Example Problems Packet

Mix Design & Production Control Recertification

Quality Control / Quality Assurance

SD DEPARTMENT OF TRANSPORTATION

Gmm = maximum specific gravity of paving mix

Gsb = bulk specific gravity of mineral aggregate

Pb = percent asphalt binder content

Gmb = bulk specific gravity of compacted mix

Gb = specific gravity of asphalt binder

DOT-86 Equations

Gse (Effective specific gravity of mineral aggregate)	=	$\frac{100 - Pb}{\left(\frac{100}{Gmm}\right) - \left(\frac{Pb}{Gb}\right)}$
Va (Percent Air Voids)	=	$\left(\frac{Gmm - Gmb}{Gmm}\right) \times 100$
Ps (Percent aggregate content of mixture)	=	$100 - Pb$
VMA (Voids in the Mineral Aggregate)	=	$100 - \left(\frac{Gmb \times Ps}{Gsb}\right)$
VFA (Voids Filled with Asphalt)	=	$\left(\frac{VMA - Va}{VMA}\right) \times 100$
Pba (Percent asphalt absorption)	=	$100 \times \left(\frac{Gse - Gsb}{Gse \times Gsb}\right) \times Gb$
Pbe (Percent effective asphalt content)	=	$Pb - \left(\frac{Pba \times Ps}{100}\right)$
Dust to Binder Ratio	=	$\left(\frac{\% - \#200\ material + \%\ hydrated\ lime}{Pbe}\right)$
Gmb x	=	$\left(\frac{Gmb_{(measured)} \times height_{(measured)}}{height\ x}\right)$
Calculation for G_{mb} bulk specific gravity of compacted mix at any given gyration point in the compaction process when x is number of gyrations such as at N_{ini} or N_{des}		
% of Gmm (Percent of mixture theoretical maximum specific gravity)	=	$\left(\frac{Gmb}{Gmm}\right) \times 100$

Problem #1

Flat & Elongated (SD 212)

Given the following gradation, calculate the percent of flat and elongated particles.

Gradation	
Sieve Size	**Retained (g)**
3/4"	0.0
5/8"	0.0
1/2"	227.8
3/8"	696.9
1/4"	1219.8
#4	922.8

	A	B	C	D	E
Sieve Size	**Total Sample Weight on Sieve**	**Weight of Tested Portion** (100 pieces)	**Weight of Flat/Elongated Particles**	**% Flat/Elongated (Individual Sieve)**	**% Flat/Elongated Weighted Average**
3/4" to 1/2"		227.8	5.0		
1/2" to 3/8"		222.2	7.3		
3/8" to #4		61.1	3.0		
Total Sample Wt.		F			

Percent flat and elongated particles in the total sample (weighted average) rounded

Problem #2

Given:

- Q2R mix with 20% RAP to be added by weight of aggregate
- Solvent extraction test result of 6.50% binder in RAP
- 1.00% hydrated lime added by weight of total mix
- Aggregate bin splits
  - 30% Rock
  - 25% Crushed Fines
  - 30% Natural Fines
  - 15% Sand

a) Prepare a 4750 gram batch with 4.5% added new binder by weight of total mix.

b) Determine amount of added new binder, lime, RAP, rock, crushed fines, natural fines and sand to be added for a gyratory specimen.

c) Also determine total binder, new(added) and old (RAP).

Problem #3

DOT-86
Gyratory Worksheet

Complete the DOT-86 for a Q3R Mix.

Use the equation sheet in the Problems Packet.

Mix Temp	275
% binder Pb	6.0
Gsb	2.554
binder Gb	1.024
dust (- #200)	4.69
lime	1.00
dust(-#200) + lime	

No. of gyrations

N initial		**Gse**	
N design		**Pba**	
N max		**Pbe**	

	Spec. A (Ndes)		Spec. B (Ndes)				
	@ N ini	@ N des	@ N ini	@ N des	@ N ini	@ N des	@ N max
a) Height, mm	122.6	114.5	124.7	116.3	124.7	116.1	114.9
b) Weight in air		4697.7		4698.9			4696.8
c) Weight in water		2667.0		2668.2			2687.3
d) SSD Weight		4699.2		4700.4			4697.4
e) Gmb (measured) b / (d - c)							
f) Gmb (calculated)							

	Gmm #1	Gmm #2
Weight of sample in air	1545.1	1534.2
Weight of canister + H_2O	1365.4	1365.4
Weight of canister + H_2O + sample	2271.5	2264.1
Temperature of water	77.0	78.0
H_2O correction factor	1.0000	0.9999
Rice SpGr (Gmm)		

Average Max SpGr (Gmm)

	N initial	N design	N maximum
Average Gmb			
% of Rice SpGr (Gmm)			

% Air Voids (Va)		**% VMA**		**% VFA**	**Dust to Binder Ratio**	
Specs:						