New Asphalt Binder       78.7       80.5       80.6       82.4       83.9       Curve         Aggregate Type Used       A       Car34       Or Beter       93 <th></th> <th></th> <th>-</th> <th></th> <th>Sjratorj Di</th> <th>itti</th> <th></th> <th></th>			-		Sjratorj Di	itti		
Gmb @ N-Des.2.3652.3782.3792.4022.409 $N-Initial$ Max. Sp.Gr. (Gmm)2.4942.4792.4782.4612.4537% Gmm @ N-Max89.690.590.692.192.5N-Design% Air Voids5.24.14.02.41.8 $N-Max$ % VFA63.370.871.382.387.0 $N-Max$ % VFA63.370.871.382.387.0 $Method A$ Filler Bit. Ratio1.111.011.000.900.84 $2.624$ Gse2.6792.6792.6792.692 $Pba / %Abs Ratio$ $0.55$ Pba0.770.770.760.770.96 $0.55$ % New Asphalt Binder78.780.580.682.483.9 $0.55$ Slope of Compaction7.9261.02591.0257 $0.057$ $Mix Check$ Aggregate Type UsedAContributionFriction Type 3 (+4)00Ga.2.626% Friction Type 3 (+4)00 $0.0$ % Water Abs1.50% Friction Type 3 (+4)00 $0.0$ Shand Equivalent85Type 2 Fineness Modulus0.00.0 $0.0$ % First Stip Dose (%)0.00 $%$ Friction Type 2 (+4)00 $0.0$ Virgin G <sub>6</sub> @ 25°C1.0249% Crushed73.09.7Ant-Stip Dose (%)0.00 $%$ First Stop Compared to start this project $0.0$ Water Abs1.00 <td>% Asphalt Bi</td> <td>nder</td> <td>4.60</td> <td>5.00</td> <td>5.02</td> <td>5.50</td> <td>6.00</td> <td>Number of Gyrations</td>	% Asphalt Bi	nder	4.60	5.00	5.02	5.50	6.00	Number of Gyrations
Max. Sp. Gr. (Gmm)2.4942.4792.4782.4612.4537 $\%$ Gmm @ N- Initial89.690.590.692.192.5N-Design $\%$ Gmm @ N-Max014.013.613.850 $\%$ VMA14.114.014.013.613.8 $\%$ VFA63.370.871.382.387.0Filler Bit. Ratio1.111.011.000.900.84Gse2.6792.6792.6792.692Pbe3.874.274.304.775.10Pba0.770.770.760.770.96 $\%$ New Asphalt Binder78.780.580.682.483.9Combined Gb @ 25°C1.02601.02591.02581.0257Aggregate Type UsedACombinedFriction Type 4 (+4)935 $\%$ Water Abs1.50% Friction Type 2 (+4)00S.A. m²/Kg.4.92Or Better935% Water Abs1.50% Friction Type 2 (+4)00S.A. m²/Kg.4.92Or Better00S.A. m²/Kg.0.00% Friction Type 2 (+4)00% Flat & Elongated0.0% Friction Type 2 (+4)00% Water Abs1.0249% Crushed73.09.7Anti-Strip Dose (%)0.00.00%Net RequiredWirgin Gh_@ 25°C1.0249% Crushed73.09.7Anti-Strip Dose (%)0.00.0	Gmb @ N-D	les.	2.365	2.378	2.379	2.402	2.409	N-Initial
% Gmm @ N- Initial       89.6       90.5       90.6       92.1       92.5       N-Design         % Gmm @ N-Max       5.2       4.1       4.0       2.4       1.8       50         % VMA       14.1       14.0       13.6       13.8       50       N-Max         % VMA       14.1       14.0       13.6       13.8       N-Max       50         % VFA       63.3       70.8       71.3       82.3       87.0       N-Design         Film Thickness       7.87       8.68       8.74       9.70       10.37       Method A         Gse       2.679       2.679       2.679       2.692       Pba / %Abs Ratio       0.55         Pba       0.77       0.77       0.76       0.77       0.96       Slope of Compaction       Curve         Combined Gb@ 25°C       1.0260       1.0259       1.0258       1.0257       Mix Check       God         Gsb       2.626       % Friction Type 4 (+4)       93       5       5       Mix Check       God $G_{sb}$ 2.626       % Friction Type 3 (+4)       0       0       0       Angularity-method A       42       % Friction Type 2 (+4)       0       0       0K <t< td=""><td>Max. Sp.Gr. (C</td><td>imm)</td><td>2.494</td><td>2.479</td><td>2.478</td><td>2.461</td><td>2.453</td><td>7</td></t<>	Max. Sp.Gr. (C	imm)	2.494	2.479	2.478	2.461	2.453	7
%Gmm @ N-Max       6       6       6       6       6       6       6       6       6       6       6       6       6       6       7       <	% Gmm @ N-1	Initial	89.6	90.5	90.6	92.1	92.5	N-Design
% Air Voids       5.2       4.1       4.0       2.4       1.8         % VMA       14.1       14.0       13.6       13.8         % VFA       63.3       70.8       71.3       82.3       87.0         Film Thickness       7.87       8.68       8.74       9.70       10.37         Gse       2.679       2.679       2.679       2.692       2.622         Pbe       3.87       4.27       4.30       4.77       5.10       0.55         Pba       0.77       0.77       0.76       0.77       0.96       Slope of Compaction         % New Asphalt Binder       78.7       80.5       80.6       82.4       83.9       2.0278         Combined Gb@ 25°C       1.0260       1.0259       1.0258       1.0257       Contribution       Curve         Aggregate Type Used       A       Constribution       From RAM       Good       Mix Check       Good         Gaa       2.734       Or Better       93       5       1.40       0       0         % Water Abs       1.50       % Friction Type 2 (+4)       0       0       0       0K       Specification Check       0K         Sand Equivalent       85 </td <td>%Gmm @ N-</td> <td>Max</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>50</td>	%Gmm @ N-	Max						50
% VMA       14.1       14.0       14.0       13.6       13.8       13.8         % VFA       63.3       70.8       71.3       82.3       87.0       10.37         Film Thickness       7.87       8.68       8.74       9.70       10.37       Method A         Gse       2.679       2.679       2.678       2.6679       2.692       Pbe       3.87       4.27       4.30       4.77       5.10       0.55	% Air Void	s	5.2	4.1	4.0	2.4	1.8	N-Max
% VFA         63.3         70.8         71.3         82.3         87.0           Film Thickness         7.87         8.68         8.74         9.70         10.37           Filler Bit. Ratio         1.11         1.00         0.90         0.84         2.624           Gse         2.679         2.679         2.679         2.679         2.692         Pba/%Abs Ratio           Pba         0.77         0.76         0.77         0.96         3.87         0.55           % New Asphalt Binder         78.7         80.5         80.6         82.4         83.9         0.55           Combined Gb @ 25°C         1.0260         1.0259         1.0258         1.0257         Slope of Compaction           Aggregate Type Used         A         Contribution         From RAM         Good         Good           Gs.a         2.734         Or Better         93         5         1.40         0           % Water Abs         1.50         % Friction Type 2 (+4)         0         0         0         RAM Check         OK           Angularity-method A         42         % Friction Type 2 (+4)         0         0         0         0K         0K           % Flat & Elongated <t< td=""><td>% VMA</td><td></td><td>14.1</td><td>14.0</td><td>14.0</td><td>13.6</td><td>13.8</td><td></td></t<>	% VMA		14.1	14.0	14.0	13.6	13.8	
Film Thickness         7.87         8.68         8.74         9.70         10.37           Filler Bit. Ratio         1.11         1.01         1.00         0.90         0.84         2.624           Gse         2.679         2.679         2.679         2.692         Pba         2.624 $Gse$ 3.87         4.27         4.30         4.77         5.10         0.55           Pba         0.77         0.77         6.76         0.77         0.96         Slope of Compaction           % New Asphalt Binder         78.7         80.5         80.6         82.4         83.9         Slope of Compaction           Combined Gb @ 25°C         1.0260         1.0259         1.0258         1.0257         Slope of Compaction           Gs         2.626         % Friction Type 4 (+4)         93         5         Slope of Compaction           Gs         2.626         % Friction Type 3 (+4)         0         0         RAM Check           Gs         2.626         % Friction Type 2 (+4)         0         0         RAM Check           Gs         2.626         % Friction Type 2 (+4)         0         0         0           S.A. m <sup>2</sup> / Kg         4.92         % Friction Type 2 (	% VFA		63.3	70.8	71.3	82.3	87.0	Gsh for Angularity
Filler Bit. Ratio         1.11         1.01         1.00         0.90         0.84         2.624           Gse         2.679         2.679         2.678         2.679         2.692         Pba         0.77         0.76         0.77         0.96         0.55         9ba         0.55         9ba         0.55         Slope of Compaction         0.55         Slope of Compaction         0.55         Slope of Compaction         0.55         Slope of Compaction         Curve         1.40         Scan # 2,734         0.0258         1.0257         1.0267         1.40         Scan # 2,734         0         0         Scan # 2,734         0 <t< td=""><td>Film Thickne</td><td>ess</td><td>7.87</td><td>8.68</td><td>8.74</td><td>9.70</td><td>10.37</td><td>Method A</td></t<>	Film Thickne	ess	7.87	8.68	8.74	9.70	10.37	Method A
Gse         2.679         2.679         2.678         2.679         2.692 $2.692$ Pbe         3.87         4.27         4.30         4.77         5.10 $0.55$ Pba         0.77         0.77         0.76         0.77         0.96           % New Asphalt Binder         78.7         80.5         80.6         82.4         83.9           Combined Gb @ 25°C         1.0260         1.0259         1.0258         1.0258         1.0257           Aggregate Type Used         A         Contribution         Contribution         Contribution         Good           G <sub>sb</sub> 2.626         % Friction Type 4 (+4)         93         5         1.00257         1.00258         1.00257           % Water Abs         1.50         % Friction Type 3 (+4)         0         0         0         RAM Check         0K           S.A. m <sup>2</sup> /Kg.         4.92         Or Better         93         5         1.40         0K           % Flat & Elongated         0.0         % Friction Type 2 (+4)         0         0         0K         Specification Check         Comply           Virgin G <sub>b</sub> @ 25°C         1.0249         % Crushed         73.0         9.7         Anti-Strip D	Filler Bit. Ra	tio	1.11	1.01	1.00	0.90	0.84	2 624
Pbe         3.87         4.27         4.30         4.77         5.10         0.05           Pba         0.77         0.77         0.76         0.77         0.96         0.55         Slope of Compaction           % New Asphalt Binder         78.7         80.5         80.6         82.4         83.9         Curve         Slope of Compaction         Curve           Aggregate Type Used         A         Combined From RAM         1.0259         1.0259         1.0258         1.0257         Mix Check         Good         Curve           Aggregate Type Used         A         Combined From RAM         From RAM         Good         Pb Range Check         Good         Mix Check         Good         Pb Range Check         1.40         Not Required         Not Reader         OK         Mix Check         Good         Pb Range Check         1.40         Not Required         Not Reader         OK         Not Required	Gse		2.679	2.679	2.678	2.679	2.692	Pha / %Abs Ratio
Pba $0.77$ $0.77$ $0.76$ $0.77$ $0.96$ Slope of Compaction           % New Asphalt Binder         78.7 $80.6$ $82.4$ $83.9$ $1.0257$ $Contribution$ $Curve$ $Curve$ Aggregate Type Used         A $Contribution$ $Contribution$ $Contribution$ $Curve$ $Curve$ $God$ $Godd$ <	Pbe		3.87	4.27	4.30	4.77	5.10	0.55
% New Asphalt Binder Combined Gb @ 25°C78.7 1.026080.5 1.025980.6 1.025982.4 1.025883.9 1.0257Sole CumpationAggregate Type Used GasA $\hline$ $\hline$ Contribution Combined $\hline$ $ContributionFrom RAMGas2.626% Friction Type 4 (+4)935SGod\hlineMix CheckGood% Water Abs1.50% Friction Type 3 (+4)00RAM CheckI.40% New Asphalt Binder4.92Or Better935SI.40% Mater Abs1.50% Friction Type 2 (+4)00RAM CheckS.A. m²/Kg4.92Or Better0OOK% Flat & Elongated0.0% Friction Type 2 (+4)00OK% Flat & Elongated0.0% Friction Type 2 (-4)0OKVirgin Gb @ 25°C1.0249% Crushed73.09.7Anti-Strip Dose (%)0.00OKComplyUpsposition :An asphalt content of5.0\% is recommended to start this project.$	Pba		0.77	0.77	0.76	0.77	0.96	Slone of Compaction
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	% New Asphalt I	Binder	78.7	80.5	80.6	82.4	83.9	Curve
Aggregate Type Used $G_{sb}$ AContribution CombinedMix Check From RAM $G_{sb}$ 2.626% Friction Type 4 (+4)935 $G_{sa}$ 2.734Or Better935% Water Abs1.50% Friction Type 3 (+4)00S.A. $m^2$ / Kg.4.92Or Better00% Flat & Elongated0.0% Friction Type 2 (+4)00% Grand Equivalent85Type 2 Fineness Modulus0.00.0Virgin G_b@ 25°C1.0249% Crushed73.09.7Anti-Strip Dose (%)0.00Mamburg CheckDisposition :An asphalt content of5.0%is recommended to start this projectNot Required	Combined Gb @	25°C	1.0260	1.0259	1.0259	1.0258	1.0257	04.70
Aggregate Type UsedACombinedFrom RAMGood $G_{ab}$ 2.626% Friction Type 4 (+4)935 $G_{ab}$ 2.734Or Better935% Water Abs1.50% Friction Type 3 (+4)00S.A. $m^2/Kg.$ 4.92Or Better00Angularity-method A42% Friction Type 2 (+4)00% Flat & Elongated0.0% Friction Type 2 (+4)00% rigin $G_b$ 2.5°C1.0249% Crushed73.09.7Anti-Strip Dose (%)0.00Mamburg CheckDisposition :An asphalt content of5.0%is recommended to start this project.Not Required	A	г т					Contribution	Mix Check
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Aggregate Type Used	A				Combined	From RAM	Good
$G_{a}$ 2.734Or Better935% Water Abs1.50% Friction Type 3 (+4)00S.A. m² / Kg.4.92Or Better00Angularity-method A42% Friction Type 2 (+4)00% Flat & Elongated0.0% Friction Type 2 (+4)00% Flat & Elongated0.0% Friction Type 2 (+4)00Sand Equivalent85Type 2 Fineness Modulus0.00.0Virgin Gb @ 25°C1.0249% Crushed73.09.7Anti-Strip Dose (%)0.00Use the start this projectNot RequiredDisposition :An asphalt content of5.0% is recommended to start this projectNot Required	G <sub>sb</sub>	2.626		% Friction	Type 4 (+4)	93	5	Pb Range Check
% Water Abs       1.50       % Friction Type 3 (+4)       0       0         S.A. $m^2 / Kg.$ 4.92       Or Better       0       0         Angularity-method A       42       % Friction Type 2 (+4)       0       0         % Flat & Elongated       0.0       % Friction Type 2 (+4)       0       0         % Flat & Elongated       0.0       % Friction Type 2 (-4)       0       0         Sand Equivalent       85       Type 2 Fineness Modulus       0.0       0.0         Virgin G_b@ 25°C       1.0249       % Crushed       73.0       9.7         Anti-Strip Dose (%)       0.00       .00       Hamburg Check         Disposition :       An asphalt content of       5.0%       is recommended to start this project	G <sub>sa</sub>	2.734			Or Better	93	5	1.40
S.A. m² / Kg.       4.92       Or Better       0       0         Angularity-method A       42       % Friction Type 2 (+4)       0       0         % Flat & Elongated       0.0       % Friction Type 2 (+4)       0       0         Sand Equivalent       85       Type 2 Fineness Modulus       0.0       0.0         Virgin G <sub>b</sub> @ 25°C       1.0249       % Crushed       73.0       9.7         Anti-Strip Dose (%)       0.00	% Water Abs	1.50		% Friction	Type 3 (+4)	0	0	RAM Check
Angularity-method A     42     % Friction Type 2 (+4)     0     0       % Flat & Elongated     0.0     % Friction Type 2 (-4)     0     0       Sand Equivalent     85     Type 2 Fineness Modulus     0.0     0.0       Virgin G <sub>b</sub> @ 25°C     1.0249     % Crushed     73.0     9.7       Anti-Strip Dose (%)     0.00	S.A. m <sup>2</sup> / Kg.	4.92			Or Better	0	0	OV
% Flat & Elongated     0.0     % Friction Type 2 (-4)     0     0       Sand Equivalent     85     Type 2 Fineness Modulus     0.0     0.0       Virgin G <sub>b</sub> @ 25°C     1.0249     % Crushed     73.0     9.7       Anti-Strip Dose (%)     0.00	Angularity-method A	42		% Friction	Type 2 (+4)	0	0	ÖK
Sand Equivalent         85         Type 2 Fineness Modulus         0.0         0.0           Virgin G <sub>b</sub> @ 25°C         1.0249         % Crushed         73.0         9.7           Anti-Strip Dose (%)         0.00         Work Required         Not Required           Disposition :         An asphalt content of         5.0% is recommended to start this project         Not Required	% Flat & Elongated	0.0		% Friction	1 Type 2 (-4)	0	0	Specification Chash
Virgin Gb @ 25°C     1.0249     % Crushed     73.0     9.7       Anti-Strip Dose (%)     0.00       Attripping Inflection Point       Disposition :     An asphalt content of     5.0% is recommended to start this project	Sand Equivalent	85		Type 2 Finen	ess Modulus	0.0	0.0	Comply
Anti-Strip Dose (%) 0.00 Stripping Inflection Point Disposition : An asphalt content of 5.0% is recommended to start this preject	Virgin Gb @ 25°C	1.0249			% Crushed	73.0	9.7	Hamburg Check
Stripping Inflection Point Disposition : An asphalt content of 5.0% is recommended to start this project	Anti-Strip Dose (%)	0.00						Na Barried
Disposition: An asphalt content of 5.0% is recommended to start this project	stripping Inflection Point							ivot Required
is recommended to start this broker	Dispositio	n: An aspha	ilt content of	<u>5.0%</u> i	is recommend	led to start th	is project	

Data shown in 5.02% column is interpolated from test data.

CI391

The % ADD AC to start project is 4.0%

Comments :

Copies to : Manatt's Inc.

Mix Designer & Cert.# :

Brad Karsten

Signed : Shane Fetters(District 1 Materials)

Form 955 ver. 11.08

#### Iowa Department of Transportation Highway Division-Office of Materials

### Proportion & Production Limits For Aggregates

County :	Marshall		Project No.: FM-CO6	4(127)55-6	54		Date:	08/16/18	
Project Location:	E41/235th	St, from H	ECL of State Center E 9 Miles to	IA 330.	Miz	C Design N	lo.:	1BD16-0	65
Contract Mix Tonr	nage:	15,340	Course: Su	rface		Mix Siz	ze (in.):	3/4	
Contractor:	Manatt's	Inc.	Mix Type:	ST		Design	Traffic:	Standard	Traffic
Material	Ident #	% in Mix	Producer & Locatio	m	Type (A or B)	Friction Type	Beds	Gsb	%Abs
3/4" Clean	A64002	34.0%	Martin Marietta Aggregates/Fer	rguson	A	4	10-17	2.630	1.78
3/8" Chips	A64002	5.0%	Martin Marietta Aggregates/Fer	rguson	Α	4	10-17	2.628	1.85
Manufactured Sand	A64002	24.0%	Martin Marietta Aggregates/Fer	rguson	A	4	10-17	2.646	1.75
Screened	A64002	20.0%	Martin Marietta Aggregates/Fer	rguson				2.630	0.55
Classified RAP	RAP18-02	17.0%	17% ABC18-0068 (5.97 % AC	)	А	4		2.585	1.63
Type and Source of A	Asphalt Bind	der:	PG 58-28S BITUMIN	NOUS MAT	ERIALS T	AMA, IA		1 1	

#### Individual Aggregates Sieve Analysis - % Passing (Target)

1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
100	98	72	42	8.0	3.5	3.0	2.9	2.8	2.7	2.5
100	100	100	94	27	5.0	3.5	3.0	2.8	2.6	2.5
100	100	100	100	97	41	16	9.0	4.0	3.5	2.8
100	100	100	99	98	95	87	75	33	8.0	5.0
100	100	97	91	73	57	46	34	17	12	9.8
	1" 100 100 100 100	1"         3/4"           100         98           100         100           100         100           100         100           100         100           100         100           100         100	1"         3/4"         1/2"           100         98         72           100         100         100           100         100         100           100         100         100           100         100         100           100         100         97	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						

#### Preliminary Job Mix Formula Target Gradation

S.A.sq. m/kg	Total	4.92		+0.41	0.24	0.33	0.49	0.69	0.71	0.67	1 30
Lower Tolerance	100	92	83	71	52	35	10040	20		0.0	22
Comb Grading	100	99	90	78	59	40	30	24	11	5.5	4.3
Upper Tolerance	100	100	97	85	66	45		28	[	1	6.3

Production Limits for Aggregates Approved by the Contractor & Producer.

Sieve Size	34.0% 3/4"	of mix Clean	5.0% 3/8"	of mix Chips	24.0% Manufact	of mix ured Sand	20.0% Scree	of mix ened	17.0% Classif	of mix ied RAP	
in.	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	ann a a c
1"	98.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	an an property .	max	1.
3/4"	91.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0			
1/2"	65.0	79.0	98.0	100.0	100.0	100.0	98.0	100.0			
3/8"	35.0	49.0	87.0	100.0	98.0	100.0	92.0	100.0		e	
#4	1.0	15.0	20.0	34.0	90.0	100.0	91.0	100.0			
#8	0.0	8.5	0.0	10.0	36.0	46.0	90.0	100.0			
#30	0.0	6.9	0.0	7.0	5.0	13.0	71.0	79.0			
#200	0.5	2.5	0.5	2.5	0.8	2.8	2.0	50			
Comm	ents:									e 1040) 104	
pies to:	N	Aanatt's Inc									

The above target gradations and production limits have been discussed with and agreed to by an authorized representative of the aggregate producer.

Producer

Signed:

Signed:

Contractor

4/25/13 /	er 18 07	10/10/2018						<u>iov</u>	WA DOT A	SPHALT PA	VING	DAILY PLA	NT REPORT					10/	10/18 7 43	PM	
Activ	Project No.	FM-CO64(1	127)55-64					Contractor:		Manatt's	s Inc.			Active Placement		Surface (T	ravel I ane	)	10/10/143	Perent	Ala 7
Mi	Contract ID. r Design No.	18D18-065	2/ D1			-		County:		Marst	hall			Mix Type:	St	Surface No	one 3/4 (HM	AA)	– La	b Voids Ti	arget 40
[	Cooligi: No	10010-000				-	RAF	Stockpile ID		ABC18-0068 (	5.97 % /	AC)		Active Bid Item	2303-1033	750 ST SU	RF 3/4IN N	O (HMA)	De	sign Gyrat	ons: 50
		UNCOMPACT	ED MIXTURE	Ε				COMP	ACTED JOI	NT						COMPACT	ED MAT				
(Theoretical	SUR-07-A	SUR-07-B	SUR-C	SUR-D			Core					Date of		1	14/5	14/2 10 1120	14/2 14/-1	-	Tari		
%AC)	(5.24%)	(5.14%)	(5.07%)	(5.24%)			#	Station	Joint ID	Gmb	Co	Placeme	nt Station	CL Reference	Dry (g)	(g)	(a)	Gmb	Grom	Pa (%)	Thickness (ir
Date Sampled	10/10/18	10/10/18	10/10/18	10/10/18			1	B9+00 21	L-Centerline	2.18		10/10/20	18 89+0		2 015 7	1 1 151 /	2017.9	2 2 2 7	02.0	-	0.00
Time	9:00 AM	1:00 PM	4:00 PM	5:30 PM			2	60+00 21	L-Centerline	2.26	2	10/10/20	18 79+2	5 6.0 SW Dr	2 3130	1,131.4	2,017.0	2.321	93.9	6.1	2.00
Station	84+00	36+00	90+00	64+00			3				3	10/10/20	18 60+0	0 40 SW DD	2 188 8	1 238 4	2 180 6	2.305	95.1	4.9	2.00
Bar Code ID											4	10/10/20	18 44+5	0 8.0 SW Dr	2 256 5	1 294 3	2 257 8	2 3/2	92.9	5.5	2.00
Sample (Tons)	189.00	956.00	1,592.00	1,963.00				Avera	age Joint G <sub>mb</sub>	2.22	5	10/10/20	18 26+5	0 2.0 S\W Dr	1.882.4	1 074 3	1 883 3	2 3 27	03.0	6.1	1.75
G <sub>mb</sub>	2.393	2.374	2.375	2.377				Avera	age Mat G <sub>mb</sub>	2.325	6	10/10/20	18 10+0	0 4.0 S\W Drv	2,108.6	1 197 7	2 110 2	2.311	033	67	2.00
Gmb (DOT)	0.470							%	Mat Density	95.5	7	10/10/20	18 89+0	2.0 N/E Dry	2.093.6	1,195.6	2 094 4	2 329	94.0	6.0	2.00
Gmm	2.4/3	2.479	2.483	2.473				For infe	ormation O	nly	8	10/10/20	18 62+2	5 4.0 N\E Drv	2,300.9	1.306.2	2,303.5	2 307	93.1	6.0	2 25
Gmm (DOT)		1.0						Joi	int Length, ft	4,800										0.0	
P (%) (DOT)	3.2	4.2	4.3	3.9	-			Unit Price Adju	ustment (\$/ft)	)									<u> </u>		
Pa (70) (001)			1	Aug C	Ave																
				2 2 2 0 mb	2 477	Avg Pa (%)														1	
			1	2.300	2.4//	3.9		Joint Price A	djustment =	and the second second second	1		Course Placed	Surface (Trav	el Lane)			Thi	ckness QI		1.06
												Intende	d Lift Thickness	2.0	0			Ava M	at Density		3.26
		GRADA	TION (%Passi	ing)		Use DOT		USE D.C	O.T. RESU	LTS	1		Date Placed	10/10/	18			Ava 9	6 of Gmm	4	3,820
Sieve	Specs	CF10-10			Avg	District		(Er	nter an 'X')				Test Date/By	10/11/	18	Rich A	mendt	AV0 % E		9	3.030 8.1£
1 in.	100	100.0			100.0													74tg. 70 ;			5.10
3/4 in.	92-100(99)	100.0			100.0							0 ( ( ( ) ) =	(0.	965 x 2.47	7) - 2	325				DMI (los	100
1/2 in.	83-97(90)	91.0			91.0			TES	ST STRIP		וו	ar (lower) =		0.018	3		- =	3.63	$\rightarrow$	F VVL (10)	100.0
* #4	52-66(50)	64.0			82.0			(En	iter an "X")												
* Dev	+7.0	5.0			54.0		L			The second se	] ] ,	Q   (upper) =	2.3	25 (0.91	5 x 2.4	77)	_	2 25		PWL (up	per) 100 0
*#8	35-45(40)	45.0			45.0		<b></b>	CU 14 70 0004			7			0.018	3		-	J.20	~	-	100,0
*Dev	+50	5.0			40.0 E 0			FILM THICKN	NESS (FT)	8.0-15.0]		PWL (total) =		100.0	+	100.0			100.0		400.0
#16	10.0	34.0			5.0			FT, μm		8.8		(,		100.0		100.0		-	100.0		100.0
	20.00/24	04.0			34.0		1	Price Adjust	ment	\$0.00											
*#30	20-28(24)	26.0			26.0		_												Pay	Factor =	1.040
* Dev	± 4.0	2.0			2.0			Gyr	ratory VMA			ons of Mix for	PWL Field Void	s Analysis (189.33			Provide States	TA			
#50		13.0			13.0			VMA, %	>	14.1				deducted)=	2,15	7.86	Fi	eld Voids Ir	ncentive =	\$1.	950.71
#100		5.3			5.3							CA.						And in case of the local division of the loc			the state of the
*#200	2.3-6.3(4.3)	3.7			3.7			QUANTITY	Y FOR PAYN	MENT					TEMPE	RATURE *F	-			and the second division	
*Dev	± 2.0	-0.6			-0.6			Mix Unit Price (	(\$/ton)	\$22.60		Time	7:00	9:00	11:00	1:00	3:00	5:00	7:00	Casa	Complet
Gradation Co	mpliance?	Yes			Yes		8	Binder Unit Price	e (\$/ton)	\$400.00		Air Temp		58	54	53	50	49	1.00	opec	Comply
DBR	Sugg 0.6 ~ 1.4	0.84			0.84			Tons of Mix on	Road	2,347.19		Binder Temp		305	309	311	312	313		260-330	PE Voe
% +4 Type 4		100.0			100.0		To	ons to Other Bid	i item(s)			Plant Temp		327	321	325	329	323		225-330	°E Yes
% +4 Type 3					0.0			Tons of Bind	der	121.23		Mat Temp	295	329	315	325	315	305		225-330	°E Yes
(+4/-4) Type 2		00.0/00.0			00.0/00.0			Tons of Wa	ste	73.04											
L	110.000						1	Tons of Binder t	to Date	773.74		Break Down	Vix Change	Information (when	changes are	made to star	t the day, ide	ntify them a	on previou	s day's rep	ort):
(						-		Tons of Mix to	Date	15,177.45	L.,	. Rain Out		Old Target	New Target	Tons	Agg	Initial %	New %	I onA	nitia New %
	r	BINDE	R					PLACEM	ENT RECOR	RD						1		T		1.39	
Ri Addad	Diadas	Target	Actual	Spec	Comply?	From	Station	To Stat	tion	Lane	Width (f	t)									
% Added	sinder	4.15	4.19	N/A		0+	-00	96+0	00	S8/WB Drive Lr	12										
% I otal E	inder	5.12	5.17	4.82-5.42	Yes	48-	+00	96+0	00	NB/E8 Drive Ln	12										
10 RA	5	17.00	17.07%	≥100%	res							1	L								
% Rinder Ren	lacement	19.00%	18 01%	< 30%	Vas							1	Comments								
PG Gr	de	58.0	85	59,290	Vec			L													
		00-2	00	30-203	185	Certified	Tech	B	rad Karste	en	Cert. No	CI391									
Gb	1.03251 T	Gsb:	2.626 T	Phe (%)	1 30	Cerufied	riech	5	bally Slave	n	Cert. No	01489									
		000.	2.320	· DC (90).	+.00	Distributio		Uist Materials	Proj E	ngineer C	Contractor										

Mart Building Decemption         Surface (Tree) Land)         Surfa								$\sim$						REPORT					10/11	/18 2:54	PM	
Market Pipette         Witches         Market Pipette         Bit Pipette	4/25/13 ver 1	11 07	10/11/2018					چ	P	IOWA DOT AS	PHALI PAVIN	IG DA	LT PLANT	KEPOKI	ctive Placement	S	urface (Tra	avei Lane	)		Report	No 8
Conversion         State         Conversion         Conversion </td <td>Active F</td> <td>Project No.</td> <td>FM-CO64(127</td> <td>7)55-64</td> <td></td> <td></td> <td></td> <td></td> <td>Contract</td> <td>tor:</td> <td>Manatt's in Marshall</td> <td>IC.</td> <td></td> <td>- 7</td> <td>Mix Type:</td> <td>St S</td> <td>urface Nor</td> <td>ne 3/4 (HM</td> <td>MA)</td> <td>Lat</td> <td>Voids Ta</td> <td>rget: 4.0</td>	Active F	Project No.	FM-CO64(127	7)55-64					Contract	tor:	Manatt's in Marshall	IC.		- 7	Mix Type:	St S	urface Nor	ne 3/4 (HM	MA)	Lat	Voids Ta	rget: 4.0
Due Despite         BUELBORNET         COMANTER	C	Contract ID	54-CO64-127					RAP	Stocknik	e ID /	ABC18-0068 (5.9	7 % AC		-	Active Bid Item	2303-1033	750 ST SUF	RF 3/4IN N	O (HMA)	Des	ign Gyrati	ons <u>50</u>
UNCONCENTER NUMBE	Mix I	Design No	1BD18-065R1								T						COMPACT	ED MAT	Cores have	been wa	ived	
Note State All			JNCOMPACTED	MIXTURE	r				T	COMPACTED SOIN			Date of			W1	W2 in H20	W3 Wet	6.	% of	P. (%)	Thickness (in
Chooce         (colore)         (colore) <th(colore)< th="">         (colore)         <t< td=""><td>Hot Box I.D</td><td>SUR-A</td><td>SUR-B</td><td></td><td></td><td></td><td></td><td>Core</td><td>Statio</td><td>on Joint ID</td><td>Gmb</td><td>Core</td><td>Placement</td><td>Station</td><td>CL Reference</td><td>Dry (g)</td><td>(g)</td><td>(g)</td><td>- Omb</td><td>Gmm</td><td>,</td><td></td></t<></th(colore)<>	Hot Box I.D	SUR-A	SUR-B					Core	Statio	on Joint ID	Gmb	Core	Placement	Station	CL Reference	Dry (g)	(g)	(g)	- Omb	Gmm	,	
Construint         Construnt         Construint         Construn	(Theoretical	(5.08%)	(5.30%)																			
The second isolation         State	Date Sampled	10/11/18	10/11/18					1														
Dates         24-00         6-00	Time	9:20 AM	10:50 AM					2	+			2		+								
Dir Colo	Station	34+00	6+00					3	1			1°					1					
Same         Same <th< td=""><td>Bar Code ID</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Luigh C</td><td></td><td>5</td><td></td><td>+</td><td></td><td></td><td>, in the second se</td><td></td><td></td><td>L</td><td></td><td></td></th<>	Bar Code ID									Luigh C		5		+			, in the second se			L		
Bit         2.344         2.383         Non-         Non-           Bit         2.489         2.489         1<	Sample (Tons)	301.00	696.00							Average Joint Gmb		6									1	
Det BOT	Gmb	2.344	2.383							Average Mat Omb		7		-								
Com         2.486         2.483	Gmb (DOT)									% Wat Density	dv.	8										
Dem (207)         -	Gmm	2.496	2.483							For information on	.,											
P. (%)       6.1       4.0       Aug       Aug <t< td=""><td>Gmm (DOT)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Lipit Dri</td><td>ice Adjustment (\$/ft)</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<>	Gmm (DOT)								Lipit Dri	ice Adjustment (\$/ft)												
P. 10(007)       Ang C	Pa (%)	6.1	4.0						Onit Ph	de Adjustition (ent)		-									+	
Image: Note of the section o	P <sub>a</sub> (%) (DOT)				Auro	Ava G	Avg Pa (%)													1		
Interved         L. 200         And to Dentify and the state         Ang Mail Dentify and State           Sever         Sever         Control         4000         100.0         40000         100.0         400000         40000         400000 <t< td=""><td></td><td></td><td></td><td>F</td><td>2 264</td><td>2 490</td><td>51</td><td></td><td>Joint</td><td>Price Adjustment =</td><td></td><td></td><td></td><td>ourse Placed</td><td>Surface (Trav</td><td>rel Lane)</td><td></td><td></td><td>Ini</td><td>ckness Q</td><td></td><td></td></t<>				F	2 264	2 490	51		Joint	Price Adjustment =				ourse Placed	Surface (Trav	rel Lane)			Ini	ckness Q		
ORACINON (RPassing)         UNICOT           Sile         Crission         1000         100000         100000         100000         100000         100000         100000         100000         100000         100000         1000000         1000000         10000000         10000000         10000000         100000000         1000000000000000000000000000000000000			r		2.304	2.450	0.1						Intended	Lift Thickness					Avg. M	at Density	r.	
Sive C         Orbit NI         Avg B         District T         Note Control (New Sector)											TO	8	menado	Data Placed	. 10/11	/18			Avg.	% of Gmb	E.	
Seve         Cr10:11         Arg         Detrin           1in         100         100.0 </td <td></td> <td>and the second se</td> <td>GRADAT</td> <td>ION (%Passin</td> <td>ig)</td> <td></td> <td>Use DOT</td> <td>11</td> <td>U</td> <td>SE D.O.T. RESU</td> <td>LIS</td> <td>1</td> <td></td> <td>Test Date/By</td> <td></td> <td></td> <td>Rich</td> <td>Amendt</td> <td>Avg. % F</td> <td>ield Voids</td> <td></td> <td></td>		and the second se	GRADAT	ION (%Passin	ig)		Use DOT	11	U	SE D.O.T. RESU	LIS	1		Test Date/By			Rich	Amendt	Avg. % F	ield Voids		
In       400       100.	Sieve	Specs	CF10-11			Avg	District	-		(Enter an 'X')				Test Duterby								
M4 n       92-00(90)       100.0       100.0         M4 n       92-00(90)       100.0       93.0       93.0       93.0       93.0         M3 n       71-86/20       83.0       83.0       83.0       93.0	1 in.	100	100.0			100.0				and the second								_		$\rightarrow$	PWL (i	ower)
12 n       83-97(00)       93.0	3/4 in.	92-100(99)	100.0			100.0		-		TECT CTDID		0	1 (lower) =								=	
Life in       T1-88(7)       83.0       65.0       65.0         r2a       528(6)       66.0       7.0       7.0       7.0       7.0         r2a       528(6)       66.0       7.0       7.0       7.0       7.0       7.0         r2a       528(6)       66.0       7.0	1/2 in.	83-97(90)	93.0			93.0		11		(Enter an "X")		-							÷.			
Feat       62.86(0)       66.0       06.0       07.0       7.0         1000       \$7.0       7.0       \$7.0       \$7.0       \$7.0       \$7.0       \$7.0         196       35.45(0)       80.0       80.0       \$7.0	3/8 in.	71-85(78)	83.0			83.0				(Enter an X)								_ =		$\rightarrow$	PWL (u	.pper)
Image: 10 mining of the sector of t	• #4	52-66(59)	66.0			56.0							t.t. (upper) ≃								=	
res       33-44(a)       48.0       49.0         10ev       5.0       8.0       8.0       8.0         115       20-28(24)       26.0       2.0       0.0       7.0       2.0       2.0       0.0 </td <td>* Dev</td> <td>± 7.0</td> <td>7.0</td> <td></td> <td></td> <td>7.0</td> <td></td> <td></td> <td>EILA</td> <td>A THICKNESS (ET) [</td> <td>8.0-15.01</td> <td></td> <td></td> <td></td> <td></td> <td>+</td> <td></td> <td></td> <td>_ 3s</td> <td>100.0</td> <td>) =</td> <td></td>	* Dev	± 7.0	7.0			7.0			EILA	A THICKNESS (ET) [	8.0-15.01					+			_ 3s	100.0	) =	
Open         15.0         8.0         8.0         8.0         8.0         8.0         8.0         97.0<	*#8	35-45(40)	48.0			40.0			T ICIN	FT	83		PWL (total) =			т						
eff       37.0       37.0       93.0	*Dev	± 5.0	8.0			8.0		-11-	Drieg	FI, μm	\$0.00									Dev	Factor	_
W30       20-28/24/l       28.0       28.0       28.0       28.0       28.0       35.1       35.1       35.1       35.1       13.0       14.0       14.6       No       14.6       No       14.6       No       14.6       No       14.6       No       14.6       No       14.0       No       10.0	#16		37.0			37.0		┥┕━	FILLE	Aujustitient										Fay	Factor	-
Bit Dev       ± 4.0       2.0       Gyratory VMA         #50       13.0       13.0       13.0       13.0       13.0       14.6       14.7 </td <td>+#20</td> <td>20-28(24)</td> <td>26.0</td> <td></td> <td></td> <td>26.0</td> <td></td> <td>_</td> <td></td> <td></td> <td></td> <td>, <b> </b></td> <td></td> <td></td> <td>de Aselucia (808 d</td> <td>c</td> <td></td> <td></td> <td>- Sti</td> <td></td> <td></td> <td></td>	+#20	20-28(24)	26.0			26.0		_				, <b> </b>			de Aselucia (808 d	c			- Sti			
Biol         13.0         13.0         VMA, %         14.5           #100         5.5         5.5         5.5         5.5           "B200         23.4 3(43)         3.5         3.5         0         0           "B200         23.4 3(43)         3.5         0.8         0.8         0.8         0.08         0.00         0         0.00	#30	+4.0	2.0			2.0				Gyratory VMA			ons of Mix for	PWL Field Vo	deducted)	e ≓		Field V	oids Price	Sustment	-	
Column 1         5.5         CUANTITY FOR PAYMENT           '''200         23.6.3(4.3)         3.5         -0.8           '''200         23.6.3(4.3)         3.5         -0.8         -0.1         -0.0	#50		13.0			13.0				VMA, %	14.6		······································						6			
100       236.3(43)       3.5       0.8       0.5         ''200'       2.2.0       0.8       -0.8	#100		5.5			5.5						1				TEME	FRATURE	•F				
model       100       0.8         Organization       No       No       No         OBR       Sueg Del 14       0.84       0.084       100.0       100.0       100.0       100.0       100.0       100.0       245-330 °F       V         Stress Del 14       0.84       0.00       100.0       100.0       100.0       100.0       100.0       100.0       245-330 °F       V         Stress Del 14       0.00       0.00       0.00       0.00       0.00       100.0       100.0       100.0       100.0       100.0       245-330 °F       V         Stress Del 14       0.00 <t< td=""><td>+#200</td><td>2 3-6 3/4 3</td><td>3.5</td><td></td><td></td><td>3.5</td><td></td><td></td><td>C</td><td>UANTITY FOR PAY</td><td>MENT</td><td></td><td></td><td>7.00</td><td>0:00</td><td>11:00</td><td>1.00</td><td>3:00</td><td>5.00</td><td>7:00</td><td>Sp</td><td>ec Comp</td></t<>	+#200	2 3-6 3/4 3	3.5			3.5			C	UANTITY FOR PAY	MENT			7.00	0:00	11:00	1.00	3:00	5.00	7:00	Sp	ec Comp
Binder Unit Price (\$ton)         \$400.00         311         312         312         311         260-330 °F         Y           DBR         \$ugg 06-14         0.84         0.00         <	*Dev	+2.0	-0.8			-0.8			Mix U	Init Price (\$/ton)	\$22.60		Time	7:00	37	30	42	-				
DBR         Sug 0 6 - 14         0.84         0.0 <t< td=""><td>Gradation</td><td>Compliance?</td><td>No</td><td></td><td></td><td>No</td><td></td><td></td><td>Binder</td><td>Unit Price (\$/ton)</td><td>\$400.00</td><td>·</td><td>Air remp</td><td>211</td><td>312</td><td>312</td><td>311</td><td>-</td><td></td><td>-</td><td>260-3</td><td>30 °F Yos</td></t<>	Gradation	Compliance?	No			No			Binder	Unit Price (\$/ton)	\$400.00	·	Air remp	211	312	312	311	-		-	260-3	30 °F Yos
Yest A Type 4       100 0       100.0       100.0       100.0       100.0       245-330 °F         % +4 Type 3       0       0.0 <td>DBR</td> <td>Sugg 0.6 - 1</td> <td>4 0.84</td> <td></td> <td></td> <td>0.84</td> <td></td> <td></td> <td>Tons</td> <td>of Mix on Road</td> <td>808.16</td> <td></td> <td>Binder Lemp</td> <td>200</td> <td>325</td> <td>321</td> <td>318</td> <td></td> <td></td> <td>1</td> <td>245-3</td> <td>30 °F Yes</td>	DBR	Sugg 0.6 - 1	4 0.84			0.84			Tons	of Mix on Road	808.16		Binder Lemp	200	325	321	318			1	245-3	30 °F Yes
No. 47. Spa 3       O.0       Tons of Binder       41.90       Mat temp       Let 1        Let 1       Le	% +4 Type 4	+	100.0			100.0			Tons to	Other Bid Item(s)	44.00		Mat Tamp	520			1	-			245-3	30 °F
Toris of Waste       B9,64       Break Down       Researcher mendation without in the day. Identify them on previous day's report.         (44/-4) Type 2       00.0/00.0       00.0/00.0       Toris of Waste       B9,64       Break Down       Researcher mendation without in the day. Identify them on previous day's report.         (44/-4) Type 2       00.0/00.0       Toris of Waste       B9,64       Break Down       Researcher mendation without in the day. Identify them on previous day's report.         BinDER       Toris of Mix to Date       Toris of Mix to Date       Did Target       New Target       Toris day. Identify them on previous day's report.         % Added Binder       4.15       4.20       N/A       Herein to Date       Did Target       New Target       Toris day's report.         % Total Binder       5.12       5.18       4.82-5.42       Yes       Second       NB/EB Drive Lr       12         % Total Binder Replacement       19.00%       18.90% ≤ 30%       Yes       Certified Tech       Brad Karsten       Cert No Cl391         Geb       1.03251       Gab       2.626       Pbe (%):       4.18       Databator       Data Maternals       Proj. Engineer       Contractor	% +4 Type 3	+				0.0			Тс	ons of Binder	41.90		Mattemp						and the second se			
Image: Constraint of Date         Tons of Binder to Date         Tons of Binder to Date         Rain Out         Old Target         New Y agg         Initial %         New %	(+4/-4) Type 2		00.0/00.0			00.0/00.0			Т	ons of Waste	89.64	1	Break Down	Re-start	after mandatory shutd	en changes a	ire made to s	start the day	identify the	m on prev	ious day's	report):
BINDER         PLACEMENT RECORD         Other Harget         Non         Harget         How         Harget         Harget         How         Harget	(14/-4) Type 2								Tons	of Binder to Date		1	Rain Out	Max Officing	Old Torget	New Tara	et Toos	Agg	Initiai %	6 New	% Agg	Initia New
PLACEMENT RECORD           Target         Actual         Spec         Complexity           % Added Binder         4.15         4.20         N/A         -	L				A A A A A A A A A A A A A A A A A A A				Ton	s of Mix to Date	1	Ji		ſ	Old Target	INEW Targ		1	1		1	TT
Target         Actual         Spec         Comply?           % Added Binder         4.15         4.20         N/A			BIND	R						PLACEMENT REC	ORD											
% Added Binder       4.15       4.20       N/A       49+00       NB/EB Drive Ln       12         % Total Binder       5.12       5.18       4.82-5.42       Yes         % RAP       17.00       17.14%       5100%       Yes         % RAS			Target	Actual	Spec	Comply?	Fro	om Statio	n	To Station	Lane	Width	<u>(ft)</u>									
% Total Binder       5.12       5.18       4.82-5.42       Yes         % RAP       17.00       17.14%       1900%       Yes         % RAP       17.00       17.14%       Yes         % RAS	% Adde	d Binder	4.15	4.20	N/A			48+00		96+00	NB/EB Drive L	n 12	-									
No.000000000000000000000000000000000000	26 Tota	al Binder	5.12	5.18	4.82-5.42	Yes						+	-					-				
% RAS         19.00%         18.90%         ≤ 30%         Yes         Certified Tech         Brad Karsten         Certified Tech         Certified Tech         Certified Tech         Certified Tech         Sally Slaven         Certified Tech         Sally Slaven         Certified Tech         Sally Slaven         Certified Tech         Certifi	-70 TOta	RAP	17.00	17.14%	≤100%	Yes							-	Common	•							
% Binder Replacement         19.00%         18.90%         ≤ 30%         Yes           PC Grade         58-285         58-285         Yes         Certified Tech         Brad Karsten         Cert No Cl391           Gb         1.03251         Gab         2.626         Pbe (%):         4.18         Demostor         Det Materials         Proj Engineer         Certified Tech	96 1	RAS										+		Comment								
PG Grade         58-28S         58-28S         Yes         Certified Tech         Brad Karsten         Cert No         Class           Gb.         1.03251         Gsb.         2.626         Pbe (%):         4.18         Destruction         Destruction         Certified Tech         Ce	% Binder F	Replacement	19.00%	18.90%	≤ 30%	Yes					1	1 Our I	 									
Gb.         1.03251         Gsb         2.626         Pbe (%):         4.18         Destruction         Destruction         Contractor	PG	Grade	58-	28S	58-28S	Yes	Cert	ified Tec	:h'	Brad Kars	sten	_ Cert	No. C1489									
Gb 1.03251 Gab 2.626 Pbe (%): 4.18 Distribution Dist Maternals Proj Engineer Comrador							Cert	ified Tec	:h	Sally Sla	ven	Cert	01400									
	Gb	1.03251	Gsb	2.626	Pbe (%):	4.18	Dist	ibution .	Dis	Materials Pro	1 Engineer	Contract	ut									

Addre Poeting         Bit (2003)         LL Poeting         Addre Poeting<															_	AR	/4		170		Y	
Description         Stription         Description	4/25/13	er.8.10	9/8/2013		_				IOWA DOT	ASPH	ALT PAVING	DAIL	PLANT	REPORT	/	14	$\leq 1$	77	9/9	13 1:42 F	, M	
No trage 10:         No trage 10:<	Active	Project No.: Contract ID:	STP-006-6	(74)-2C-52	2		_		Contractor:		L.L. Pel	ling		Activ	e Piacement;		Surface (Tr	avel Lane	)	_	Report I	No.: 1
UNCOMPACTED MOTURE         COMPACTED ADIT         Comparison	Mic	Design No.;	ABC13-604	3			-	R	AM Lab Number: AE	BC13-0	Johns 119 (3 38 % AC	<u>оп</u>		-	Mix Type: tive Bid Item:	2303-0053	A Surface 1	1/2 L-3 (HI		_ La	b Voids Ta sion Gumbin	rget: 4.0
Nime La         Output         Control (Control (Contro) (Control (Control (Control (Control (Contro) (Con			LINCOMPACT							_						2000 0000		11 17201 L-C			aight Gyradi	///a
Summaria         Que de assumption         Qu	Hot Boy J D					·	<u> </u>		COMPACTE	IOL O	VT						COMPACT	ED MAT				
6 Sampler         10	(Theoretical %AC)	Su9-8c (4.38%)						Core ID	Lane	G <sub>mb</sub>	Pa (%) (Gmm=2.609)	Core	Station	CL Reference	W1 Dry (g)	W2 in H20 (g)	W3 Wet (9)	Diff.	Gmb	% of Gmm	P. (%)	Thickness (in.)
Involution         Involut	Date Sampled	9/8/13	<u> </u>					1-				1	234+65	3.0 SW Pass	819.5	479,5	820.0	340.5	2.407	92.3	7.7	1.63
matrix         matrix<	ine itation	10:31 PM	· · ·		<u> </u>			1				2	229+88	4.6 S\W Pass	867.8	516.5	868.3	351.8	2.467	94.6	5.4	1.75
Bite Trans         Zes Add         A         Distance         Sec Add	lide								<u>├</u>	· · -		3	229+33	8.0 S\W Pass	814.9	487.5	815.1	327.6	2.487	95.3	4.7	1.50
2.540   <	Sample (Tons)	259.00						2				4	213+89	1.0 SWV Pass	715.3	422.9	701.9	293.0	2.441	93.6	6.4	1.50
0.007/00         2.651         0         0         0.00	'mb	2.549				· · ·		2-	t			6	209+39	7.2 S\W Pass	650.4	389.9	650.8	260.9	2.403	95.6	44	1.25
	mb (DOT) (In)	2.551						2-	1			7	† • • •	1			1		1 21.00		1	
Introduction         2	mm.	2.609						2-				8										
Control         Control <t< td=""><td>mm (DOT) (ln)</td><td>2.614</td><td><u> </u></td><td> </td><td><u> </u></td><td></td><td><b>↓</b></td><td>3</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<>	mm (DOT) (ln)	2.614	<u> </u>		<u> </u>		<b>↓</b>	3														
No. 10.0000000000000000000000000000000000	. (%) (DOT)	2.3		<u> </u>			<u> </u>		┞───┼				<u> </u>									
Image: Control (Travel Lane)         Thickness 0:         0.96           Bitwa         Specie         Arange Pa (M)         Contre Placed Surface (Travel Lane)         May Mat Density:         2.460           Bitwa         Specie         Arange Pa (M)         USE D.O.T. RESULTS         Arange Pa (M)         Arange Pa (M)           Bitwa         Specie         Arange Pa (M)         USE D.O.T. RESULTS         Arange Pa (M)         Arange Pa (M)           Bitwa         Specie         Arange Pa (M)         USE D.O.T. RESULTS         Arange Pa (M)         Arange Pa (M)         Arange Pa (M)           Bitwa         Specie         Arange Pa (M)         USE D.O.T. RESULTS         Arange Pa (M)         Arange P	ficia 2303 03 E **	meli Our-site	Applies to 2011	<u> </u>	Avg G	Avg Gmm	Avg Pa (%)	15	┼────┤-			<u> </u>	1						1			
GRACATION (NPassing)         Control (NPassing)         Contrel (NPassing)         Cont	Lantity		NUPRES TOT 300 B	ou <b>pran</b>	2.549	2.609	2.3		Average Pa (%)			-	L	i Irse Placed	Surface (T	ravel Lane	<u> </u>		] This		Ļ	<u> </u>
GRADATION (%Peasang)         □         Lenzy           Stare         Stare         Arg				[											0011000 (1		,		1146			400
stere         Sevec         Sevec <t< td=""><td></td><td></td><td>GRADA</td><td>LION (%Pass</td><td>sina)</td><td></td><td>L UK TOT</td><td><b></b></td><td>USEDOT</td><td>DECII</td><td>Te</td><td></td><td>Intended Li</td><td>ft Thickness:</td><td>1.:</td><td>50</td><td></td><td></td><td>Avg. Ma</td><td>at Density:</td><td>2</td><td>.460</td></t<>			GRADA	LION (%Pass	sina)		L UK TOT	<b></b>	USEDOT	DECII	Te		Intended Li	ft Thickness:	1.:	50			Avg. Ma	at Density:	2	.460
100         1000 <th< td=""><td>Sieve</td><td>Specs</td><td>Su9-8c</td><td></td><td>1</td><td>Avo</td><td>District</td><td></td><td>USE D.U.T. F</td><td>1 E 3 U 1</td><td>-13</td><td></td><td>С Т.</td><td>ate Placed;</td><td>09/0</td><td>5/13 9/12</td><td></td><td>21.0.000</td><td>Avg. %</td><td>6 of Gmm:</td><td>94</td><td>.300</td></th<>	Sieve	Specs	Su9-8c		1	Avo	District		USE D.U.T. F	1 E 3 U 1	-13		С Т.	ate Placed;	09/0	5/13 9/12		21.0.000	Avg. %	6 of Gmm:	94	.300
m.       100       100.0       100	in.	100	100.0			100.0	100		(Ciller a)	<u>, v)</u>			1	est Date/By:	09/04	<u>5/1</u> 5	MIKE	5100 <b>m</b>	Avg. % Fi	ield Voids:		5.70
In.       IS-Seq02.       91.0       92.0       TEST STRIP (Enter an XP)         10       75.0       83         4       476(154)       52.0       52.0       57.0       83         32-42(37)       35.0       35.0       35.0       35.0       35.0       99.9         7.0       2.0       2.0       2.0       2.10       2.10       2.27       PVM. (utper)       99.9         9.0       13-21(17)       17.0       21.0       25.0       28       Price Adjustment       50.0         0       13-21(17)       17.0       21.0       24.60       0.032       100.0       99.9         100       5.3       5.3       5.3       7.5       0.00       17.0       2.17       Price Adjustment       \$0.00         100       13-21(17)       17.0       17.0       2.17       Price Adjustment       \$0.00         100       2.43       4.4       4.4       6.0       16.5       Binder the Price (Sim) \$10.0       100.0       100.0       198.0         102       1.20       1.20       1.20       1.20       1.20       1.20       1.20       1.20       1.20       1.20       1.20       1.20       1.20	'4 in.	100	100.0			100.0	100				است.			(0.96	5 x 26	i09)	2 460				DMI (mu	(a)
In       76-90(3)       79.0	2 in.	85-99(92)	91.0			91.0	92		TEST ST	TRIP		Q.I.	(lower) =		0.0	32	2. 100	=	1.80	$\rightarrow$	F VVL (10W	98.0
4       4/3(164)       52.0       57         1       32/40(7)       35.0       35.0       39         1       32/40(7)       35.0       35.0       39         1       32/40(7)       35.0       39       39         1       32/40(7)       35.0       39       39         3       5.0       26.0       25.0       28         3       10       25.0       28       25.0       28         3       10       17.0       17.0       17.0       17.0       10.0       = 97.9         1000       9.0       9.0       9.0       10.0       40.0       0       44.0       10.0       10.0       = 97.9         1000       2.46.4(4.4)       4.4       6.0       10.0       10.0       10.0       = 97.9         1000       2.46.4(4.4)       4.4       6.0       16.5       10.0	8 in.	76-90(83)	79.0			79.0	83		(Enter an	ו"X")												
Line         27.0         22.0         3           1         32.42(37)         3.5.0         3.6         3.	#4	4/-61(54)	52.0			52.0	5/					Q.I.	(upper) =	2.460	0.9 — (0.9	15 x 2	2.609)	=	2 27	د	PWL (upp	xer) oo o
Jockson/ Tow         Jockson/ 100         Jockson/ 100<	- Dev	32_42/37)	-2.0	<u> </u>	<u> </u>	-2.0	30	<b>1</b>							0.0	32		_		~	=	33.3
Los         Los <thlos< th=""> <thlos< th=""> <thlos< th=""></thlos<></thlos<></thlos<>	·····	+ 5.0	30		i	35.0			FILM THICKNESS	(FT) [8	3.0-15.0]	PV	/L (total) =	9	8.0	+	99.9	_	-	100.0	=	97 9
Image: Solution of the speed of th	-Dev	10.0	-2.0			-2.0	20		FT, µm		8.2									100.0		01.5
0         17.0         17.0         21           0         0.0         17.0         21           0         9.0		19.01/17)	17.0	—		23,0	20		Price Adjustment		\$6.00	Article	9 2303.03,E A	pplies for 30	) ton plan quar	ntity.					•	
Dev         4.0         0         4.0           0         9.0         9.0         12.0           20         5.3         5.3         7.5           00         2.48.4(4.4)         4.4         6.0         11.5           00         2.48.4(4.4)         4.4         6.0         11.5           00         2.48.4(4.4)         4.4         6.0         11.5           00         2.48.4(4.4)         4.4         6.0         11.5           01         2.44         7.5         0         0         1.6           01         1.20         1.20         1.83         54.55         Binder Unit Price (ston)         \$40.55           01         100.0         110.00         100.0         119.8         31.75           10         0.0         119.8         10.0.0         119.8         10.0.0           17.92         (25/0)         32.1/12.6         35.9/11.5         Tons of Waste         13.92           10         10         3.10         N/A         12.6         32.2/12.6         35.9/11.5           10         N/A         3.10         N/A         4.30         4.38         4.00.4         1.82           1	30	(3-21(17)	17.0		[	17.0	21															
2         9.0         9.0         12.0         VMA %         11.5           00         5.3         5.3         7.5         0         2.4-6.4(4.4)         4.4         6.0           10ev         ± 2.0         0         0         1.6         0         1.6           Catablin Compliance?         Yes         Yes         Yes         Yes         Yes           24 17.92         0         0         1.63         0         1.00         10.00	* Dev	± 4.0	0			0	4.0	<u> </u>	Mix Unapproved (S	See IM	510A)							Field Voic	is Price Adi	iustment =	\$	0.00
Color         0.3         1.3         1.4           00         24.6.4(4.4)         4.4         6.0           Dev         ± 2.0         0         0         1.6           Gradation Conglance?         Yes         Yes         Yes         Yes           DBR         0.6 - 1.4         1.20         1.20         1.63         Sinder Unit Price (Stron)         \$48.55           Binder Unit Price (Stron)         548.55         Sinder Unit Price (Stron)         \$48.55           Sinder Unit Price (Stron)         548.55         Sinder Unit Price (Stron)         \$48.55           Binder Unit Price (Stron)         548.55         Sinder Unit Price (Stron)         \$48.55           Dev         0.0         119.8         Tors of Binder         13.92           Tors of Binder to Date         13.92         Tors of Binder to Date         13.92           Tors of Binder to Date         13.92         Tors of Mix to Date         317.54           Mat Temp         See Dow         Beak Dow         Beak Dow         Recare made to stall the day, lettern the remadeery studown           Mat Temp         310         N/A         Comply?         Nor of Mix to Date         313.92           Tors of Mix to Date         31.92         Tors of Station	00		9.0			9.0	72.0	L	VMA, %	·	11.5										Ŷ	0.00
Construction         Transmitter         Tay	200	2 4.8 4/4 4				5.3	60		011111													
Gradation Compliance?         Yes	*Dev	±2.0	n 1		<u> </u>	- <del>4</del>	16		QUANTITY FOR		CAD EF		T	·····		TE	MPERATURE	Ξ, °F				]
DBR         0.6 + 1.4         1.20         1.20         1.63           6 +4 Type 4         80         100.0         100.0         119.8           6 +4 Type 3         45         0.0         119.8           6 +4 Type 2         (250)         32.1/12.6         35.9/11.5           7 ons of Mix on Road         317.54           9 and Target         0.0         100.0           1 Tons of Mix on Road         317.54           9 and Target         0.0         100.0           1 Tons of Mix on Road         317.54           9 and Target         0.0         100.0           1 Tons of Mix on Road         317.54           9 and Target         0.0         100.0           1 Tons of Mix on Road         317.54           9 and Target         Actual         Spec           1 Target         Actual         Spec           9 Added Binder         3.10         3.10           3.10         3.10         N/A           2 Stride         225+27           9 & RAS         4.38         4.00-4.60           9 & RAS         200+50         SB/WB Pass Lr         12           9 & RAS         64-28         Yes           9	Gradation Co	mpliance?	Yes			Yes	Yes	в	inder Unit Price (S/tor	n)	\$686.20		ir Temp	7:00	9:00	11:00	1:00	3:00	5:00	7:00	Spec	Comply?
6+4 Type 4       80       100.0       119.8       Tons to Other Bid Item(s)       13.92       200 309       200 309       245.330 °F       Yes         6+4 Type 3       45       0.0       119.8       Tons to Other Bid Item(s)       13.92       Mat Tamp       245.330 °F       Yes         4(4) Type 2       (25/0)       32.1/12.6       35.9/11.5       Tons of Waste       13.92       Mat Tamp       245.330 °F       Yes	DBR	0.6 - 1.4	1.20	1	<u> </u>	1.20	1.63		Tons of Mix on Road	; - <del> </del>	317.54	Bir	der Temo	300	300	300	┝━━━╸ ╽			<u> </u>	260 220	•E V
6+4 Type 3         45         0.0         70% of Binder         13.92         Mat Temp         240-300 F         Tos           4/4) Type 2         (25/0)         32.1/12.6         32.1/12.6         35.9/11.5         Tons of Binder         13.92         Mat Temp         245.300 F         Tos           4/4) Type 2         (25/0)         32.1/12.6         35.9/11.5         Tons of Binder to Date         13.92         Image: Complexity Stretcom         245.300 F         Tos           Max Temp         Image: Complexity Stretcom         Tons of Binder to Date         13.92         Image: Complexity Stretcom         Max Change Information (when changes are made to start the day, identity them on previous day's report):         Old Target New Target Tons         Agg         Initial %         New %         Agg         Initial %         N	% +4 Type 4	80	100.0			100.0	119.8	Т	ons to Other Bid Item(	(s)	1	PI	ant Temp	320	309	322	····				245-330	
4(4) Type 2       (25/0)       32.1/12.6       35.9/11.5       Tons of Binder to Date       13.92         Tons of Binder to Date       13.92       Tons of Binder to Date       13.92         BINDER       Target       Actual       Spec       Comply?         % Added Binder       3.10       N/A       PACCEMENT RECORD         % Added Binder       3.10       N/A       235+54       226+27       SB/WB Pass Lr       12         % RAS       211-60       206+60       SB/WB Pass Lr       12       Image: Certified Tech:       Taylor Maxfield       Certified Tech:       Taylor Maxfield       Certified Tech:       Taylor Maxfield       Certified Tech:       Taylor Maxfield       Cert No. EC593       specified in the approved mix design and was produced in compliance with the         Gb:       1.01956       Gasb:       2.754       Pbe (%):       3.67       Data Materials       Proj. Engineer       Contractor	% +4 Type 3	45				0.0			Tons of Binder		13.92	N	at Temp		<u> </u>	VLL					245-330	°F
Tons of Binder to Date         13.92         Mix Change Information (when changes are made to start the mon previous day's report):           BINDER         Target         Actual         Spec         Comply?           % Added Binder         3.10         3.10         N/A         PLACEMENT RECORD           % Added Binder         3.10         N/A         235+54         226+27         SB/WB Pass Lr         12           % Total Binder         4.30         4.33         4.00-4.60         Yes         217+60         208+50         SB/WB Pass Lr         12           % RAS         1         1         1         1         1         1         1           % Binder Replacement         28.96%         29.29%         ≤ 30%         Yes         Certified Tech:         Taylor Maxfield         Cert. No. EC593         Specified in the approved mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produced in compliance with the provided mix design and was produ	+4/-4) Type 2	(25/0)	32.1/12.6		1	32.1/12.6	35.9/11.5		Tons of Waste				· · · · · · · · · · · · · · · · · · ·				Deret D			De atració de		<u>i la sera se se s</u> el
BINDER         Tons of Mix to Date         317.54         Old Target New Target Tons         Agg         Initial % New % Agg         Initial % New %         Agg							ليصحد		Tons of Binder to Date	9	13.92			Mix Change	Information (	when change	s are made to	start the d	ay, identify t	them on pi	r mandatory s revious day	's report):
PLACEMENT RECORD           Target         Actual         Spec         Comply?           % Added Binder         3.10         N/A         To Station         Lane         Width (T)           % Added Binder         3.10         N/A         235+54         222+27         SB/WB Pass Lr         12           % Total Binder         4.30         4.38         4.00-4.60         Yes         217+60         206+60         SB/WB Pass Lr         12           % RAP         38.00         39.21%         \$100%         Yes         217+60         206+60         SB/WB Pass Lr         12 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Tons of Mix to Date</td><td></td><td>317.54</td><td></td><td></td><td></td><td>Old Target</td><td>New Target</td><td>Tons</td><td>Agg</td><td>Initial %</td><td>New %</td><td>Agg li</td><td>nitia New %</td></td<>									Tons of Mix to Date		317.54				Old Target	New Target	Tons	Agg	Initial %	New %	Agg li	nitia New %
Target         Actual         Spec         Comply?           % Added Binder         3.10         3.10         N/A         235+54         226+27         SB/WB Pass Lr         12           % Total Binder         4.30         4.38         4.00-4.50         Yes         217+60         SB/WB Pass Lr         12           % RAP         38.00         39.21%         \$100%         Yes         217+60         SB/WB Pass Lr         12           % RAS			BINDE	R	<u>,                                     </u>				PLACEMENT F	RECOF	RD											
Normalization         0.10 <th0.10< th="">         0.10         0.10</th0.10<>	Pé Addod	Binder	Target	Actual 3 10	Spec N/A	Comply?	-rom	Station	To Station	<u> </u>	Lane V	Vidth (ft										
Microscope       Tool	% Total C	linder	3.10	4 99	4 00 4 60	Yes	23	7-34 7-60	226+2/		BAND C	12		<u> </u>								
% RAS       Comments:         % Binder Replacement       28.96%       29.29%       \$30%       Yes         PG Grade       64-28       64-28       Yes       Certified Tech:       Taylor Maxfield       Cert. No. EC593       specified in the approved mix design and was produced in compliance with the         Gb:       1.01956       Gab:       2.754       Pbe (%):       3.67       Distribution:       Distribution:       Proj. Engineer       Contractor	% RA	P	38.00	39.21%	≤100%	Yes				f	DEVINE Pass Lr	12										
% Binder Replacament       28.96%       29.29%       ≤ 30%       Yes       Centified Tech:       Taylor Maxfield       Cert. No. EC593       specified in the approved mix design and was produced in compliance with the         Gb:       1.01956       Gsb:       2.754       Pbe (%):       3.67       Distribution:       Dist. Materiale       Proj. Engineer       Contractor	% RA	5 S								- +				Commenter								
PG Grade       64-28       64-28       Yes       Certified Tech:       Taylor Maxfield       Cert. No. EC593       Specified in the approved mix design and was produced in compliance with the         Gb:       1.01956       Gsb:       2.754       Pbe (%):       3.67       Distribution:       Dist Materials       Proj. Engineer       Contractor	% Binder Re	lacement	28.96%	29.29%	≤ 30%	Yes						-		The asphal	t mixture cor	tains certifi	ad aspha# h	inder and r	annoved	bogroacte		
Gb:         1.01956         Gsb:         2.754         Poe (%):         3.67         Distribution:         Dist Materialis         Proj. Engineer         Contractor	PG Gr	de	64-	28	64-28	Yes	Certifie	Tech:	Taylor	Maxfie	eld (	Cert. No	EC593	specified in	the approve	d mix desig	in and was r	moduced in	Complian	ce with th	- d3  A	
Gb: 1.01956 Gsb: 2.754 Pbe (%): 3.67 Distribution: Dist. Materials Proj. Engineer Contractor			_				Certifie	1 Tech:	Dave M	IcDov	vell	Cert. No	EC898	provisions	of Article 230	3.03, E.						·····-
	Gb:	1.01956	Gsb:	2.754	Pbe (%):	3.67	Distribut	on:	Dist. Materials	Proj. E	ngineer C	ontractor			_							

Form 955r ver. 8.10

#### **Iowa Department of Transportation**

#### Highway Division-Office of Materials Proportion & Production Limits For Aggregates

			rioporada di riconomia	00 0				
County :	Johnson		Project No.: STP-006-6(74)2C	-52		Date:	09/08/13	
Project Location:	In Iowa Ci	ity from 50	00' N of S Jet IA 1 to Lakeside Dr		Mix Desi	gn No.:	ABC13-6	5043
Contract Mix Ton	nage:	300	Course: Surface (Trave	l Lane)	Mix Size	(in.):	1/2	
Contractor:	L.L. Pelli	ng	Mix Type: HMA (1	OM ESAI	.), Surface	, 1/2, FR	CL-3	
Material	Ident #	% in Mix	Producer & Location	Type (A or B)	Friction Type	Beds	Gsb	%Abs
Sand	A52508	11.0%	Williams/S&G Materials Inc	A	4		2.634	0.47
TAT4 M. Sand	A52006	14.0%	Klein/River Products Co	A	4	2-10	2.649	0.84
3/8"chins	A58002	12.0%	Columbus Junction/River Products Co	A	4	16-19	2.583	3.23
3/4" A	A52006	11.0%	Klein/River Products Co	A	4 .	2-10	2.652	0.86
3/8" Slag	A70008	14.0%	Montpelier/Blackheart Slag	A	2		3.709	1.20
RAP	Surface mi	38.0%	ABC13-0119 (3.38 % AC)	Α	2	0	2.662	1.30
Type and Source of	Asphalt Bi	nder:	64-28 Bituminous Matr'l	& Supply (	Tama, IA)			

		Indivi	dual Agg	regates S	ieve Analy	ysis - % P	assing (I	arget)			
Material	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
Sand	100	100	100	100	95	90	79	53	16	2	1
TAT4 M. Sand	100	100	100	100	98	76	43	20	8.3	2.8	2.5
3/8"chips	100	100	100	95	50	15	4	2.7	2.6	2.5	2.3
3/4" A	100	100	55	19	4	3	3	2.5	2.5	2	2
3/8" Slag	100	100	100	100	31	1.8	1.6	1.5	1.5	1.4	1
RAP	100	100	93	80	51	36	27	20	14	10	8.8

#### Preliminary Job Mix Formula Target Gradation

								-			
Upper Tolerance	100	100	99	90	61	42		21			6
Comb Grading	100	100	92	83	54	37	26.0	17.0	8.0	5.1	4.4
Lower Tolerance	100	100	85	76	47	32		13			2.4
S.A.sq. m/kg	Total	4.46		+0.41	0.22	0.30	0.43	0.49	0.55	0.62	1.44

#### 38.0% of mix 11.0% of mix 14.0% of mix 11.0% of mix 14.0% of mix 12.0% of mix Sieve RAP Size TAT4 M. Sand 3/8"chips 3/4" A 3/8" Slag Sand Min Max Max Min Max Min in. Min Max Min Max Min Max 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 1" 100.0 3/4" 100.0 100.0 100.0 98.0 100.0 100.0 100.0 98.0 100.0 100.0 100.0 100.0 100.0 48.0 62.0 100.0 100.0 86.0 100.0 1/2" 100.0 100.0 100.0 100.0 98.0 73.0 87.0 98.0 100.0 88.0 100.0 12.0 26.0 98.0 100.0 3/8" 98.0 100.0 44.0 58.0 24.0 38.0 #4 88.0 100.0 91.0 100.0 43.0 57.0 0.0 11.0 0.0 31.0 41.0 6.8 #8 85.0 95.0 71.0 81.0 10.0 20.0 0.0 8.0 0.0 5.5 16.0 24.0 0.0 6.7 0.0 6.5 24.0 #30 49.0 57.0 16.0 0.0 3.0 6.8 10.8 0.5 0.3 4.3 0.0 4.0 #200 0.0 4.5 3.0

#### Production Limits for Aggregates Approved by the Contractor & Producer.

Comments: Copies to:

This is a revised report which includes field changes to the aggregate proportions

The above target gradations and production limits have been discussed with and agreed to by an authorized representative of the aggregate producer.

Producer

Signed:

Signed:

Contractor

form 956 - ver. 10	),10			Iowa I H	<b>Departme</b> lighway Divis HMA Gy	ent of Tran ion - Office of M yratory Mix Desi	<b>sportation</b> Materials ign	Letti	ng Date :	4/16/2 ABD13	-3034	
· · · · · ·				-		TPN-182-1(7)	2J-60	1	Mix No. :	ADDIS	505.	
Smax Country'		Lyon		Р	Project	riState	,	C	ontract #:	08/23	2/13	
County:		1/2	Туре	A C	Contractor 1	notate 30	000 000		Date:	06/24	2/15	
Mix Size (III.)	•	HMA 3M	1	L-3 I	Design Life I	ESALS. 5,0	IA	182 fro US18 ir	n Inwood N.	to IA 9	EAA	Friction
Mix Type:		Surface		I	Location : N	MP0-9		Beds	Gsb	%Abs	46.0	2
Intended Use	<u> </u>	% in M	x So	urce ID	Sc	ource Location		1	2.633	0.35	40.0	2
Aggreg	zate	10.0%	A	SD004 \$	Sioux Falls (	Quartzite/Conc	Tele Mails	1	2.633	0.35	40.0	2
3/8 X	. 8	E 504	Δ.	SD004	Sioux Falls (	Quartzite/Conc	rete Mans	i	2.634	0.30	46.0	4
Manf. S	Sand	2.570	. A	SD004	Sioux Falls	Quartzite/Conc	orete Maus	1	2.617	0.76	40.0	3
4 X 3	20	27.57	, Λ · Δ	84510	Hawarden-P	Vorth/Lg Everi	st inc		2.669	1.10	46.0	3
San	ıd	17.07	ν Λ	60548	O'Conner/H	fallett Material	s Co		2 633	1.03	42.0	2
1/2 Cr.	Gravel	25.0%	0 Z1 / AD/	C13-0094	11% RAP/4	% RAS (8.4%	AC)		1.000			
RAP/	RAS	15.0%	• AD	013-009-1								
			_			Questioned (	Tradation (Sie	ve Size in.)			_	
				Job N	Mix Formula	- Combineu C	Jiadation (21)	#30	#50	#100	#200	
		1/2	,	3/8"	#4	#8	#10	1,50				
1"	3/4"	1/2		2		Upper Tole	rance	10			5.9	
				05	76	48		19	9.2	5.6	3.9	
100	100	100	,	88	69	43	26	15			1.9	
100	100	97		81	62	38		11				
100	100	90		01		Lower Tole	erance		T			
	. In Cal	urce and Gi	ade:			D.					Constions	
Asphalt B	inder So	100 and 0.				Gyratory Da	1a			Number	OI Gylations	
Ad	just grade is	Dinder		4.60	5.10	5.33	2 201			7	-muai	
	% Aspnan	Dinaer	1	2.315	2.317	2.352	2.371		1		Design	
Con	rected Gin	(Com)	1	2.471	2.460	2.450	2.4.70	ł		N	-Design	
Ν	fax. Sp.G	N. Initial		86.2	86.4	88.2	90.2	1			80	
9/	6 Gmm @	N Moy	1	93.7	94.2	96.0	20.1	1			N-Max	
	%Gmm @	leide		6.3	5.8	4.0	1.5	ł			134	
	% Air	V OLOS	1	17.4	17.8	16.7	07.6	1		<u>Gsb to</u>	or Angularity	
	% V.	MA TA	1	63.7	67.3	76.1	11 52	1		<u>N</u>	Aethod A	
	% V	PA · ·		9.35	10.25	10.84	0.76	1			2.627	
	Film Th	uckness	1	0.94	0.86	0.81	0.70	4		<u>Pba</u>	/%Abs Ratio	
	Filler B	n. Rano		2.670	2.678	2.676	2.075				0.29	
	G	se	1	4.14	4.54	4.80	5,11			Slope	of Compaction	<u>n</u>
	Р	be	1	0.44	0.55	0.52	0,48	1			Curve	
	Р	ba		73.5	76.3	77.3	/8.5		1			
q	% New As	phalt Billion		1.0300	0 1.030	0 1.0300	1.0300			]	Mix Check	
	Combined	00 (6) 20 0					Combined	From RA	м		Good Duran Charle	
	- Twee 11-	ed	А	1			1) 10.3	8.1		Pb	Kange Check	
Aggregat	te Type Us		2.640	4	% Fr	iction Type 4 (+	4) 10.5 . 100.4	8.5	1	1.00		
	പം		2.689	1		Or Bet	ter 100.4	0.0		1	RAM Check	
	G <sub>sa</sub>		0.69		% Fr	iction Type 3 (+	-4) 09.0	0.4			OK	
%	Water At	IS	1 12	1		Or Bet	tter 90.1	0.4	l l			,
S	.A. m <sup>2</sup> / K	g, 1	4.45	1	% F1	riction Type 2 (4	+4) 21.0	0.4		Spe	cification Che	CK
Angu	larity-meth	od A	45	1	% F	riction Type 2 (	-4) 54.8	0.0 0.4			Comply	Ch l-
% F!	lat & Elon	gated	87	1	Type 2	2 Fineness Modu	ilus 2.5	53	1	<u>Moistu</u>	re Sensitivity	UNECK
Sa	nd Equiva	ient	1 03		-	% Crus	hed 13.0		1	SIP (0% AS)=	-11,393	
Vir	gin G <sub>b</sub> @ 2	<u>13°C  </u>	1.05		0.50	0.75			ł	SIP (0.75% A	S)=18,577	
Anti	-Strip Dos	e (%)	11 20	, )3	9,382 1	8,577		art this proje	] ect.			
Strippi	ing Inflecti	on Point	An 89	phalt cont	ent of 5.2	3% is recon	nmended to st	art uns proje	ASS	Source: LOF650	0	
	D	sposmon	5 3 20%	column	is interpola	ted from test d	iata.		Dee	e Rate= 0.75	% of bii	nder
	Data s	nown m	<u>5.3570</u>	o start pro	iect is 4.	1%			005			
		The % AI	DACI	o atari pro								
	Cor	nments :										
		-										
	С	opies to : <u>1</u>	riState									
		-		Ch uniterrated	CI-5	515	Signe	d:				
Mix	Designer d	& Cert.# :	.]	nuisman	015							

## Iowa Department of Transportation

Form 955 ver. 10.10

Highway Division-Office of Materials Limits For Aggregates

County : Project Location: Contract Mix Tonn Contractor: Material 3/8 X 8 Manf. Sand 4 X 20 Sand 1/2 Cr. Gravel RAP/RAS	Lyon IA 182 fro age: TriState ASD004 ASD004 ASD004 ASD004 A84510 A60548 BC13-009	I US18 in In 13,571 % in Mix 10.0% 5.5% 27.5% 17.0% 25.0% 9 15.0%	Project No.: Project No.: wood N. to IA 9 Course Mit Produce Sioux Falls Quartz Sioux Falls Quartz Sioux Falls Quartz Hawarden-North/I O'Conner/Hallett 11% RAP/4% RA	x Type: x Type: x Loca ite/Concr. ite/Concr. ite/Concr. x Everist Materials S (8.4% 4	tion ete Matls Co ete Matls Co ete Matls Co ete Matls Co ete Matls Co ete Matls Co ete Matls Co	Type (A or B) A A A A A A A A A A	ix Design N Mix Siz Design Lif Friction Type 2 2 2 4 3 2	Date: io.: ee (in.): e ESAL's Beds 1 1 1	08/22/13 ABD13-30 1/2 s: 3,000,000 Gsb 2.633 2.633 2.633 2.634 2.617 2.669 2.633	%Abs 0.35 0.35 0.30 0.76 1.10 1.03
Type and Source of	f Asphalt Bi	nder:								

Individual Aggregates         Sieve Analysis - % Passing (Target)         #100         #20           Material         1"         3/4"         1/2"         3/8"         #4         #8         #16         #30         #50         #100         #20           3/8 X 8         100         100         100         100         40         4.0         2.0         1.0         1.0         1.0         1.0           3/8 X 8         100         100         100         100         40         4.0         2.0         1.0         1.0         1.0         1.0           3/8 X 8         100         100         100         100         97         75         57         37         16         5.0           Manf. Sand         100         100         100         100         99         46         12         5.8         4.5         3.6         2           4 X 20         100         100         100         96         78         55         27         7.5         1.2         0           Sand         100         100         88         57         16         8.5         6.2         5.1         4.4         3.7         3           1/2 Cr.	Material 3/8 X 8 Manf. Sand 4 X 20 Sand 1/2 Cr. Gravel RAP/RAS	Individual Agg 3/4" 1/2" 100 100 100 100 100 100 100 100 100 100 100 100 0 100 88 0 100 99	arcgates         Sieve Analy           3/8"         #4           100         40           100         100           100         99           100         96           57         16           93         80	rsis - % Pa #8 4.0 97 46 78 8.5 67	ssing (1a #16 2.0 75 12 55 6.2 52	#30 1.0 57 5.8 27 5.1 35	#50 1.0 37 4.5 7.5 4.4 26	#100 1.0 16 3.6 1.2 3.7 19	#200 1.0 5.6 2.8 0.6 3.0 15
--	--	---	---	---	--	--	---	--	---

### Preliminary Job Mix Formula Target Gradation

			1 Iouuu	any voi							5.9	L
Upper Tolerance Comb Grading Lower Tolerance S.A.sq. m/kg	100 100 100 Total	100 100 100 4.43	100 97 90	95 88 81 +0.41	76 69 62 0.28	48 43 38 0.35	26 0.42	19 15 11 0.44	9.2 0.57	5.6 0.69	3.9 <u>1.9</u> <u>1.29</u>	
								9. Deadura	24.			

Production Limits for Aggregates Approved by the Contractor & Producer.

		Pr	oduction L	imits for <i>l</i>	Aggregates	Approve			05.09/	of mix	15.0%	of mix
Figure	10.0%	ofmix	5.5%	ofmix	27.5%	ofmix	17.0%	of mix	25.0% ( 1/2 Cr. )	Gravel	RAP/	RAS
Size	3/8	X 8	Manf.	Sand	4 X	20	5a	Max	Min	Max	Min	Max
in.	Min	Max	Min	Max	Min	100 0	100.0	100.0	100.0	100.0		
1"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
3/4"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	81.0	95.0		
1/2"	100.0	100.0	100.0	100.0	98.0	100.0	100.0	100.0	50.0	64.0		
3/8"	95.0	100.0	95.0	100.0	92.0	100.0	89.0	100.0	9.0	23.0		
#4	33.0	47.0	0.0	100.0	41.0	51.0	73.0	83.0		8.0		
#8	0.0	5.0	50.0	65.0	0.0	10.0	23.0	31.0	0.0	5.0		
#200	0.0	3.0	0.0	8.0	0.0	4.5	0.0	1.5				

Comments:

Copies to:

TriState

The above target gradations and production limits have been discussed with and agreed to by an authorized

Producer

representative of the aggregate producer.

Signed:

Signed:

Contractor

form 956 ver. 1	0.10		ſ	owa D Hig	epartme ghway Divisio HNIA Gyr	nt of Tran on - Office of I ratory Mix Des	sportation Materials ign	1 Let	ting Date :	4/16/	2013	
imax						FDN 182-1/7	21-60		Mix No. :	ABD1	3-3034	
County :		Lyon		Pro	oject: SI	(FIN-102-1(7)	)- 23 00	(	Contract #:			
Mix Size (in.	):	1/2	Турс А	Co	ntractor: 11	notate 3(	000.000		Date:	08/3	0/13	
Mix Type:		HMA 3M	L - 3	De	sign Life E	SALS	IA	182 fro US18	in Inwood N. t	o IA 9		<u> </u>
intended Use	;:	Surface		Lo	cation : M	PU-9		Beds	Gsb	%Abs	FAA	Friction
Aggre	gate	% in Mix	Source	ID	Sot	irce Location	rete Mails	1	2.633	0.35	46.0	2
3/8 2	κ̃ 8	13.0%	ASD0	)4 Si	oux Falls Q	uartzne/Conc	rote Matis	1	2.633	0.35	46.0	2
Manf.	Sand	8.5%	ASD0	04 Si	oux raiis Q	uartzite/Cone	rete Matis	1	2.634	0.30	46.0	2
4 X	20	24.5%	ASD0	04 Si	oux Falls Q	uarizite Con	et Inc		2.617	0.76	40.0	4
Sar	ıd	20.0%	A845	10 H	awarden-No	Hatt Material	« Co		2.669	1.10	46.0	3
1/2 Cr.	Gravel	25.0%	A605	48 O	Conner/Ha				2.634	1.16	42.4	2
RAP/	RAS	9.0%	ABC13-	0094 59	% KAP/4%	K/33 (10.070	1(0)					
				Joh Mi	v Formula -	Combined G	radation (Sie	eve Size in.)				
_				200 IVII	. i ormuna		<i>щ16</i>	#30	#50	#100	#200	
1 "	3/4"	1/2"	3/8	4	#4	#8	#16	#30	100			
L						Upper Tolei	ance	20			5.4	
100	100	100	96		75	49	25	20	9.3	5.2	3.4	
100	100	97	89	)	68	44	27	10	2.0		1.4	
100	100	90	82	!	61	39		12				
						Lower Tole	rance		[			
Asphalt B	inder Sour	ce and Grad	ie:		C	<b>Gyratory Date</b>	a		┼───	Number	of Gyrations	
Adj	ust grade to P	Condan	4.0	50	5.10	5.33	5.60			<u>N N</u>	-Initial	
9	Asphan B	Andra A M Dec	2.3	15	2.317	2.352	2.391			-	7	
Corre	ected Gmb (	(C-m)	2.4	71	2.460	2.450	2.438		1	N	Design	
M	lax. Sp.Gr. (	Unitial	86	.2	86.4	88.2	90.2		1		86	
%	Gmm @ N	- Innas I Mari	93	7	94.2	96.0	98.1			ſ	N-Max	
,	Gmm @ N	-141a.x	6	.3	5.8	4.0	1.9				134	
	% Air vo	A A	1	.4	17.8	16.7	15.6			Gsb fo	r Angularity	
	% VN1/	A.	6	3.7	67.3	76.1	87.6			M	ethod A	
	70 VF7	1	9	65	10.54	11.14	11.87		1		2.627	
	Film Thies	Datio	0	82	0.75	0.71	0.67			Pba /	%Abs Ratio	
	Filler Bit.	Ratio	2.	570	2.679	2.677	2.674				0.32	
	1160		4	.13	4.51	4.77	5.08	1		Slope	of Compaction	
	F UC Dhe		0	.45	0.58	0.55	0.51				Curve	
<b>A</b> (	Norther Acobe	di Binder	8	0.0	82.0	82.9	83.7				-	
%	ombined Gb	n@ 25°C	1.	300	1.0300	1.0300	1.0300	<u> </u>	-	M	<u>lix Check</u>	
	onionica di	- <u></u>			-		Combined	From RAM	4	-	Good	
Agoregate	Type Used	A	1				Combined	3 5	7	<u>196 F</u>	Range Check	
VERIORATO	G <sub>4</sub>	2.63	9		% Frictic	on Type 4 (+4)	100.2	3.7		1.00		
	G.,	2.68	37			Or Better	- 100.3 (0.0	0.0		<u>R</u> .	<u>AM Check</u>	
04 V	→sa Vater Abs	0.6	8		% Friction	on Type 3 (+4)	08.0	0.0		_	OK	
70 \	m <sup>2</sup> /1 <sup>r</sup> a	42	8			Or Bette	94.1	0.2				
S.A	LIII / Kg.	A 43			% Fricti	on Type 2 (+4)	) 26.2	0.2		Speci	fication Check	
Angula	- Ry-metriod	. 0	5		% Frict	ion Type 2 (-4	) 56.7	0.0			Comply	
% Flat	Equivalent	8	,		Type 2 Fit	neness Modulu	s 2.2	0.2		Moisture	Sensitivity Che	e <u>ck</u>
Sand	- Equivation		3			% Crushe	1 76.0			SIP (0% AS)=11	,393	
v irgu	trin Dore /0	<u>~</u>	0.00	0.5	0 0.7	75			4	SIP (0 75% AS)	=18,577	
Anti-S	Inflection 1	Point 1	1,393	_9,38	2 18,5	<u> </u>		t this mains	l	511 (0.7570710)		
Stripping	Diepo	sition : A	n asphalt c	ontent o	of <u>5.3%</u>	is recomm	ended to star	T this projec	ι. Λ 9 9ου	rce LOF6500		
	Data show	vnin 53	3% colu	mn is i	nterpolated	from test dat	a.			ato = 0.75	% of binde	r
	Data show	10 % ADD A	C to start	project	is <u>4.4%</u>				Dose R	ate= <u>9.75</u>		
	Comme	ents :										
	Copie	es to : <u>TriSta</u>	nte									
Mix De	sioner & Ce		Thuism	m	CI-515		Signed	:				

Mix Designer & Cert.# :

KeNised (KEN)

## Iowa Department of Transportation

Form 955 ver. 10.10

Highway Division-Office of Materials Proportion & Production Limits For Aggregates

V	°A.	Ŋ	Ø	$\checkmark$
V	ÚÃ,	/ )[	$\varphi$	V

08/30/13 Date: STPN-182-1(7)--2J-60 Project No.: ABD13-3034 Lyon County : Mix Design No .: Project Location: IA 182 fro US18 in Inwood N. to IA 9 1/2 Mix Size (in.): Surface Design Life ESAL's: 3,000,000 Course: Contract Mix Tonnage: 13,571 HIMA 3M Mix Type: Contractor: TriState Friction Type %Abs Gsb Beds Type Producer & Location (A or B) 0.35 Ident # % in Mix 2.633 Material 1 Sioux Falls Quartzite/Concrete Matls Co 2 А 13.0% 2.633 0.35 ASD004 2 1 3/8 X 8 Sioux Falls Quartzite/Concrete Matls Co А 0.30 8.5% 2.634 ASD004 Manf. Sand 2 1 Sioux Falls Quartzite/Concrete Matls Co Α 24.5% 0.76 ASD004 2.617 4 X 20 А 4 Hawarden-North/Lg Everist Inc 20.0% 1.10 A84510 2.669 3 Sand А O'Conner/Hallett Materials Co 25.0% 1.16 2.634 A60548 1/2 Cr. Gravel 2 A 5% RAP/4% RAS (10.6% AC) BC13-009 9.0% RAP/RAS Type and Source of Asphalt Binder:

$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Material 3/8 X 8 Manf. Sand 4 X 20 Sand 1/2 Cr. Gravel RAP/RAS	1" 100 100 100 100 100	Indiv 3/4" 100 100 100 100 100 100	vidual Agg 1/2" 100 100 100 100 88 99	regates S 3/8" 100 100 100 100 57 95	ieve Analy #4 40 100 99 96 16 84	rsis - % Pa #8 4.0 97 46 78 8.5 71	ssing (Ta #16 2.0 75 12 55 6.2 56	rget) #30 1.0 57 5.8 27 5.1 38	#50 1.0 37 4.5 7.5 4.4 31	#100 1.0 16 3.6 1.2 3.7 23	#200 1.0 5.6 2.8 0.6 3.0 17
---	--	---------------------------------------	---	--	---	---	---	--	---	---	--	---

Preliminary Job Mix Formula Target Gradation

Upper Tolerance Comb Grading Lower Tolerance	100 100 100 Total	100 100 100 4.28	100 97 90	96 89 82 +0.41	75 68 61 0.28	49 44 39 0.36	27	20 16 12 0.46	9.3 0.57	5.2 0.64	5.4 3.4 1.4 1.11	
S.A.sq. m/kg	100											

Production Limits for Aggregates Approved by the Contractor & Producer.

		Pi	concuon r	Junto IOL /					25.00/	of mix	9.0%	of mix
			0 50%	ofmix	24.5%	of mix	20.0%	ofmix	25.0%	011111		DAG
Sieve	13.0%	of mix	0.370	01 1117	4 V	20	Sa	.d	1/2 Cr.	Gravel	RAP	KAS
Size	3/8	X 8	Manf.	Sand	4 ^	20	Min	Max	Min	Max	Min	Max
5120	Min	Max	Min	Max	Min	Max	IVIIII	100.0	100.0	100.0		-
<u>m</u>	IVIIII	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
1"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
3/4"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	81.0	95.0		
1/2"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.0	64.0		
1/2	100.0	100.0	100.0	100.0	98.0	100.0	100.0	100.0	50.0	04.0	1	
3/8"	95.0	100.0	100.0	100.0	02.0	100.0	89.0	100.0	9.0	23.0		
#4	33.0	47.0	95.0	100.0	92.0	100.0	72.0	83.0	0.0	13.0		
"	0.0	9.0	0.0	100.0	41.0	51.0	15.0	03.0	0.0	8.0	1	
#8	0.0	5.0	50.0	65.0	0.0	10.0	23.0	31.0	0.0	0.0	4	
#30	0.0	5.0	50.0	05.0	0.0	4.5	0.0	1.5	0.0	5.0		
#200	0.0	3.0	0.0	8.0	0.0	<del>1</del> .J						

Comments:

Copies to: \_\_\_\_

The above target gradations and production limits have been discussed with and agreed to by an authorized

representative of the aggregate producer.

TriState

Producer

Signed:

\_**-**-

Signed:

Contractor

4/25/13 ve	r.11.07	9/14/2018		_			G	)	IOWA DOT	ASPHALT PA	VING D	AILY PLANT	REPORT					9/15	5/18 10:38	AM		
Active	Project No.:	NHSX-018-	8(45)3H-3	33		-		Contrac	tor.	Mathy Con	struction	n		Active Placement:	5	Surface (Tr	ravel Lane	)		Report I	No.:	9
	Contract ID:	33-0188-04	5			-		Cou	nty:	Faye	ette		-	Mix Type:	Ht	Surface L	- 4 1/2 (HN	/A)	Lat	Voids Ta	rget;	4.0
	Design No.:	ABD18-202	./			-	RAP	Stockpil	e ID	ABC14-0116	5.52 % A	C)		Active Bid Item:	2303-1043	3504 HT SU	RF 1/2IN L	-4 (HMA)	Des	ign Gyratio	ons:	75
		UNCOMPACT	ED MIXTUR	E					COMPACTED J	ТИІС				_		COMPACT	ED MAT					
(Theoretical %AC)	9-14A (5.23%)	9-14B (5.23%)					Core #	Statio	on Joint ID	G <sub>mb</sub>	Core	Date of Placement	Station	CL Reference	W1 Dry (g)	W2 in H20 (g)	W3 Wet (g)	G <sub>mb</sub>	% of Gmm	P <sub>a</sub> (%)	Thickne	ess (in.)
Date Sampled	9/14/18	9/14/18					1	504+	78 2L-Centerline	2 285		9/14/2018	8 504+78	90 SW Pass	654.8	367.6	655.5	2 274	01.4	86	1	44
Time	4:05 PM	5:15 PM	1				2	514+	18 2L-Centerline	2 297	- 2	9/14/2018	514+18	10 SW Pass	889.0	507.6	889.7	2 3 27	93.5	6.5	1	88
Station	505+50	529+00		1			3	524+	25 2L-Centerline	2 239	3	9/14/2018	3 524+25	4 1 SW Pass	958.2	542.6	959.0	2.301	92.4	7.6	2	00
Bar Code ID	D2-004528	D2-004527								2.200	4				000.2	0.0	000.0	2.001	52.4	1.0		
Sample (Tons)	234.40	419.27							Average Joint G	mb 2.274	5											
G <sub>mb</sub>	2.407	2.402							Average Mat G	mb 2.301	6											
Gmb (DOT)									% Mat Dens	ity 98.8	7								1			
Gmm	2.489	2.489						1	For information	Only	8											
Gmm (DOT)					-				Joint Length,	ft 4,423												
Pa (%)	3.3	3.5						Unit Pric	ce Adjustment (\$	ft) \$0.240												
Pa (%) (DOT)																						
				Avg G <sub>mb</sub>	Avg G <sub>mm</sub>	Avg Pa (%)																
				2.405	2.489	3.4			Joint Incentive	= \$1,061.52		C	ourse Placed:	Surface (Trav	el Lane)			This	ckness QI:	·	0.49	
											-	late a de d	1 W. Thisterson		· ·							
		GRADA	TION /%Page	(no)	r	7	<b></b>	115	EDOT PE		٦	intended	Lift Thickness	2.00	10			Avg. Mi	at Density:	2	.301	
Sieve	Snoce	CE 9.14 A		l l	A1/7	District		03	5E D.O.T. RES				Date Placed:	09/14/	18			Avg. 9	% of Gmm:	93	2.433	
1 in	100	100.0			100.0	District			(Enter an X	)	┨┣──		Test Date/By:	09/15/	18	Jimmy	Lemke	Avg. % F	ield Voids:		7.57	
2/4 in	100	100.0			100.0						1		(0.1									
3/4 IN.	100	100.0			100.0				TRATATO		- 0	2.1. (lower) =		965 X 2.489	<del>)</del> — 2.	.301	- =	3.74	$\rightarrow$	PWL (lov	ver)	100.0
1/2 In. 3/8 in	91-100(98)	98.0			98.0				IESI SIRI	P				0.027	,					=		
* #4	56-70(63)	65.0			65.0				(Enter all X	)			2.2	01 (0.01)		(00)						
t Day	+7.0	2.0			20		L				<b>_</b>   c	).l. (upper) =	2.3	01 (0.913	D X 2.4	489)	- =	0.87	$\rightarrow$	PWL (up	per)	80.3
+#0	11.51(AE)	49.0			2.0		[ <b>`</b> ```				<b>n</b>			0.027						-		
#0	41-01(40)	40.0		+	40.0			FILM	THICKNESS (FT	) [8.0-15.0]		PWL (total) =		100.0	+	80.3	-		100.0	=		80.3
*Dev	± 5.0	2.0			2.0			F	Τ, μm	8.1												
#16		36.0			36.0		L	Price /	Adjustment	\$0.00									Bay	Footor -		1 000
*#30	20-28(24)	27.0			27.0														Fay	-actor -		1.000
* Dev	± 4.0	3.0			3.0				Gyratory VM	4		ons of Mix for P	WL Field Void	s Analysis (304.08								
#50		14.0			14.0			V	MA, %	13.5				deducted)=	584	4.53	Field Voi	ds Price Adj	justment =	\$	50.00	
#100		6.2			6.2		P															
*#200	0.9-4.9(2.9)	3.9			3.9			QU	ANTITY FOR PA	YMENT					TEMPE	PATURE *	-					
*Dev	± 2.0	1.0		†	1.0			Mix Unit	Price (S/ton)	\$25.97	1	Time	7:00	9:00	11:00	1.00	3:00	5:00	7:00	Enor		amaluO
Gradation Co	mpliance?	Yes		1	Yes			Binder Ur	nit Price (\$/ton)	\$481.81		Air Temp	1.00	3.00	11.00	1.00	85	85	7.00	opec		omply?
DBR	Sugg 0.6 - 1.4	0.90			0.90		Ē	Tops of	Mix on Road	888.61		Binder Tomo					300	304		260.200	l	Van
% +4 Type 4		92.6	-		92.6		- I	one to O	ther Bid Item/c)	000.0	'I  '	Diricer remp					320	324		200-330		res
% +4 Type 3		02.0			0.0		1 '	Torre	of Binder	46.47	,	Met Temp				205	291	284		225-330		res
(+4/-4) Tune 2		00.0/00.0			00.0/00.0			Terre	of Monte	40.47	, L 🖵	matremp			I	295	280	7.290		225-330		res
(		00.0/00.0			00.0/00.0	L		Tone of	Binder to Deta	844.07	1 🗆	Break Down	Mix Change	ter mandatory shutdow	n changes are	made to etc	rt the day in	entify them	on provice	e dave	nort'	
L								Toris of	Diriuer to Date	45 400 00		Rain Out	the onange	and and an	sinanges are	made to sta	it the day, lo	enary mem	on previou	s uays rep	unt);	
								Tons of	r Mix to Date	15,492.66	J	7		Old Target	New Target	Tons	Agg	Initial %	New %	Agg	nitia M	New %
		BINDE	R		_			PL	ACEMENT REC	ORD	1	-1										
N 1 5 5 5 1	Diadaa	Target	Actual	Spec	Comply?	From	Station		To Station	Lane	Width (f	<u>u</u>										
% Added	Binder	4.32	4.44	N/A		493	3+32		504+00	SB/WB Pass L	<u>r 10</u>	-										
% Total E	Binder	5.11	5.23	4.81-5.41	Yes	504	4+00	L	526+40	SB/WB Pass L	r 16	-										
% RA	.Р	15.00	14.99%	≤100%	Yes	526	5+40		529+98.46	SB/WB Pass L	r 18	-	L									
% RA	S	45 5001	18 15 1	1.000		524-	+60.5		534+50	SB/WB Pass L	r 18	4	Comments:									
% Binder Rep	placement	15.50%	15.13%	≤ 30%	Yes	534	1+50		539+09	SB/WB Pass L	r 12.6	_										
PG Gr	ade	58-3	34H	58-34H	Yes	Certified	Tech:		Jay Ha	as	Cert. No	NE208										
	4 00700		0.000	I =	1.5.	Certified	i ⊺ech:		Jen Star	lley	_ Cert. No	b. <u>EC223</u>										
Gb:	1.02728	Gsb:	2.636	Pbe (%):	4.34	Distributi	on:	Dist. Ma	terials Pro	j. Engineer	Contractor											

4/25/13 ve	r.11.07	9/15/2018					G	10	WA DOT A	SPHALT PAV	ING DA	ALLY PLANT	REPORT					9/17/	18 10:50	MA		
Active	Project No.:	NHSX-018-	8(45)3H-3	33			_	Contractor:		Mathy Cons	truction		A	ctive Placement:	S	urface (Tra	vel Lane)	1		Report	No.:	10
	Contract ID:	33-0188-04	5					County:		Fayet	te		-	Mix Type:	Ht S	Surface L -	4 1/2 (HM	IA)	Lab	Voids Ta	rget:	4.0
Mix	Design No.:	ABD18-202	.7				RAP	Stockpile ID_		ABC14-0116 (5	.52 % AC	<i>;</i> )	-	Active Bid Item:	2303-1043	04 HT SUR	F 1/2IN L-	4 (HMA)	Des	ign Gyrati	ons:	75
		UNCOMPACT	ED MIXTURE					СОМ	IPACTED JOI	NT						COMPACTE	D MAT					
Hot Box I.D.	9-15-A	9-15B	9-15C	9-15D			Core	Clation	Islat ID		0.000	Date of	Challen	OL Deferment	W1	W2 in H20	W3 Wet	0	% of	D (91)	Thielener	an (in )
(Theoretical %AC)	(5.30%)	(5.30%)	(5.25%)	(5.26%)			#	Station	Joint (D	Gup	Core	Placement	Station	GL Reference	Dry (g)	(g)	(g)	Gup	Gmm	Pa(70)	Tricknes	35 (III.)
Date Sampled	9/15/18	9/15/18	9/15/18	9/15/18			1	431+05	2L-Centerline	2.301	1	9/15/2018	431+05	1.5 N\E Drv	932.5	533.3	932.8	2.334	93.7	6.3	2.0	10
Time	9:30 AM	11:45 AM	12:55 PM	2:45 PM			2	526+75	2L-Centerline	2.275	2	9/15/2018	452+75	2.4 N\E Drv	897.8	519.3	898.5	2.368	95.1	4.9	1.8	8
Station	440+00	483+25	499+00	531+50			3	531+41	2L-Centerline	2.329	3	9/15/2018	472+30	8.2 N\E Drv	939.3	536.7	940.1	2.328	93.5	6.5	2.0	10
Bar Code ID	D2-004526	D2-004525	D2-004524	D2-004468							4	9/15/2018	478+10	8.3 N\E Drv	969.5	558.0	970.0	2.353	94.5	5.5	2.0	10
Sample (Tons)	357.65	1,188.33	1,550.99	2,113.74				Aver	rage Joint G <sub>m</sub>	ь 2.302	5	9/15/2018	496+35	1.9 N\E Drv	805.1	457.2	805.7	2.310	92.7	7.3	1.7	5
Gmb	2.394	2.408	2.406	2.408				Ave	erage Mat G <sub>m</sub>	ь 2.341	6	9/15/2018	526+35	6.9 N\E Drv	1,063.1	607.7	1,064.0	2.330	93.5	6.5	2.1	8
Gmb (DOT)								q	% Mat Density	y 98.3	7	9/15/2018	531+41	1.9 N\E Drv	898.0	518.5	898.3	2.364	94.9	5.1	1.8	18
Gmm	2.490	2.490	2.493	2.492				For in	nformation O	niy	8	9/15/2018	539+54	10.4 N\E Drv	879.3	504.8	880.1	2.343	94.1	5.9	1.8	;8
Gmm (DOT)								J	Joint Length, f	t 13,317												
P <sub>a</sub> (%)	3.9	3.3	3.5	3.4				Unit Price Ad	ijustment (\$/ft	) \$0.173												
P <sub>a</sub> (%) (DOT)					Aug 0																	
				Avg G <sub>mb</sub>	Avg G <sub>mm</sub>	Avg Pa (%)				60 202 04		L		Outras (Tras					<u> </u>		1.01	
			1	2.404	2.491	3.5		JO	int Incentive =	= \$2,303.64		C	ourse Placed:	Surface (Travi	er Lane)			Thic	kness QI:		1.04	
											. I	Intended I	_ift Thickness:	2.00	)			Avg. Ma	at Density:	2	.341	
		GRADA	TION (%Pass	ing)	1	Use DOT		USE D	0.0.T. RESU	JLTS			Date Placed:	09/15/	18			Avg. %	6 of Gmm:	9	4.000	
Sieve	Specs	CF 9-15 A			Avg	District	1	(1	Enter an 'X')			-	Test Date/By:	09/17/	18	Jamie	Haas	Avg. % Fi	eld Voids:		6.00	
1 in.	100	100.0			100.0																	
3/4 in.	100	100.0			100.0		-					(lower) =	(0.9	65 x 2.491	1) — 2.3	341	=	3.14	$\rightarrow$	PWL (lo	ver) 1	00.0
1/2 in.	91-100(98)	98.0			98.0			T	EST STRIP		<b>`</b>			0.020	)			0.11		=		00.0
3/8 in.	82-96(89)	89.0			89.0			(E	Enter an "X")							<b>64</b>						
* #4	56-70(63)	64.0			64.0		L				a 🛛	.l. (upper) =	2.34	0.91	5 X 2.4	91)	=	3.09	$\rightarrow$	PWL (up	per) 1	00.0
- Dev	± 7.0	1.0			1.0		<b>[</b>	EV M TUR		0.0.45.01				0.020	,					-		
-#8	41-01(46)	49.0			49.0			FILM THIC	KNESS (FI)	8.0-15.0	P	WL (total) =	1	00.0	+	100.0		-	100.0	=	1	00.0
*Dev	± 5.0	3.0			3.0			FT, μ	m	8.2												
#16		38.0			38.0		L	Price Adju	stment	\$0.00									Pav	Factor =	1	040
*#30	20-28(24)	28.0			28.0														,			.040
* Dev	± 4.0	4.0			4.0			G	Gyratory VMA		Т	ons of Mix for P	WL Field Voids	Analysis (420.15	1.00	0.00	-	iold Moide Is			045.04	
#50		14.0			14.0			VMA,	%	13.6				deducted)=	1,96	9.20	-	ieid volas ir	icentive =	32	,045.61	' I
#100		6.0			6.0						C-income of the second											
*#200	0.9-4.9(2.9)	3.6			3.6		[	QUANTI	ITY FOR PAY	MENT					TEMPE	RATURE, "F						
*Dev	± 2.0	0.7			0.7			Mix Unit Price	e (\$/ton)	\$25.97		Time	7:00	9:00	11:00	1:00	3:00	5:00	7:00	Spec	Co	mply?
Gradation Co	mpliance?	Yes			Yes		L_ 6	Binder Unit Pri	ice (\$/ton)	\$481.81		Air Temp		71	82	87	88					
DBR	Sugg 0.6 - 1.4	0.83			0.83			Tons of Mix of	on Road	2,389.35	E	Binder Temp		324	322	322	320			260-33	)°F	Yes
% +4 Type 4		89.7			89.7		Т	ons to Other B	Bid Item(s)			Plant Temp		289	285	286	286			225-33	)°F	Yes
% +4 Type 3					0.0			Tons of B	Binder	126.04		Mat Temp		300	285	280	280			225-33	) °F	Yes
(+4/-4) Type 2		00.0/00.0			00.0/00.0			Tons of V	Vaste	6.00			Re-start -0	ar mandatory chutdes	10							
								Tons of Binde	er to Date	971.01		Break Down	Mix Change	nformation (when	changes are	made to star	t the day, id	entify them	on previou	is day's re	port):	
								Tons of Mix	to Date	17,882.01		Rain Out		Old Target	New Target	Tons	Agg	Initial %	New %	Agg	Initia N	ew %
		BINDE	ER					PLACE	EMENT RECO	ORD		]										
		Target	Actual	Spec	Comply?	From	Station	To S	Station	Lane	Width (ft	1										
% Added	Binder	4.32	4.47	N/A		422	2+45	502	2+20	NB/EB Drive Ln	16	]										
% Total E	Binder	5.11	5.28	4.81-5.41	Yes	502	2+20	5294	+98.46	NB/EB Drive Ln	12	]										
% RA	λP	15.00	15.33%	≤100%	Yes	524	+60.5	54	1+20	NB/EB Drive Ln	12	]										
% RA	AS					541	1+20	546	6+75	NB/EB Drive Ln	16		Comments:									
% Binder Re	placement	15.50%	15.33%	≤ 30%	Yes	548	6+75	549	9+46	NB/EB Drive Ln	15	]	2395.35 Tor	ns produced								
PG Gr	ade	58-3	34H	58-34H	Yes	Certified	d Tech:		Jay Haa	S	Cert. No	NE208	6.0 Tons roa	ad waste								
						Certified	d Tech:		Jen Stanl	ey	Cert. No	. <u>EC223</u>	2389.35 Tor	ns used for surfa	ice on Hwy.	18						
Gb:	1.02729	Gsb:	2.636	Pbe (%):	4.32	Distributi	on:	Dist. Materials	s Proj.	Engineer	Contractor											

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Form 955 ver. 11.07

#### **Iowa Department of Transportation** Highway Division-Office of Materials Proportion & Production Limits For Aggregates

County :	Fayette		Project No.: NHSX-	-018-8(45)3H	1-33		Date:	09/14/18	
Project Location:	On US 18	from Co. R	Rd. B64 to the Turkey River in	Clermont	Miy	Design N	No.:	ABD18-2	027
Contract Mix Tonn	age:	17,481	Course: S	Surface		Mix Siz	ze (in.):	1/2	
Contractor:	Mathy Co	onstruction	n Mix Type:	HT		Design	Traffic:	High Trat	ffic
Material	Ident #	% in Mix	Producer & Loca	tion	Type (A or B)	Friction Type	Beds	Gsb	%Abs
1/2" AC	A96004	35.0%	Skyline Materials Ltd/Hovey		А	4	1-6	2.570	2.40
Man. Sand	A96011	34.0%	Bruening Rock Products Inc/	Gjetley	Α	4	1-3	2.731	1.04
Concrete Sand	A33522	16.0%	Bruening Rock Products Inc/	Pape	А	5		2.623	0.69
Classified RAP	rings 2RAI	15.0%	15% ABC14-0116 (5.52 % A	(C)	А			2.599	1.13
Type and Source of A	sphalt Bin	der:	PG 58-34H MIDW	EST LACRO	SSE, WI				

	Individual Aggregates Sieve Analysis - % Passing (Target)														
Material	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200				
1/2" AC	100	100	95	70	13	5.0	4.5	4.3	4.2	4.1	3.5				
Man. Sand	100	100	100	100	95	64	39	24	11	3.3	1.3				
Concrete Sand	100	100	100	100	94	84	72	45	10	0.7	0.3				
Classified RAP	100	100	99	97	78	63	54	49	34	15	8.4				

Preliminary Job Mix Formula Target Gradation

Upper Tolerance	100	100	100	96	70	51		28			4.9
Comb Grading	100	100	98	89	63	46	34	24	12	4.8	2.9
Lower Tolerance	100	100	91	82	56	41		20			0.9
S.A.sq. m/kg	Total	4.57		+0.41	0.26	0.38	0.56	0.69	0.72	0.59	0.96

Production Li	imits for	Aggregates	Approved	by the	Contractor	&	Producer
---------------	-----------	------------	----------	--------	------------	---	----------

Sieve	35.0%	of mix	34.0%	of mix	16.0%	of mix	15.0%	of mix		
Size	1/2	" AC	Man.	Sand	Concre	te Sand	Classifi	ed RAP	s.	
in.	Min	Max	Min	Max	Min	Max	Min	Max		
1"	100.0	100.0	100.0	100.0	100.0	100.0				
3/4"	98.0	100.0	100.0	100.0	100.0	100.0				
1/2"	88.0	100.0	100.0	100.0	100.0	100.0				
3/8"	63.0	77.0	98.0	100.0	98.0	100.0				
#4	6.0	20.0	88.0	100.0	87.0	100.0				
#8	0.0	10.0	59.0	69.0	79.0	89.0				
#30	0.3	8.3	20.0	28.0	41.0	49.0				
#200	1.5	5.5	0.0	3.3	0.0	2.3				
Comr	nents:	Item #014	40							
Copies to:	Mat	thy Constru	ction							

The above target gradations and production limits have been discussed with and agreed to by an authorized representative of the aggregate producer.

Signed:

Producer

Contractor

Signed:

Form 956 ver. 11.07



Iowa Department of Transportation Highway Division - Office of Construction & Materials HMA Gyratory Mix Design

Ndesign						Letting Date :	1/17	/2018	
County :	Fayette		Project : NHS	X-018-8(45)3H-33	3	Mix No. :	ABD1	8-2027	
Mix Size (in.):	1/2	Type A	Contractor : Math	y Construction		Contract #:	33-01	88-045	
Mix Type:	HT	L - 4	Design Traffic :	High Traffic		Date:	09/	14/18	
Intended Use :	Surface		Location :		On US 18 fro	m Co. Rd. B64 to	the Turkey River	in Clermont	
Aggregate	% in Mix	Source ID	Source	e Location	Beds	Gsb	%Abs	FAA	Friction
1/2" AC	35.0%	A96004	Skyline Materials	Ltd/Hovey	1-6	2.570	2.40	45.0	4
Man. Sand	34.0%	A96011	Bruening Rock P	roducts Inc/Gjetley	1-3	2.731	1.04	45.0	4
Concrete Sand	16.0%	A33522	Bruening Rock P	roducts Inc/Pape		2.623	0.69	38.0	5
Classified RAP	15.0%	prings 2RAP	115% ABC14-011	6 (5.52 % AC)		2.599	1.13	39.8	

			Job	Mix Formula	- Combined	Gradation (S	ieve Size in.)			
1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
					Upper Tol	erance				
100	100	100	96	70	51		28			4.9
100	100	98	89	63	46	34	24	12	4.8	2.9
100	100	91	82	56	41		20			0.9

Asphalt Binder Source	and Grade.	MIDI	VEST LACROSS	EGWEI TOI	PG 58-34H		1		
rispitate Dinder Source	und orade.	MID	TEST EACTOR	Gyratory Dat	a 0.00-0411				
% Asphalt Bin	der	5.11	5 34	5.80	u	1	Range OUT	Number (	of Gyrations
Gmh @ N-De	ine in the second se	2.377	2 383	2 395			a set	N-I	Initial
Max Sn Gr (Gi	nm)	2.476	2 464	2 440					8
% Gmm @ N- Ir	nitial	90.1	90.6	91.7				N-F	Design
%Gmm @ N-M	fav	2011	20.0	21.7					75
% Air Voids		4.0	33	1.8				N-	-Max
% VMA		14.4	14.4	14.4					
% VEA		72.3	77.2	87.2				Gsh for	Angularity
Film Thickne	22	9.85	10.48	11 77				Met	thod A
Filler Bit Rat	io	0.64	0.61	0.54				2	671
Gse		2.681	2.676	2.667				Pba / %	Abs Ratio
Phe		4.50	4 79	5 38			12	104770	) 40
Pha		0.65	0.58	0.45			14 A	Slone of (	Compaction
% New Asphalt B	linder	84.5	85.2	86.4				C	urve
Combined Gb @	25°C	1.0241	1.0240	1.0239				-	
						Contribution	1	Mix	Check
Aggregate Type Used	A	1			Combined	From RAM		P	oor
G <sub>th</sub>	2.636	1	% Friction	Type 4 (+4)	88	0	1	Pb Ran	ige Check
Gen	2.742			Or Better	88	0		0.46	< 1.0 Spec.
% Water Abs	1.47		% Friction	n Type 3 (+4)	0	0		RAM	1 Check
S.A. m <sup>2</sup> / Kg.	4.57			Or Better	0	0			ОК
Angularity-method A	10,5800		% Friction	n Type 2 (+4)	0	0			
% Flat & Elongated		OUT	% Frictio	n Type 2 (-4)	0	0		Specifica	ation Check
Sand Equivalent		OUT	Type 2 Finer	ness Modulus	0.0	0.4		OUT Does	s Not Comply
Virgin G <sub>b</sub> @ 25°C	1.023			% Crushed	75.0	5.3		Hambu	irg Check
Anti-Strip Dose (%)	0.0	0					N	ot Required	
Stripping Inflection Point									
Dispositio	n: An asp	phalt content of	f <u>5.1%</u>	is recommen	ded to start th	his project.			
Data shown in	5.11%	column is in	terpolated fro	m test data.		aa aa waxay da ahaa ahaa ahaa ahaa ahaa ahaa ahaa			
The %	ADD AC to	start project i	s 4.3%						

Comments : Item #0140 Surface. One point Volumetrics Verification for RAM substitution. Copies to : Mathy Construction DOC Field Materials Tech. Mix Designer & Cert.# : Signed : Jon Kleven Form 956 ver. 11.05



# Iowa Department of Transportation Highway Division - Office of Construction & Materials WMA Gyratory Mix Design

MA	Gyratory	Mix	Design	

			WMA	Gyratory	Mix Design					
Ndesign							Letting Date :	3/20	/2018	
County :	Harrison		Project :	FM-C04	13(84)55-43		Mix No. :	ABD	8-4057	
Mix Size (in.):	1/2	Type A	Contractor :	Western	Engineering Co., I	Inc	Contract #:	43-C0	043-084	
Mix Type:	ST	No Frictn	Design Tra	iffic :	Standard Traff	fic	Date:	10/	22/18	
Intended Use :	Surface		Location :		(	On F66 from	L-20 E. 4.8 miles to	o Nixon Ave.		
Aggregate	% in Mix	Source ID		Source Lo	ocation	Beds	Gsb	%Abs	FAA	Friction
5/8" Type A	10.0%	A78002	Schildberg	Construc	tion Co/Crescent	25B-25F	2.599	1.50	45.0	5
1/2" Type A	30.0%	A78002	Schildberg	Construc	tion Co/Crescent	25B-25E	2.599	1.50	45.0	5
Limestone Mansand	20.0%	<b>ANE010</b>	Martin Ma	rietta Agg	gregates/Ft Calhou	25B-25E	2.592	1.52	45.0	5
Oakland Sand	40.0%	A78504	Western En	ngineering	g Company/Oakla		2.635	0.50	40.0	4

			Job	Mix Formula	<ul> <li>Combined</li> </ul>	Gradation (S	ieve Size in.)				
1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	
					Upper Tol	erance					
100	100	100	95	77	55		27			5	
100	100	97	88	70	50	34	23	7.7	3.8	3.0	
100	100	90	81	63	45		19			1.0	
					Lower Tol	erance					
Asphalt Binde	r Source	and Grade:	FLIN	THILLS OMAH	A, NE	PG 58-28S	(AI = 3.6)	WMA Tech	nology & Rate:		
					Gyratory Dat	a		[Water Injection	on System @ 0.5 b	y % of binder]	
% As	phalt Bind	ler	5.25	5.50	5.89	6.25	6.50		Number of	of Gyrations	
Gmb	@ N-De	s.	2.296	2.308	2.321	2.333	2.345		N-1	Initial	
Max. S	p.Gr. (Gr	nm)	2.438	2.430	2.418	2.407	2.396			7	
% Gmn	n @ N- In	itial	88.8	89.5	90.4	91.2	92.0		N-I	Design	
%Gm	m @ N-M	fax								50	
%	Air Voids		5.8	5.0	4.0	3.1	2.1		N-	Max	
9	6 VMA		16.7	16.5	16.4	16.3	16.1				
9	% VFA		65.1	69.6	75.6	81.1	86.7		Gsb for	Angularity	
Film	Thicknes	s	11.55	12.14	13.01	13.79	14.45		Met	hod A	
Fille	r Bit. Rati	io	0.61	0.58	0.54	0.51	0.49		2.	.624	
	Gse		2.636	2.636	2.638	2.640	2.637		<u>Pba / %</u>	Abs Ratio	
	Pbe	- 1	4.91	5.16	5.53	5.86	6.14		C	.35	
	Pba		0.36	0.36	0.39	0.42	0.38		Slope of	Compaction	
% New	Asphalt B	inder	100.0	100.0	100.0	100.0	100.0		<u>C</u>	urve	
Combin	ed Gb @	25°C	1.0360	1.0360	1.0360	1.0360	1.0360				
							Contribution		Mix	Check	
Aggregate Type I	Used	A				Combined	From RAM		Exc	cellent	
G <sub>sb</sub>		2.612		% Friction	n Type 4 (+4)	11	0		Pb Ran	ge Check	
G <sub>sa</sub>		2.689			Or Better	11	0		1.25		
% Water A	bs	1.10		% Friction	n Type 3 (+4)	0	0		RAM	f Check	
S.A. $m^2/k$	Kg.	4.25			Or Better	0	0			ОК	
Angularity-me	thod A	42		% Friction	n Type 2 (+4)	0	0				
% Flat & Elon	ngated	1.8		% Frictio	n Type 2 (-4)	0	0		Specifica	ation Check	
Sand Equiva	alent	92		Type 2 Finer	ness Modulus	0.0	0.0	1	Co	mply	
Virgin G <sub>b</sub> @	25°C	1.036		100	% Crushed	60.0	0		Hambu	rg Check	
Anti-Strip Dos	se (%)	0.00							Not Required		
Stripping Inflecti	ion Point										

g interction Point Disposition : An asphalt content of 5.9% is recommended to start this project. Target plant temp is Data shown in 5.89% column is interpolated from test data. <u>270 °F</u>

Comments :

Copies to : Western Engineering Co., Inc

Mix Designer & Cert.# : Eric Labenz

SW585

Signed : Marcia Buthmann District 4 Materials

Form 955 ver. 11.05

#### **Iowa Department of Transportation** Highway Division-Office of Materials Proportion & Production Limits For Aggregates

County :	Harrison		Project No.:	FM-C0	043(84)55-43			Date:	10/22/18	
Project Location:	On F66 fre	om L-20 E.	4.8 miles to Nixon	Ave.		Miz	k Design l	No.:	ABD18-4	057
Contract Mix Tonn	age:	5,285	Course	e:	Surface		Mix Si	ze (in.):	1/2	
Contractor:	Western J	Engineerir	ig Co., Inc Mi	ix Type:	ST		Design	Traffic:	Standard	Traffic
					-	Туре	Friction			
Material	Ident #	% in Mix	Produce	er & Loca	tion	(A or B)	Type	Beds	Gsb	%Abs
5/8" Type A	A78002	10.0%	Schildberg Constru	uction Co/	Crescent	Α	5	25B-25E	2.599	1.50
1/2" Type A	A78002	30.0%	Schildberg Constru	uction Co/	Crescent	Α	5	25B-25E	2.599	1.50
Limestone Mansand	ANE010	20.0%	Martin Marietta A	ggregates/	Ft Calhoun	Α	5	25B-25E	2.592	1.52
Oakland Sand	A78504	40.0%	Western Engineeri	ing Compa	ny/Oakland	А	4		2.635	0.50
Type and Source of A	Asphalt Bin	der:	PG 58-28S	FLINT	HILLS OMAI	HA. NE				

		Indiv	idual Agg	regates S	ieve Anal	ysis - % Pa	assing (Ta	urget)			
Material	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
5/8" Type A	100	100	80	58	27	11	6.6	5.5	5.0	4.9	4.4
1/2" Type A	100	100	95	73	37	15	11	8.1	7.0	6.3	5.5
Limestone Mansand	100	100	100	100	99	59	22	12	6.4	4.3	2.7
Oakland Sand	100	100	100	100	92	81	65	44	9.5	1.5	1.0

Preliminary Job Mix Formula Target Gradation

Upper Tolerance	100	100	100	95	77	55		27			5.0
Comb Grading	100	100	97	88	70	50	34	23	7.7	3.8	3.0
Lower Tolerance	100	100	90	81	63	45		19			1.0
S.A.sq. m/kg	Total	4.25		+0.41	0.29	0.41	0.56	0.66	0.47	0.47	0.99

Sieve	10.0%	of mix	30.0%	of mix	20.0%	of mix	40.0%	of mix	
Size	5/8" T	ype A	1/2" 1	Гуре А	Limestone	Mansand	Oaklan	d Sand	
in.	Min	Max	Min	Max	Min	Max	Min	Max	
1"	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
3/4"	98.0	100.0	98.0	100.0	100.0	100.0	100.0	100.0	
1/2"	73.0	87.0	88.0	100.0	100.0	100.0	100.0	100.0	
3/8"	51.0	65.0	66.0	80.0	98.0	100.0	98.0	100.0	
#4	20.0	34.0	30.0	44.0	92.0	100.0	85.0	99.0	
#8	6.0	16.0	10.0	20.0	54.0	64.0	76.0	86.0	
#30	1.5	9.5	4.1	12.1	8.0	16.0	40.0	48.0	
#200	2.4	6.4	3.5	7.5	0.7	4.7	0.0	3.0	

#### Production Limits for Aggregates Approved by the Contractor & Producer.

Comments:

Copies to: Western Engineering Co., Inc

The above target gradations and production limits have been discussed with and agreed to by an authorized representative of the aggregate producer.

Signed:

Producer

Signed:

Contractor

4/25/13 ve	er.11.07	11/13/2018					G	<u>ه</u> ا	OWA DOT	ASPHALT PA	VING D	AILY PLAN	REPORT					11/20	0/18 10:42	AM	
Active	Project No.:	FM-C043(8	4)55-43	-				Contractor:	W	estern Engine	erina C	o., Inc	A	ctive Placement:	5	Surface (Tr	avel Lane	)		Report 1	No: 4
	Contract ID:	43-C043-08	34					County:		Harri	son			Mix Type:	St S	Surface No	ne 1/2 (HN	AA)	Lat	Voids Ta	get: 4.0
Mix	Design No.:	ABD18-405	7				RAF	Stockpile ID					_	Active Bid Item:	2303-1033	500 ST SU	RF 1/2IN N	O (HMA)	Des	ign Gyrati:	ns: 50
Samples from mul included for Gmm	tiple days average.	UNCOMPACT	ED MIXTURI	2				CON	IPACTED JO	INT	Core	s from multiple da	ys included in thi	s report		COMPACT	ED MAT	************************************	and can be an a stand		
Hot Box I.D. (Theoretical	SUR11- 13A	SUR11- 13B	SUR11-	SUR11- 14B	SUR11- 14C		Core	Station	Joint ID	G <sub>mb</sub>	Con	e Date of	Station	CL Reference	W1	W2 in H20	W3 Wet	G <sub>mb</sub>	% of	Pa (%)	Thickness (in.)
%AC) Date Sampled	(5.96%) 11/13/18	(5.96%) 11/13/18	(6 19%)	(6.22%)	(6 19%)		<del> </del>					11/13/201	B 105+72	6.2 S\W Drv	1.396.2	765.7	1.369.3	2.313	95.4	4.6	1.39
Time	12:20 PM	4:10 PM	10:25 AM	12:40 PM	3:30 PM		2				2	11/13/201	B 96+5B	4.0 S\W Drv	1,601.6	894.4	1.601.8	2.264	93.4	6.6	1.63
Station	110+85	36+25	145+50	110+00	15+90		3				3	11/13/201	B 31+90	1.0 S\W Drv	1,632.9	915.9	1,633.8	2.275	93.9	6.1	1.63
Bar Code ID	D4-009155	D4-009154	D4-00915	D4-009152	D4-009151						4	11/13/201	8 135+69	5.5 S\W Drv	1,678.5	954.0	1,678.9	2.315	95.5	4.5	1.65
Sample (Tons)	115.65	502.00	502.00	502.00	502.00			Ave	erage Joint G <sub>m</sub>	nb	5	11/14/201	8 122+85	2.5 N\E Drv	1,562.3	870.9	1,562.9	2.258	93.2	6.8	1.68
Gmb	2.340	2.325	2.335	2.326	2.324			Av	erage Mat Gr	2.286	6	11/14/201	B 114+53	6.0 N\E Drv	1,786.8	1,013.1	1,787.1	2.309	95.3	4.7	1.78
Gmb (DOT)									% Mat Densit	y .	7	11/14/201	8 94+75	9.2 N\E Drv	1,965.6	1,103.5	1,966.2	2.278	94.0	6.0	1.97
G <sub>mm</sub>	2.432	2.432	2.419	2.417	2.419			For i	nformation C	Dnly	8	11/14/201	B 38+68	9.5 N\E Drv	1,670.1	936.4	1,670.6	2.275	93.9	6.1	1.68
Gmm (DOT)									Joint Length,	ft						1					
P <sub>a</sub> (%)	3.8	4.4	3.5	3.8	3.9			Unit Price A	djustment (\$/f	ti						1					
P <sub>a</sub> (%) (DOT)									-				1								
				Avg G <sub>mb</sub>	Avg G <sub>mm</sub>	Avg Pa (%)										1					
			1	2.330	2.424	3.9		Joint Price	e Adjustment	=		C	ourse Placed:	Surface (Trav	el Lane)			Thic	kness QI:		1.17
											_	Intended	Lift Thickness:	1.50	)			Avg. Ma	at Density:	2	.286
		GRADA	TION (%Pass	sing)	[	Use DOT		USED	0.0.T. RES	ULTS	1		Date Placed:	Multip	le			Avg. 9	6 of Gmm:	94	4.325
Sieve	Specs	CF11-13A			Avg	District			(Enter an 'X')				Test Date/By:	11/20/	18	Karley	Arman	Avg. % Fi	ield Voids:		5.68
1 in.	100	100.0	1		100.0																
3/4 in.	100	100.0			100.0						- I		(0.9	65 x 2.424	4) - 2.	286				PWL (lov	ver) don o
1/2 in.	90-100(97)	96.0			96.0			T	EST STRIP	>	י ור	2.1. (lower) =		0.023	, ,		. =	2.31	$\rightarrow$	=	100.0
3/8 in.	81-95(88)	89.0	'		89.0			(	Enter an "X")	)											1
* #4	63-77(70)	71.0			71.0								2.28	6 — (0.915	5 x 2.4	24)	_	0.00		PWL (up)	per) too o
* Dev	± 7.0	1.0			1.0		Chatranacard	diter and the second				a.i. (upper) =		0.023			. =	2.96	$\rightarrow$	=	100.0
*#8	45-55(50)	53.0		1	53.0			FILM THIC	KNESS (FT)	[8.0-15.0]	ור										
*Dev	± 5.0	3.0			3.0			FT .	m	114	1	PWL (total) =	1	00.0	+	100.0	-	-	100.0	=	100.0
#16		39.0			39.0			Price Adi	Istment	\$0.00											1
	40.07(02)	07.0			07.0		L	1 1100 / 1010	ounon	1 40.00	1								Pay	Factor =	1.040
*#30	19-27(23)	27.0	ļ		27.0						" L								-		
* Dev	± 4.0	4.0			4.0				Syratory VMA			Tons of Mix for	PWL Field Void	is Analysis (00.00	547	.66	F	ield Voids Ir	ncentive =	\$6	308.35
#50		9.8			9.8			VMA,	%	16.2	┛┖┈			deducted)=	• * *						
#100		4.1			4.1																
*#200	1.0-5.0(3.0)	3.5			3.5			QUANT	ITY FOR PAY	MENT					TEMPE	RATURE, °F	:				
*Dev	± 2.0	0.5			0.5			Mix Unit Price	ce (\$/ton)	\$36.90		Time	7:00	9:00	11:00	1:00	3:00	5:00	7:00	Spec	Comply?
Gradation Co	mpliance?	Yes			Yes			Binder Unit Pr	rice (\$/ton)	\$390.00		Air Temp	12	21	25	28	34	30	26		
DBR	Sugg 0.6 - 1.4	0.64			0.64			Tons of Mix	on Road	547.66	5	Binder Temp		300	300	300	300			260-330	)°F Yes
% +4 Type 4		11.0			11.0		Т	ons to Other	Bid Item(s)			Plant Temp		329	330	327	325			245-330	)°F Yes
% +4 Type 3					0,0			Tons of E	Binder	33.43	3	Mat Temp			295		288			245-330	F Yes
(+4/-4) Type 2		00.0/00.0			00.0/00.0			Tons of \	Naste	2.70											
								Tons of Bind	er to Date	258.90		Break Down	Mix Change	nformation (when	n changes are	made to star	t the day, id	entify them	on previou	s day's rep	port):
							1	Tons of Mix	to Date	4,405,57		Rain Out		Old Target	New Target	Tons	Agg	Initial %	New %	Agg I	nitia New %
[		BINDE	R					PLACE	EMENT RECO			7				1 1				1.39	
		Tarnet	Actual	Spec	Comply?	Erom	Station	7.00	Station	Lane	Madth /	+									
MAdded %	Binder	5.89	6.10	N/A	Sompor	11	8+94	100	2+09	SB/WB Drive I	n 11	4				<u>├</u> ──┤					
% Total E	Rinder	5.80	6.10	5 59-6 10	Ves		+00		8450	CRANP Drive L	- 11										
% TO(BIE % RA	P	0.09	0.10	0.00-0.19	105	43	1+40	8	3+25	NB/EB Drive L		1									
96 RA				<u>+</u>					2+40	NR/ER Drive L	- 11	-	Commenter			L			L		
% Binder Per	lacement							1.	JT40	IND/ED Drive L	4 11 	-	Comments:								
20 Binder Rep	ada	E0 /	000	59.090	Ves	Cartific	d Teek	L. NI	othon Urde	nucod	Cont										
PG Gr	ade	58-2	200	00-205	Tes	Certifie	d Tech:	N	Kay Peter	1W000	Cert. No	0. <u>377965</u>	******								
01	1.02500	Cabi	2612	Dhe (9/)	E 40	Certifie	u rech:		Ray Felen	561	_ Cert. No	0.41/0/9	Deed Maria	0.7							
GDI	1.03500	GSD;	2.012	PD8 (%):	0.40	Distribut	ion:	_ Dist. Materiak	s Proj.	Engineer	Contractor		Road vvaste								

Form 956 ver. 11.08

Iowa Department of Transportation Highway Division - Office of Construction & Materials

	C		WMA Gy	ratory Mix Design					
Ndesign						Letting Date :	1/17	/2018	
County :	Union		Project : FI	M-C088(55)55-88		Mix No. :	ABD1	8-4063	
Mix Size (in.) :	1/2	Type A	Contractor : H	enningsen Const. Inc.		Contract #:	88-C0	88-058	
Mix Type:	HT	No Frictn	Design Traffic	c: High Traffic		Date:	10/2	25/18	
Intended Use :	Surface		Location :	(	On P-53 from	US-34 north 6.4 m	iles to H-17 RE/	A road	
Aggregate	% in Mix	Source ID	Sou	urce Location	Beds	Gsb	%Abs	FAA	Friction
sand	14.0%	A25518	Martin Mariet	ta Aggregates/Raccoon		2.611	0.61	40.0	5
man sand	16.0%	A61002	Schildberg Co	onstruction Co/Early Cha	15A-15C	2.582	1.88	45.0	5
3/4" clean	18.0%	A63002	Martin Mariet	ta Aggregates/Durham N	101	2.519	2.62	45.0	4
3/8" chips	24.0%	A63002	Martin Mariet	ta Aggregates/Durham N	101	2.519	2.62	45.0	4
qtz man sand	13.0%	ASD002	L G Everist In	c/Dell Rapids-East		2.635	0.37	47.0	2
Classified RAP	15.0%	ABC2-208	15% ABC2-20	08 (4.45 % AC)		2.570	1.85	41.6	

			Job	Mix Formula	a - Combined	Gradation (Si	ieve Size in.)				
1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	
					Upper Tol	erance					
100	100	100	97	84	46		19			4.6	
100	100	95	90	77	41	23	15	6.4	3.4	2.6	
100	100	88	83	70	36		11			0.6	
					Lower To	lerance					

Asphalt Binder Source and Grade: BITUMINOUS MATERIALS TAMA, IA PG 58-28H (AI = 2.6) WMA Technology & Rate: Gyratory Data [Water Injection System @ 1.8% added a/c] % Asphalt Binder 5.30 5.36 Number of Gyrations 5.80 Gmb @ N-Des. 2.294 2.296 2.307 N-Initial Max. Sp.Gr. (Gmm) 2.393 2.391 2.380 8 % Gmm @ N- Initial 88.1 88.2 88.7 N-Design 75 %Gmm @ N-Max 96.1 N-Max % Air Voids 4.1 4.0 3.1 % VMA 15.3 15.3 15.2 Gsb for Angularity % VFA 72.9 73.8 79.9 Film Thickness 14.25 14.45 15.52 Method A 2.599 Filler Bit. Ratio 0.52 0.51 0.47 Gse 2.582 2.582 2.586 Pba / %Abs Ratio Pbe 5.03 5.10 5.48 0.16 0.28 0.28 0.34 Slope of Compaction Pba % New Asphalt Binder 88.0 88.1 89.1 Curve Combined Gb @ 25°C 1.0379 1.0379 1.0380 Contribution Mix Check Combined Aggregate Type Used A 2.564 From RAM Good Pb Range Check % Friction Type 4 (+4)  $G_{sb}$ 71 0 2.689 0.50 G<sub>sa</sub> Or Better 72 0 RAM Check % Water Abs 1.81 % Friction Type 3 (+4) 0 0 S.A. m<sup>2</sup>/Kg. 3.53 Or Better 0 OK 1 Angularity-method A 44 % Friction Type 2 (+4) 0 % Friction Type 2 (-4) Specification Check % Flat & Elongated 7.5 17 0 Comply Hamburg Check Sand Equivalent 91 Type 2 Fineness Modulus 0.4 0.5 80.0 Virgin G<sub>b</sub> @ 25°C 1.039 % Crushed 8.7 Anti-Strip Dose (%) 0.00 Not R ired Stripping Inflection Point Disposition : An asphalt content of 5.4% is recommended to start this project. Target plant temp is <u>255 °F</u> Data shown in 5.36% column is interpolated from test data. The % ADD AC to start project is 4.7%

Comments : Also for use on FM-C088(58)--55-88

Copies to : Henningsen Const. Inc.

Mix Designer & Cert.# :

RW Hansn SW 046

Signed : Marcia Buthmann District 4 Materials

Form 955 ver. 11.08

#### Iowa Department of Transportation Highway Division-Office of Materials Proportion & Production Limits For Aggregates

County :	Union		Project No .:	FM-C0	88(55)55-88			Date:	10/25/18	
Project Location:	On P-53 fr	om US-34	north 6.4 miles to l	H-17 REA	road	Miz	c Design l	No.:	ABD18-4	063
Contract Mix Tonn	age:	15,525	Cours	e: 5	Surface		Mix Si	ze (in.):	1/2	
Contractor:	Hennings	en Const.	Inc. M	ix Type:	HT		Design	Traffic:	High Traf	ffic
						Туре	Friction			
Material	Ident #	% in Mix	Produce	er & Locat	tion	(A or B)	Туре	Beds	Gsb	%Abs
sand	A25518	14.0%	Martin Marietta A	ggregates/I	Raccoon River	Α	5		2.611	0.61
man sand	A61002	16.0%	Schildberg Constru	uction Co/I	Early Chapel-I	Α	5	15A-15C	2.582	1.88
3/4" clean	A63002	18.0%	Martin Marietta A	ggregates/I	Durham Mine	Α	4	101	2.519	2.62
3/8" chips	A63002	24.0%	Martin Marietta A	ggregates/I	Durham Mine	Α	4	101	2.519	2.62
qtz man sand	ASD002	13.0%	L G Everist Inc/De	ell Rapids-l	East	Α	2		2.635	0.37
Classified RAP	ABC2-208	15.0%	15% ABC2-208 (4	4.45 % AC	)	Α			2.570	1.85
Type and Source of A	Asphalt Bin	der:	PG 58-28H	BITUN	INOUS MAT	ERIALS T	AMA, IA	-		

		Indiv	vidual Agg	regates S	ieve Anal	ysis - % Pa	assing (Ta	arget)			
Material	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
sand	100	100	100	100	96	83 .	65	40	7.5	0.8	0.8
man sand	100	100	100	100	87	30	8.3	4.2	3.2	2.7	2.5
3/4" clean	100	99	78	55	12	2.0	1.5	1.4	1.3	1.1	0.9
3/8" chips	100	100	100	100	98	28	3.0	2.0	1.8	1.6	1.2
qtz man sand	100	100	100	100	99	74	47	29	12	2.7	0.7
Classified RAP	100	99	95	89	72	52	38	28	18	13	11

Preliminary Job Mix Formula Target Gradation

Upper Tolerance	100	100	100	97	84	46		19			4.6
Comb Grading	100	100	95	90	77	41	23	15	6.4	3.4	2.6
Lower Tolerance	100	100	88	83	70	36		11			0.6
S.A.sq. m/kg	Total	3.53		+0.41	0.31	0.33	0.38	0.43	0.39	0.41	0.87

#### Production Limits for Aggregates Approved by the Contractor & Producer.

Sieve	14.0%	ofmix	16.0%	of mix	18.0%	of mix	24.0%	of mix	13.0%	of mix	15.0%	of mix
Size	sa	nd	man	sand	3/4"	clean	3/8"	hips qtz man sand			Classifi	ed RAP
in.	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1"	100.0	100.0	100.0	100.0	98.0	100.0	100.0	100.0	100.0	100.0		
3/4"	100.0	100.0	100.0	100.0	92.0	100.0	100.0	100.0	100.0	100.0		
1/2"	100.0	100.0	100.0	100.0	71.0	85.0	100.0	100.0	100.0	100.0		
3/8"	98.0	100.0	98.0	100.0	48.0	62.0	98.0	100.0	98.0	100.0		
#4	89.0	100.0	80.0	94.0	5.0	19.0	91.0	100.0	92.0	100.0		
#8	78.0	88.0	25.0	35.0	0.0	7.0	23.0	33.0	69.0	79.0		
#30	36.0	44.0	0.2	8.2	0.0	5.4	0.0	6.0	25.0	33.0		
#200	0.0	2.8	0.5	4.5	0.0	2.9	0.0	3.2	0.0	2.7		

Comments:

Copies to: Henningsen Const. Inc.

The above target gradations and production limits have been discussed with and agreed to by an authorized representative of the aggregate producer.

Producer

Signed:

Signed:

Contractor

4/25/13 ve	r.11.07	11/8/2018	51				(		OWA DOT A	ASPHALT PA	/ING DA	ALLY PLANT	REPORT	ctive Placement	s	urface (Tr	avel Lane)	11/1	5/18 6:48 /	AM Report N	10 · 3
Mix	Contract ID: Design No :	88-C088-05	8 3r1				RA	County: P Stockpile ID		ABC2-208 (4	1 45 % AC)	IC.	- ^	Mix Type: Active Bid Item:	Wma H 2303-10435	t Surface I	None 1/2 ( RF 1/2IN NO	/VMA)	Lab Des	Voids Tar	get: 4.0 ns: 75
[								CON	MPACTED JOI	NT			to the state of the state			COMPACTE	ED MAT				
Hot Box I.D.	0144.04								1	1		Data ad	T		14/4		11/2 11/21		0/ of		
(Theoretical %AC)	(5.63%)	(5.67%)	(5.59%)				Cor #	Station	Joint ID	G <sub>mb</sub>	Core	Placement	Station	CL Reference	Dry (g)	(g)	(g)	G <sub>mb</sub>	% of Gmm	P <sub>a</sub> (%) 1	hickness (in.)
Date Sampled	11/8/18	11/8/18	11/8/18				1				1	11/8/2018	3 183+34	3.4 N\E Drv	1,237.1	674.8	1,240.3	2.188	91.4	8.6	1.25
Time	9:29 AM	11:40 AM	2:29 PM				2				2	11/8/2018	3 199+96	6.4 N\E Drv	1,562.9	856.8	1,564.7	2.208	92.2	7.8	1.63
Station	191+00	256+00	327+00				3		l	1	3	11/8/2018	3 213+03	5.6 N\E Drv	1,583.2	862.6	1,588.3	2.182	91.1	8.9	1.63
Bar Code ID	D4-010171	D4-010173	D4-010174				┨┣━	A.v.	arman laint C	η	4	11/8/2018	250+01	10.0 NE Drv	1,678.2	925.8	1,679.9	2.225	92.9	7.1	1.75
Sample (Tons)	283.00	2 204	1,003.00				┥┝─	Ave	verane Mat G	2,213	6	11/8/2018	200+74	8 0 N/E Drv	1 731 1	950.8	1 735 4	2 206	93.0	7.0	1.00
Gmb (DOT)	2.300	2.304	2.302	<u> </u>			┥┝─	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	% Mat Densih	v		11/8/2018	308+52	1.0 N/E Drv	1.571.5	867.2	1,573.5	2.200	92.9	7.1	1.50
Ginb (b01)	2 394	2 392	2 396				┥┢─	For	information O			11/8/2018	3 334+64	4.3 N/E Drv	1,509.3	837.4	1,510.8	2.241	93.6	6.4	1.50
Gmm (DOT)	2.004	2.002	2.000				11	1011	Joint Length f	t .	l l						.,				
P. (%)	3.9	3.7	3.9				11	Unit Price A	diustment (S/ft	)											
Pa (%) (DOT)							11	-	,					1							
			L	Avg G <sub>mb</sub>	Avg G <sub>mm</sub>	Avg Pa (%									[						
				2.302	2.394	3.8		Joint Price	e Adjustment =		Trans.	С	ourse Placed:	Surface (Trav	el Lane)			Thic	kness QI:		1.16
	PWL	=99.6										Intended	Lift Thickness:	1.5	D			Avg. Ma	t Density:	2	.213
		GRADA	TION (%Pass	ing)		Use DOT	1 🗖	USE D	D.O.T. RESU	ULTS	11		Date Placed:	11/08/	18			Avg. %	of Gmm:	92	.400
Sieve	Specs	CF 11-8-18			Avg	District	1		(Enter an 'X')				Test Date/By:	11/15/	18	Jeff Es	slinger	Avg. % Fi	eld Voids:	7	.60
1 in.	100	100.0			100.0																
3/4 in.	100	100.0			100.0							I. (lower) =	(0.9	965 x 2.39	4) — 2.2	213	=	4.86	$\rightarrow$	PWL (low	<sup>/er)</sup> 100.0
1/2 in.	88-100(95)	93.0			93.0			T	TEST STRIP	•				0.020	)				,	=	
3/8 in.	82-96(89)	89.0			89.0		┨┠──	(	(Enter an "X")							•					
* #4	58-72(65)	61.0			61.0		╷╚━				1 a	.1. (upper) =	2.2	13 - (0.91	5 X 2.3	94)	- =	1.12	$\rightarrow$	PWL (upp	<sup>/er)</sup> 87.0
* Dev	± 7.0	-4.0			-4.0		┨╔═╸	<b>TH 14 TH</b>		0.0.47.03	n			0.020	)					_	
*#8	33-43(38)	36.0			36.0		┨┠╍	FILM THIC	CKNESS (FT)	[8.0-15.0]	P P	WL (total) =		100.0	+	87.0	-	-	100.0	=	87.0
*Dev	± 5.0	-2.0			-2.0		┨┣━	FT, L	μm	12.4											
#16		23.0			23.0		┨╚━	Price Adju	ustment	\$0.00									Pav	Factor =	1.000
•#30	10-18(14)	15.0			15.0																
* Dev	± 4.0	1.0			1.0				Gyratory VMA		11 1	Fons of Mix for I	PWL Field Voi	ds Analysis (00.00	1,80	4.89	Field Void	s Price Adj	ustment =	\$	0.00
#50		8.0			8.0			VMA,	, %	15.2				deducted)=							
#100		4.8			4.8			VMA Water Injec	ction System @	1.8% added aic				a							
*#200	1.1-5.1(3.1)	3.8			3.8			QUANT	TITY FOR PAY	MENT	{				TEMPE	RATURE, °P					
*Dev	± 2.0	0.7			0.7			Mix Unit Price	ce (\$/ton)	\$41.42		Time	7:00	9:00	11:00	1:00	3:00	5:00	7:00	Spec	Comply?
Gradation Co	mpliance?	Yes			Yes		╡┝──	Binder Unit P	rice (\$/ton)	\$462.00		Air Temp	29	29	31	32	32				
DBR	Sugg 0.6 - 1.4	0.75			0,75			Tons of Mix	on Road	1,804.89		Binder Temp	300	300	300	300	300			260-330	*F Yes
% +4 Type 4		44.9			44.9			Tons to Other	Bid Item(s)	104 17		Plant Temp	328	325	330	325	320			245-330	Yes
% +4 Type 3		00.0/10.5			0.0			Tons of E	Binder	101.47		Mat Temp		282	299		272			215-330	F Yes
(+4/-4) Type 2		00.3/19.7			00.3/19.7		┨┠──	Tons of Pint	Waste	97.52 200 FP	<b>п</b>	Break Down	Re-start af	ter mandatory shutdow	changes are	made to star	t the day. in	entify them	on previou	s dav's ren	uort);
							1	Tons of Bind	der to Date	5 200.38		Rain Out	Mile Offeringe	Old Target	New Toract	Tone	Aca	Initial %	Now %		nitio Now %
								Tons of MD	x to Date	0,299.33	J	7			New Larger	TONS	Agg	Trattan 70	NOW 70	Agg i	INCE NOW 70
		BINDE	R Asturi		Comelui		- Clati	PLAC	EMENT RECO		Midth (fr	1									
0/ 64/	Dindor	l arget	Actual	Spec N/A	Comply?		R 5(8100	10	38+00	NB/ER Drive L	11	1									
76 Added	DiniUer	5.50	5.63	5 20-5 80	Yes	'	00100			INDIED DIVE EI	<u>                                     </u>	1									
70 I Otal 8	D	19.00	18 79%	<100%	Yes					1		1		+							
20 R.P	s	10.00	10.7 8 76		100								Comments:		L		·				muyal
% Rinder Re	placement	14.65%	14,15%	≤ 30%	Yes						1	1	a official root of								
PG Gr	ade	58-2	28H	58-28H	Yes	Certif	ed Tech:		David Upd	like	Cert. No	417066									
						Certif	ed Tech:		Dawn Upd	like	Cert. No	SW461									
Gb:	1.03292	Gsb:	2.561	Pbe (%):	5.07	Distrib	ution:	Dist. Material	ls Proj.	Engineer	Contractor										
100 C 100			and the second second			•															

Addre Preiset ite:         Exc.2008/55:-55:-83         Burlinger Travel Landon           Mak Hange Ite:         2820-2014         Addre Preisettinger Corte Line:         Addre Preisettinger Corte Line:         Main	1:27 PM	8/18 1:27	11/					REPORT	ILY PLANT	/ING DA	SPHALT PA	OWA DOT AS	) <u>H</u>	3					11/7/2018	er.11.07	4/25/13 vi
Contrait         Control         Distance         Multi begin         Mul	Report No.: 2	_	)	Active Placement: Surface (Travel Lane)					C.	Const. In	lenningsen (	F	Contractor:				-	5)55-88	FM-C088(5	Project No.:	Active
Int Comp         Description         Description <thdescription< th=""> <thdescription< th=""> <t< td=""><td>Lab Voids Target: 4.0</td><td>- La</td><td>WMA)</td><td colspan="5">Mix Type: Wma Ht Surface None 1/2 (WMA</td><td></td><td>n</td><td>Unio</td><td></td><td>County:</td><td></td><td></td><td></td><td></td><td>8</td><td>88-C088-05</td><td>Contract ID:</td><td>8.45×</td></t<></thdescription<></thdescription<>	Lab Voids Target: 4.0	- La	WMA)	Mix Type: Wma Ht Surface None 1/2 (WMA						n	Unio		County:					8	88-C088-05	Contract ID:	8.45×
COMPACTED MICRURE         COMPACTED SATURE         COMPACTED SATURE           COMPACTED SATURE	Design Gyrations:75	- Des	J (HMA)	(F 1/2IN NC	OU HT SUP	2303-1043	Active Bid Item:			45 % AC)	ABC2-208 (4.		стоскріве п.		•			311	ABD 10-400	Cosign No	PVD
Construction         SU11-7A				COMPACTED MAT							п	MPACTED JOIN	CO				E	ED MIXTURE	UNCOMPACT		
Data         Data <th< td=""><td>% of P<sub>a</sub> (%) Thickness (in.)</td><td>% of Gmm</td><td>G<sub>mb</sub></td><td>W3 Wet (g)</td><td>W2 in H20 (g)</td><td>W1 Dry (g)</td><td>CL Reference</td><td>Station</td><td>Date of Placement</td><td>Core</td><td>G<sub>mb</sub></td><td>Joint ID</td><td>Station</td><td>Core #</td><td></td><td></td><td></td><td>SU11-7C (5.61%)</td><td>SU11-7B (5.75%)</td><td>SU11-7A (5.75%)</td><td>(Theoretical %AC)</td></th<>	% of P <sub>a</sub> (%) Thickness (in.)	% of Gmm	G <sub>mb</sub>	W3 Wet (g)	W2 in H20 (g)	W1 Dry (g)	CL Reference	Station	Date of Placement	Core	G <sub>mb</sub>	Joint ID	Station	Core #				SU11-7C (5.61%)	SU11-7B (5.75%)	SU11-7A (5.75%)	(Theoretical %AC)
Thm         105 7 AM         104 PM         302 PM         Image: Construction of the second of	93.6 6.4 1.25	93.6	2 243	1 265 8	702.2	1 264 3	1.0 SW/ Drv	5+85	11/7/2018		2 256	2L-Centerline	5+85				-	11/7/18	11/7/18	11/7/18	Date Sampled
Barton         40-45         91+00         142/200         13         14         14         14         14         14         14         14         13         14         17         11         13         13         13         13         13         13         13         13         14         13         14         13         14         13         14         13         13         14         13         13         13         13         13         13         13         13         13         13	927 73 1.50	92.7	2 222	1 570 3	864.4	1,568,6	1.2 SW Dry	34+43	11/7/2018	2	2,223	2L-Centerline	82+15	2			1	3:02 PM	1:04 PM	10:57 AM	Time
Bar Casello         Du-010168         Du-010168 <thdu-010168< th=""> <thdu-010168< th=""> <t< td=""><td>94.1 5.9 1.63</td><td>94.1</td><td>2.255</td><td>1,684,1</td><td>938.0</td><td>1,682.8</td><td>5.1 S\W Drv</td><td>53+11</td><td>11/7/2018</td><td>3</td><td>2.19</td><td>2L-Centerline</td><td>153+43</td><td>3</td><td></td><td></td><td></td><td>142+00</td><td>91+00</td><td>40+45</td><td>Station</td></t<></thdu-010168<></thdu-010168<>	94.1 5.9 1.63	94.1	2.255	1,684,1	938.0	1,682.8	5.1 S\W Drv	53+11	11/7/2018	3	2.19	2L-Centerline	153+43	3				142+00	91+00	40+45	Station
Sample Cross)         442.00         951.00         1.658.00         Average Joint Gas         2.237         2.249         2.234         1.521.01         2.205         2.205           Gma         2.394         2.391         1.523.3         2.191           Gma COT)         Auropa Mark Gas         2.216         1.772.016         1.972.61         1.972.71         8.50.5         8.50.5         1.523.3         2.191           Mich Droba         Auropa Mark Gas         2.217         1.527.6         5.53.WU Drv         1.527.6         8.50.5         1.527.6         1.523.3         2.191           Mich Proce Adjustment Gath         Wich Droba         Auropa Mark Gas         2.216         1.772.016         1.527.6         8.50.5         1.527.6         1.527.6         1.527.6         1.527.6         1.527.6         1.527.6         1.527.6         1.527.6         1.527.6         1.527.6         1.527.6         1.527.6         1	92.2 7.8 1.38	92.2	2.210	1,443.9	791.3	1,442.0	1.0 S\W Drv	82+15	11/7/2018	4							1	D4-010170	D4-010169	D4-010168	Bar Code ID
Gas         2.287         2.284         2.284         2.284         2.284         2.284         2.284         2.284         2.284         2.394         2.394         2.394         2.394         2.394         2.394         2.394         2.394         2.394         2.394         2.394         2.394         2.217         330.41         2.217	92.0 8.0 1.50	92.0	2.205	1,521.0	831.8	1,519.8	5.2 S\W Drv	103+96	11/7/2018	5	2.223	erage Joint Gmb	Av					1,465.00	951.00	442.00	Sample (Tons)
Ome (COT)         Image: Constraints         Minimized matrix         Minimatrix         Minimatrix	92.5 7.5 1.38	92.5	2.217	1,330.4	731.0	1,329.1	1.0 S\W Drv	119+78	11/7/2018	6	2.216	verage Mat G <sub>mb</sub>	A					2.294	2.294	2.297	G <sub>mb</sub>
Gum         2.394         2.492         For information Only Joint (argth, if, 5,18)         117/2018         153+43         2.6 SWD DrV         1,230.5         670.6         1,232.3         2.191           0 mm (D07)         A.1         4.2         4.5         Image: Constraint of the second se	91.2 8.8 1.63	91.2	2.186	1,529.3	830.5	1,527.6	5.8 S\W Drv	136+78	11/7/2018	7	100.3	% Mat Density									Gmb (DOT)
Joint Length, 1         4.1         4.2         4.5         Joint Length, 1         Joint Length,	91.4 8.6 1.25	91.4	2.191	1,232.3	670.8	1,230.5	2.6 S\W Drv	153+43	11/7/2018	8	ily	information On	For					2.402	2.394	2.394	Gmm
P. (%)       4.1       4.2       4.5       Image: Arg G_m Arg G_m Arg G_m Arg Re(h)         P. (%)       Course Placed: Surface (Travel Lane)       Theorem Arg Re(h)         Jane Sees       Crass Placed: Surface (Travel Lane)       Theorem Arg Re(h)         Sees       Crass Placed: Surface (Travel Lane)       Course Placed: Surface (Travel Lane)       Theorem Arg Re(h)         Jane Sees       Crass Placed: Surface (Travel Lane)       Theorem Arg Re(h)       Course Placed: Surface (Travel Lane)       Theorem Arg Re(h)         Jane Sees       Crass Placed: Surface (Travel Lane)       Theorem Arg Re(h)       Course Placed: Surface (Travel Lane)       Theorem Arg Re(h)         Jane Sees       Crass Placed: Surface (Travel Lane)       Theorem Arg Re(h)       Course Placed: Surface (Travel Lane)       Theorem Arg Re(h)         Jane Sees       Course Placed: Surface (Travel Lane)       Theorem Arg Re(h)       Jane Sees       Jane See			ļ								6,189	Joint Length, ft									Gmm (DOT)
Pr. (10) (001)       Aug Gas Arg Gas (Arg (Arg (Arg (Arg (Arg (Arg (Arg			<b> </b>								\$0.400	djustment (\$/ft)	Unit Price A					4.5	4.2	4,1	Pa (%)
Image: Add main		ļ	j												Aura Da (0()	AvaG	Aug C			1	Pa (%) (DOT)
AAD=0.4         Joint matrixe         Joint matrin         Joint matrixe         Joint matrixe </td <td></td> <td>L</td> <td></td> <td></td> <td></td> <td></td> <td>unfond (Trouv</td> <td>Discust.</td> <td></td> <td></td> <td>\$2 475 75</td> <td>aint Incontinue of</td> <td></td> <td>4</td> <td>Avg Pa (%)</td> <td>2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2</td> <td>2 205</td> <td></td> <td></td> <td></td> <td></td>		L					unfond (Trouv	Discust.			\$2 475 75	aint Incontinue of		4	Avg Pa (%)	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 205				
Abbre 4         Arg. Map           GRADATION (%Pessing)         Use of 1in.         Use of 1in.         Use of 1in.         In.         100.0         100.0         100.0         Arg. Map           344 n.         100         100.0         100.0         100.0         100.0         100.0         100.0         100.0         400.0         100.0         100.0         100.0         100.0         400.0         100.0         400.0         100.0         100.0         400.0	35 QI: 1.15	ckness Qi	Thick			er Lane)	sunace (Trave	rse Placed:	Col		φ2,470.75	bint incentive =	J	┨┗━━	4.3	2.397	2.285				
GRADATION (MPassing)         Use DOT         Use DOT         Use DOT         Use DOT         Date of the second of t	ensity: 2.216	at Density	Avg. Ma			)	1.50	t Thickness:	Intended Lit										D=0.4	AA	
Silve         Spece         CF 11.7-18         Avg         Detrict           1n         100         100.0         100	Gmm: 92.463	6 of Gmm	Avg. %			18	11/07/	ate Placed:	C		LTS	D.O.T. RESUL	USEI		Use DOT		ing)	ION (%Pass	GRADAT		
1 In       100       100.0       10	√oids; 7.54	ield Voids	Avg. % F	alinger	Jeff Es	18	11/08/	st Date/By:	Te			(Enter an 'X')		1 —	District	Avg			CF 11-7-18	Specs	Sieve
34 m.       100       100.0       1																100.0			100.0	100	1 in.
1/2 n.       88-00(85)       92.0       92.0       92.0         3/8 n.       85.0       90.0       92.0 </td <td>→ PWL (lower) 100.0</td> <td><math>\rightarrow</math></td> <td>4.05</td> <td>=</td> <td>16</td> <td>7) — 2.2</td> <td>5 x 2,397</td> <td>(0.96</td> <td>l. (lower) =</td> <td>, Q.</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>100.0</td> <td></td> <td></td> <td>100.0</td> <td>100</td> <td>3/4 in.</td>	→ PWL (lower) 100.0	$\rightarrow$	4.05	=	16	7) — 2.2	5 x 2,397	(0.96	l. (lower) =	, Q.						100.0			100.0	100	3/4 in.
Dot m.         Docessing         Docessing <thdocessing< th=""> <thdocessing< th=""> <thdoce< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>0.024</td><td></td><td></td><td></td><td></td><td>EST STRIP</td><td>1</td><td></td><td></td><td>92.0</td><td></td><td></td><td>92.0</td><td>88-100(95)</td><td>1/2 in.</td></thdoce<></thdocessing<></thdocessing<>							0.024					EST STRIP	1			92.0			92.0	88-100(95)	1/2 in.
Image: state of the s					171		(0.016	2.24				Enter an "X")		┨┠───		62.0			62.0	58-72(65)	+ #4
image         image <th< td=""><td>→ PVVL (upper) 82.6</td><td><math>\rightarrow</math></td><td>0.95</td><td>=</td><td>57)</td><td>X 2.5</td><td>0.024</td><td>2.21</td><td>. (upper) = -</td><td>Q.1</td><td></td><td></td><td></td><td></td><td></td><td>-3.0</td><td><u> </u></td><td></td><td>-3.0</td><td>+70</td><td>* Dev</td></th<>	→ PVVL (upper) 82.6	$\rightarrow$	0.95	=	57)	X 2.5	0.024	2.21	. (upper) = -	Q.1						-3.0	<u> </u>		-3.0	+70	* Dev
Image: book with the second							0.024			1	0-15.01	KNESS (ET) 18	EILM THR			38.0			38.0	33-43(38)	*#8
July         July <th< td=""><td>0.0 = 82.6</td><td>100.0</td><td>-</td><td></td><td>82.6</td><td>÷</td><td>0.0</td><td>10</td><td><pre>//L (total) =</pre></td><td>P\</td><td>44.0</td><td></td><td>ET .</td><td></td><td></td><td>0</td><td></td><td></td><td>0</td><td>+50</td><td>*Dou</td></th<>	0.0 = 82.6	100.0	-		82.6	÷	0.0	10	<pre>//L (total) =</pre>	P\	44.0		ET .			0			0	+50	*Dou
International construction         24.0         24.0         International construction         20.0         International construction         20.0         International construction         20.0         International construction         Internating construction         Internation											11.9	ustmont	Price Adia	┨┝───		24.0			24.0		#16
***30       10-19(14)       16.0	Pay Factor = 1.000	Pav									\$0.00	sument	Fride Auj	-		24.0			24.0	40.40(4.0)	#10
• Dev         ± 4.0         2.0         Cyratory VMA           #50         8.5         8.5         9.5         9.6																16.0			16.0	10-18(14)	*#30
#50       8.5       0.8.5       VMA, %       15.5       deducted)=       How makes and the second s	nent = \$0.00	ustment =	is Price Ad	Field Void	56	1.80	Analysis (00.00	VL Field Voids	ons of Mix for PV	Т		Gyratory VMA				2.0			2.0	± 4.0	* Dev
#100       5.0       5.0       WMA Water lifection System @ 1.8% added ac         ##200       1.1.45.1(3.1)       4.0       4.0         "Bow 1.1.45.1(3.1)       4.0       4.0         "Dow 1.2.0       0.9       0.9         Gradation Compliance?       Yes       Yes         DBR       Sug 0.6 - 1.4       0.79         % +4 Type 4       45.4       45.4         % +4 Type 2       0.0.3/19.1       0.0.3/19.1         (+4(-4) Type 2       0.0.3/19.1       0.0.3/19.1         BINDER       Spec       Comply?         **       ***       Target       Actual         Spec       Comply?         % Added binder       4.85       N/A         % Added binder       5.0       5.70         % RAP       19.00       19.99%       \$10.0%       Yes						.,	deducted)=				15.5	%	VMA			8.5			8.5		#50
##200       1.1.5.1(3.1)       4.0       4.0       Guardian Compliance?       Time       Tool       Time										1 p	.8% added a/c	ction System @ 1.	AA Water Inje	WN		5.0	ļ		5.0		#100
Dev         ± 2.0         0.9         Mix Unit Price (\$10n)         \$41.42         Time         7:00         9:00         11:00         1:00         3:00         5:00         i           Gradation Compliance?         Yes         Yes         Mix Unit Price (\$10n)         \$442.00         Air Temp         26         30         35         37         36					RATURE, °F	TEMPE					IENT	ITY FOR PAYM	QUANT			4.0			4.0	1.1-5.1(3.1)	*#200
Gradation Compliance?       Yes       Yes       Yes       Yes       Yes       Yes       All Price (\$fon)       \$445,200       Air Temp       26       30       35       37       36       1000         binder Unit Price (\$fon)       0.79       0.79       0.79       0.79       Tons of Mix on Road       1,809,56       Binder Temp       300 </td <td>:00 Spec Comply?</td> <td>7:00</td> <td>5:00</td> <td>3:00</td> <td>1:00</td> <td>11:00</td> <td>9:00</td> <td>7:00</td> <td>Time</td> <td>   </td> <td>\$41.42</td> <td>ce (\$/ton)</td> <td>Mix Unit Pri</td> <td>-</td> <td></td> <td>0.9</td> <td> </td> <td></td> <td>0.9</td> <td>± 2.0</td> <td>*Dev</td>	:00 Spec Comply?	7:00	5:00	3:00	1:00	11:00	9:00	7:00	Time		\$41.42	ce (\$/ton)	Mix Unit Pri	-		0.9			0.9	± 2.0	*Dev
DER         sugg 0x - 1.4         0.79         0.79           % +4 Type 4         45.4         45.4         Tons of Mix on Road         1,809.56         Binder Temp         300				36	37	35	30	26	Air Temp		\$462.00	rice (\$/ton)	Binder Unit P			Yes			Yes	mpliance?	Gradation Co
19: +4 Type 4       45.4       Tons to Other Bid Item(s) Tons of Binder       Plant Temp       328       326       315       320       315         19: +4 Type 2       00.3/19.1       0.0       0.0       0.0       0.0       0.0       Mat Temp       262       276       268       0.0         (+4-4) Type 2       00.3/19.1       0.0.3/19.1       0.0.3/19.1       0.0.3/19.1       0.0.3/19.1       0.0.4       199.11       0.0.6       199.11       0.0.6       199.11       0.0       Beak Down       Beak Down       Beak Down       Beak Down       Beak Down       Beak Down       0.0       Contract Down       0.0       Tons of Mate Down       0.0	260-330 °F Yes			300	300	300	300	300	nder Temp	Bi	1,809.56	on Road	Tons of Mix	4		0.79			0.79	sugg 0.6 - 1.4	DBR
17: +4 1ype 3       0.0       Tons of Binder       103.76       Mat Temp       262       276       268         (+4/-4) Type 2       00.3/19.1       00.3/19.1       Tons of Binder       19.93       Image: Complex State of Binder       Image: Complex State of Binder       19.93       Image: Complex State of Binder       19.93       Image: Complex State of Binder       Image: Complex State of Binder       19.93       Image: Complex State of Binder       111       Image: Complex State of Binder       111       Image: Complex State of Binder	245-330 °F Yes			315	320	315	326	328	lant Temp	P	400.10	Bid Item(s)	ons to Other	1 1		45.4			45.4		% +4 Type 4
Image: Construction of the state         19.93         Tons of Waste         19.93         Break Down         Repart after particular state of the state the day. Identify them on £           Image: Construction of the state         199.11         Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £           Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £           Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £           Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £           Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £           Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £         Image: Construction of the state the day. Identify them on £           Image: Construction of the state the day. Identify the form of \$         Image: Construction of the state the day. Identify the form of £         Image: Construction of the state the day. Identify the form of £	215-330 °F Yes	I		268	276	262			viat Temp		103.16	Binder	⊤ons of I	-		0.0			00.0/10.4		% +4 Type 3
Image: Construction of the construction of	reviews davis report):		optify them	the device	mada ta star	hangaa oro	mandatory shutdow	Re-start after	Break Down		19.93	Waste	Tons of			00.3/19.1	L		00.3/19.1		(+4/-4) Type 2
BINDER         Comply?         PLACEMENT RECORD         PLACEMENT RECORD           % Added Binder         4.69         4.85         N/A         1+45         184+00         \$BI/WB Drive Lr         11         11         1 <td< td=""><td>evious day's report).</td><td>on previou</td><td>analy them</td><td>, une day, Ide</td><td>nade to star</td><td>undinges are</td><td>onitation (when</td><td>an Change In</td><td>Rain Out</td><td></td><td>199.11</td><td>er to Date</td><td>ions of Bind</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>L</td></td<>	evious day's report).	on previou	analy them	, une day, Ide	nade to star	undinges are	onitation (when	an Change In	Rain Out		199.11	er to Date	ions of Bind								L
PLACEMENT RECORD           Target         Actual         Spec         Comply?           % Added Binder         4.650         5.70         5.20-58.00         Yes         1445         184400         SB/WB Drive Lr         11         Image: Comply?	w % Agg Initia New %	New %	initial %	Agg	Tons	New Target	Uid Target		F	L	3,494.44	c to Date	i ons of Mi					-		and difference of	
Image:         Actual         Spec         Comply?         From Station         Lane         Width (ft)           % Added Binder         4.69         4.85         N/A         1445         184+00         SB/VB Drive Lr         11           % Total Binder         5.50         5.70         5.20-5.80         Yes         1445         184+00         SB/VB Drive Lr         11           % RAP         19.00         19.99%         \$100%         Yes         1445         184+00         1445									ŀ		RD .	EMENT RECOR	PLAC					ĸ	BINDE		l
% Added bilder         4.09         4.09         1/4         1/45         184400         SB/WB Drive L1         11           % Total Binder         5.50         5.70         5.20-5.80         Yes			l						ŀ	Width (ft)	Lane	Station	To	n Station	From	Comply?	Spec	Actual	Target	Diadaa	
™ Total Binder         0.30         0.70         0.20-0.80         Tes           % RAP         19.00         19.99%         ≤100%         Yes									ŀ	11	SB/WB Drive Lr	14+00 · S	18	+45		- Yee	N/A	4.65	4.69	Binder	% Added
									ŀ							Yes	<100%	5./0	5.50	Binder	% Total 8
		L						) among ta	Ľ							Tes	5100%	19,99%	19.00	<u>с</u>	% R/
75 TVNO 76 Bridger Rollesement 14 65% 14 85% \$ 30% Yes								Johiments:	0							Yes	≤ 30%	14 85%	14.65%	placement	% Rinder Rev
PG Grade 58-28H 58-28H Yes Certified Tachy David Lindike Cert No. 417066									417066	Cert No	(e	David Updik		ad Tech	Certifie	Yes	58-28H	8H	58-2	ade	PG Go
Certified Tech: Dawn Updike Cert. No. SW461									SW461	Cert. No.	(e	Dawn Updik		ed Tech:	Certifie		00 2011	<del>.</del>	00-2		
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