

# Example Problems Packet

## Mix Design & Production Control

### Recertification

Quality Control / Quality Assurance



## DOT-86 Equations

**Gmm** = maximum specific gravity of paving mix

**Gmb** = bulk specific gravity of compacted mix

**Gsb** = bulk specific gravity of mineral aggregate

**Gb** = specific gravity of asphalt binder

**Pb** = percent asphalt binder content

<b>Gse</b> (Effective specific gravity of mineral aggregate)	=	$\frac{100 - P_b}{\left(\frac{100}{G_{mm}}\right) - \left(\frac{P_b}{G_b}\right)}$
<b>Va</b> (Percent Air Voids)	=	$\left(\frac{G_{mm} - G_{mb}}{G_{mm}}\right) \times 100$
<b>Ps</b> (Percent aggregate content of mixture)	=	$100 - P_b$
<b>VMA</b> (Voids in the Mineral Aggregate)	=	$100 - \left(\frac{G_{mb} \times P_s}{G_{sb}}\right)$
<b>VFA</b> (Voids Filled with Asphalt)	=	$\left(\frac{VMA - V_a}{VMA}\right) \times 100$
<b>Pba</b> (Percent asphalt absorption)	=	$100 \times \left(\frac{G_{se} - G_{sb}}{G_{se} \times G_{sb}}\right) \times G_b$
<b>Pbe</b> (Percent effective asphalt content)	=	$P_b - \left(\frac{P_{ba} \times P_s}{100}\right)$
<b>Dust to Binder Ratio</b>	=	$\left(\frac{\% - \#200 \text{ material} + \% \text{ hydrated lime}}{P_{be}}\right)$
<b>Gmb x</b>	=	$\left(\frac{G_{mb(\text{measured})} \times \text{height}(\text{measured})}{\text{height} \times}\right)$
Calculation for $G_{mb}$ , bulk specific gravity of compacted mix at any given gyrations point in the compaction process when x is number of gyrations such as at $N_{10}$ or $N_{100}$ .		
<b>% of Gmm</b> (Percent of mixture theoretical maximum specific gravity)	=	$\left(\frac{G_{mb}}{G_{mm}}\right) \times 100$

# 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.	<input type="text"/>	F			

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

rounded

<input type="text"/>
<input type="text"/>

# 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).

