ANALYSIS AND DESIGN OF STONE MATRIX ASPHALT

AMIT KUMAR SINGH

M.Tech (Transportation Engineering)

ABSTRACT

Stone Matrix Asphalt (SMA) firstly developed in Germany in 1960. And it has been implemented by many countries for Flexible Pavement Road Construction. It is highly rut-resistant of bituminous coarse for heavy traffic roads.

In April-2006 the indian road congress (IRC) decided for specifications be developed for SMA. The specification of SMA approved by the IRC council in 2007.

Stone Matrix Asphalt has been proposed as a wearing course for the pavement. And carried out to meet the specification as recommended.

The marshall method was adopted for design and analysis of mix as described in the Asphalt Institute Manual MS-2. The basic principle of Mix-Design is to arrive at Optimum Binder Content at the selected and mechanical properties desired. The suitable ingredient is the most important for the deign of SMA. To make an appropriate design with Aggregate, Filler, Bitumen, Cellulose Fiber and Additive.

Stone Matrix Asphalt have a higher bitumen content which hold the aggregate with resistivity. Therefore rutting to be minimize and provide a higher rut resistant stability to the pavement under the heavy road traffic or heavy loaded vehicle. In this Mix-Design coarse aggregate proportion is high which can be optimize and prevent to the rutting.

The temperature of mix material and all the individual material like, Aggregate, Bitumen, Cellulose Fiber are very sensitive as per actual, because required compaction will achieve when the temperature of all remain within specified.

CHAPTER 1

Introduction

1.1 INTRODUCTION

Stone Matrix Asphalt Consisting of construction in a single layer(Wearing Course) or multiple layer(Intermediate Course) of Additive(fiber) stabilized on previously Prepared bituminous surface. Stone Matrix Asphaltis designing with coarse aggregate, which reduce the rutting of bituminous layer. The proposed mix design is to be adopted for wearing course. In SMA the all aggregate are in contact with each other. So that aggregate do not deform due to high asphalt binder under the high traffic load. That stone on stone contact reduce the rutting. It is more expensive compare than other Hot Mix Asphalt because in SMA require more durable aggregate, High percentage of binder and additive. Due to higher binder content Mix-Design to be prepared with low Air voids. Higher binder content improves the flexibility of bituminous layer. Some percentage of Pelletized Cellulose fibre shall be used in Mix to prevent the bleeding due to higher binder content. The SMA mix having with sufficient specialized mortar or Stabilized Additive to prevent draindown of the mix and to provide the high durability. It provide Resistance to deformation at highly pavement temperature. And also Improved the skid resistance and resistance to fatigue effects and reducing of cracking at low temperatures. It also help to reduction of Noise upon the pavement surfaces.It increases durability of Pavement surface and Reduces moisture Induced damage. SMA shall design with 4.0 percent air voids during Mix-design and 4-6 percent of Air voids shall be carried out during placement of SMA. The fibre shall be in pelletized form and mix a optimum percent which control the draindown of SMA because its have high percent of Bitumen. SMA have high durability and resistivity from the moisture.

1.2 Materials for SMA Mix-Design-

The requirement of material is very essential as per recommended for the design of Stone Matrix Asphalt.

1.2.1 Aggregate -

1.2.1.1 Coarse Aggregate :

Coarse aggregate shall totally of crushed aggregate and retainable on 2.36 mm sieve Size. Aggregate should be strong in strength and free from organic impurity and other content. The physical requirement of aggregate should be totallysatisfactory as per recommended for SMA.

- For aggregate to be effective, it must be robust and hard enough to resist crushing.

- Cling strength in concrete and total may be diminished if they are covered with biological matter, skin tone, or dust.

- The concrete admixtures must be long-lasting.

- Concrete coarse aggregates should not have any chemical activity.
- It's important that they don't have an excessive amount of angular, sharp, and hard spots.
- The final form of the aggregate must be perfectly spherical or boxy.
- The substance must be chemically inert.
- They must not have any hygroscopic girth.
- Water content in aggregates should be no more than 5% of their dry weight.
- The key is for them to be supple and see through.
- Coarse slurries should be about the same size as what goes through an IS 63 mm sieve and what stays in a 4.75 mm IS sieve, according to the standard.
- the aggregate used in construction must be devoid of fragments, alkalis, plant waste, and other contaminants.

Table- 1 : Physical Requirement of Coarse Aggregate for SMA

Properties	Test	Method	Specification
Aggregate Shape	Combined Flakiness and Elongation Index	IS:2386 (P-1)	<30 %
Cleanliness	Grain Size Analysis (75 Mic. Sieve)	IS:2386 (P-1)	< 2%
Strength	Aggregate Impact Value	IS:2386 (P-4)	< 18 %
	Los Angeles Abrasion Value	IS:2386 (P-4)	< 25 %
Polishing	Polished Stone Value	IS:2386 (P-114)	. > 55 %
Durability Test of Aggregate	Soundness (Either Sodium or Magnesium) – 5 cycles		
	Sodium sulphate	IS:2386 (P-5)	< 12 %
	Magnesium sulphate	IS:2386 (P-5)	
Water Absorption	Water Absorption of Aggregate	IS:2386 (P-3)	< 2 %

1.2.1.2 Fine Aggregate :

Fine aggregate should be 100 percent crused and free from organic matter (passing from 2.36mm sieve size and retaining on 0.075 mm sieve size). It should be in cubical shape and size and free from any deleterious substances. The recommended Sand Equivalent Test value should be more than 50 and should be Non-plastic.

- Fine aggregate shall be made from crushed stone.
- Having no presence of lumps and other impurities.
- It should be no plasticity property which impact to the aggregate binder mixing and it require more binder.

1.2.2 Mineral Filler :

It should be a finely ground mineral material, such as hydrated lime or crushed stone dust. SMA Mix should use Fly-Ash as a mineral filler. Below is a table displaying the suggested particle size distributions for mineral filler. They give contact points between individual patches and generally considered to perform the same function as the coarser patches in defying stresses assessed on the pavement. still, the fine patches of mineral filler may occasionally assume a bounding part.

Extremely fine patches may be located in the asphalt flicks that cover the coarser aggregate patches. In this case, mineral filler may alter and have an perceptible effect on the apparent density characteristics of the asphalt used in the pavement.

Table-2 : Specification for Grading Requirement of Mineral Filler.

IS Sieve (mm)	% of Passing
0.600	100
0.300	95-100
0.075	85-100

1.2.3 Bitumen :

The Bitumen which will be used in SMA shall be viscosity grade paving bitumen.

- Viscocity Grade Bitumen can be used in any Hot Mix Asphalt.
- It Provides very cohesive mixes for any type of Bituminous Mix.
- Viscosity grade Bitumen provides the high stability at a low temperature for any heavy traffic road.

Table : 3 Requirement for Viscosity grade Bitumen as per Specification.

Properties	Unit	Min	Max	Test Method
Penetration @ 25C, 100g, 5 sec	mm	35	-	IS 1203
R & B Softening Point	°C	50	-	IS 1205
Solubility in Trichloroethylene	%	99	-	IS 1216
Kinematic Viscosity at 135 °C	Cst	400	-	IS 1206 (Part3)
Absolute Viscosity at 60°C	Poises	3200	4800	IS 1206 (Part2)
Ductility @25 C Cm	CM	25		IS 1208 : 1978
Flash Point Test	°C	220	-	IS 448 (P-69)

1.2.4 Stabilizer Additive :

The Pelletized cellulose fibre only permitted in SMA. The dosage for cellulose fibre is 0.3 percent minimum of total mix by the weight. The fibre dosage should be increase or decrease as per draindown adjusted 0.3 percent maximum of SMA Mix.

- The higher asphalt contents in Stone Matrix Asphalt binder content made it draindown therefore,stabilizing additive must be used to reduce the draindown properties. The binder contentwith the aggregate during mixing.

Table : 4 Requirement for Pelletized Cellulose Fibre.

Properties	Specifications
Maximum fibre length	8 mm
Ash content	Maximum 20 %
Oil absorption	More than 4 times of the fibre weight
Moisture content	Less than 5 % by weight

CHAPTER 2

Literature Review

2.1 Mx-Design of SMA:

- Sampling of All Material like, Aggregate,Binder,Filler and Stablizer Additive from Source and Physical and Chemical Testing shall be carried out as per recommended specifications.
- After Satisfactory of Physical and chemical test of all material the Individual gradation of Aggregate shall be carried out as per specifications.
- Now Blending of Aggregate shall be done as per Individual gradation and percentage of all aggregate fraction shall be fix as per required specifications.

2.2 Aggregate grading as a whole, including coarse and fine aggregate as well as Mineral filler and stabiliser additive, must fall within acceptable ranges.

Table : 5 Combined Grading of Aggregate for SMA Mix-Design.

COMBINED GRADATION OF SMA(DRY MIX) AS Per IRC: SP:79					
Sample No. : 01				**Total Weight (gms)**	**26430**
IS Sieve (mm)	**Wt. Retnd.(gm)**	**Cu. Wt. Retnd.(gm)**	**% Wt. Retained**	**% of Passing**	**MORT&H Limits Table: 500-37**
19.00	0	0	0.00	**100.00**	**100**
13.20	1620	1620	6.13	**93.87**	**90-100**
9.50	7688	9308	35.22	**64.78**	**50-75**
4.75	10213	19521	73.86	**26.14**	**20-28**
2.36	1721	21242	80.37	**19.63**	**16-24**
1.18	1025	22267	84.25	**15.75**	**13-21**
0.600	470	22737	86.03	**13.97**	**12.-18**
0.300	431	23168	87.66	**12.34**	**10.-20**
0.075	507	23675	89.58	**10.42**	**8.-12**

Sample No. : 02				**Total Weight (gms)**	**28510**
IS Sieve (mm)	**Wt. Retnd.(gm)**	**Cu. Wt. Retnd. (gm)**	**% Wt. Retained**	**% of Passing**	**MORT&H Limits Table: 500-37**
19.00	0	0	0.00	**100.00**	**100**
13.20	1944	1944	6.82	**93.18**	**90-100**
9.50	8171	10115	35.48	**64.52**	**50-75**
4.75	11042	21157	74.21	**25.79**	**20-28**
2.36	1870	23027	80.77	**19.23**	**16-24**
1.18	1160	24187	84.84	**15.16**	**13-21**
0.600	411	24598	86.28	**13.72**	**12.-18**
0.300	354	24952	87.52	**12.48**	**10.-20**
0.075	604	25556	89.64	**10.36**	**8.-12**
Sample No. : 03				**Total Weight (gms)**	**26750**
IS Sieve (mm)	**Wt. Retnd.(gm)**	**Cu. Wt. Retnd. (gm)**	**% Wt. Retained**	**% of Passing**	**MORT&H Limits Table: 500-37**
19.00	0	0	0.00	**100.00**	**100**
13.20	1669	1669	6.24	**93.76**	**90-100**
9.50	7929	9598	35.88	**64.12**	**50-75**
4.75	10360	19958	74.61	**25.39**	**20-28**
2.36	1645	21603	80.76	**19.24**	**16-24**
1.18	1086	22689	84.82	**15.18**	**13-21**
0.600	289	22978	85.90	**14.10**	**12.-18**
0.300	439	23417	87.54	**12.46**	**10.-20**

0.075	519	23936	89.48	**10.52**	**8.-12**

2.3 Now Calculating the specific gravity data of all Aggregate Mixture.

Table : 6 Specific gravity of All Aggregate for SMA Mix-Design.

DATA ON SPECIFIC GRAVITIES

SPECIFIC GRAVITY & APPARENT SPECIFIC GRAVITY OF AGGREGATE MIXTURE

1. Aggregate Proportions & Individual Specific Gravity of Aggregates :

Aggregate Size	Proportion	Bulk Specific Gravity	Apparent Specific Gravity	Water Absorption(%)
Bin-1(20-14mm)	12%	2.841	2.895	0.66
Bin-2(14-8mm)	62%	2.824	2.884	0.75
Bin-3(8-4mm)	5%	2.809	2.883	0.91
Bin-4 (4-0mm)	11%	2.779	2.870	1.146
Silo(Filler)	10%	2.692	2.692	

2. Bulk Specific Gravity of Total Aggregate (Gsb)

$$\textbf{Gsb} = \frac{100}{\frac{P1}{Gb1} + \frac{P2}{Gb2} + \frac{P3}{Gb3} + \frac{P4}{Gb4} + \frac{P5}{Gb5}}$$

$$\textbf{i.e., Gsb} = \frac{100}{\frac{12}{2.841} + \frac{62}{2.824} + \frac{5}{2.809} + \frac{11}{2.779} + \frac{10}{2.692}}$$

Gsb = **2.807**

Where : P1, P2,& P3,---Pn = Percentage proportion of Aggregate 1,2,& 3

Gb1, Gb2,&Gb3 ----Gb.n = Bulk Specific Gravity of Aggregate 1, 2, 3 -----

3. Apparent Specific Gravity of Total Aggregate (Gsa)

$$\textbf{Gsa} = \frac{100}{\frac{P1}{Ga1} + \frac{P2}{Ga2} + \frac{P3}{Ga3} + \frac{P4}{Ga4} + \frac{P5}{Ga5}}$$

$$\textbf{i.e., Gsa} = \frac{100}{\frac{12}{2.895} + \frac{62}{2.884} + \frac{5}{2.883} + \frac{11}{2.870} + \frac{10}{2.692}}$$

Gsa = 2.863

Where : P1, P2,& P3----- Pn= Percentage proportion of Aggregate 1, 2, & 3 -

Ga1, Ga2,& Ga3 ---- Ga.n= Apparent Specific Gravity of Aggregate 1, 2,& 3 ---

4. Effective Sp. Gravity of Aggregate (Gse) = (2.807 + 2.863)/2 = 2.835

5. Specific Gravity of Bitumen = 1.02

6. Maximum Sp. Gravity of Mix (Gmm) As Per ASTM D-2041 :

$$\frac{\textbf{Pmm}}{\frac{\textbf{(Pmm-Pb)}}{\textbf{Gse}} + \frac{\textbf{Pb}}{\textbf{Gb}}} = \textbf{2.567}$$

Where :

Pmm : % by weight of total loose mixture = 100

Pb : Bitumen Content percent
Gb : Specific Gravity of Bitumen
Gse : Effective Sp. Gravity of Aggregate

- Specific Gravity, Effective specific gravity and Apparent specific gravity calculated as per IS:2386
- Theoretical Gmm also calculated as per obtained Gse. Which is.. **2.567**

2.4 Calculation for Bulk specific gravity of Coarse Aggregate(Gca).

Table : 7 Bulk specific gravity of Coarse Aggregate.

DATA ON BULK SPECIFIC GRAVITIES OF COARSE AGGREGATE

1. Aggregate Proportions & Individual Specific Gravity of Aggregates :

Aggregate Size	**Proportion**	**Bulk Specific Gravity**	**Apparent Specific Gravity**	**Water Absorption(%)**
Bin-1(20-14mm)	12%	2.841	2.895	0.66
Bin-2(14-8mm)	62%	2.824	2.884	0.75
Bin-3(8-4mm)	5%	2.809	2.883	0.91

2. Bulk Specific Gravity of Coarse Aggregate (Gca)

$$\textbf{Gca} = \frac{79}{\frac{P1}{Gb1} + \frac{P2}{Gb2} + \frac{P3}{Gb3}}$$

$$\textbf{i.e., Gca} = \frac{79}{\frac{12}{2.841} + \frac{62}{2.824} + \frac{5}{2.809}}$$

Gca = **2.826**

2.5 Calculation of Marshall Data for Evaluation of optimum Binder and other Requirement as per specifications.

Table : 8 Marshall Test Data for SMA Mix-Design.

MarshallTestData(STONEMATRIXASPHALT) AS Per MS-2			
BulkSp.Gr.ofTotalAggregate (Gsb)	**:2.807**	**RammerWeigh t**	**: 4.5kg**
EffectiveSp.Gr.ofTotalAggregate (Gse)	**:2.835**	**CompactionBlo ws**	**: 50**
ApparentSp.Gr.ofAggregate (Gsa)	**:2.863**	**MaterialMixin gTempreature(**	**: 165**
BulkSp.Gr.OfCoarseAggregate (Gca)	**:2.826**	**Proportionsof Aggregate**	**: 12 : 62 : 5 : 11 : 10**
Sp.GravityofBitumen (Gb)	**:1.02**	**TypeofBitumen /Source**	**:VG-40**

Sr.No	**%ofBitumen**	**Mould No**	**Wt.inAir(gm)**	**Wt.inWater(gm)**	**SSDWeight(gm)**	**Bulk Volume**	**Bulk Sp.Gr.ofSpecimen**	**Theoritical /LAB Sp. Gr.of Mix.**	**VoidsinMineralAggregate**	**AirVoids**	**VoidsinCoarseAggregate**
	Pb		Wa	Ww	Wssd	Bv=	Gmb =	Gmm = 100	VMA =100-	Va=100x (Gm	VCA=100-
1	5.60	1	1188.6	701.7	1191.5	489.	2.42				
		2	1184.5	705.8	1187.2	481.	2.46				
		3	1187.8	703.2	1190.3	487.	2.43				
Average							[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	5.70	1	1192.6	704.6	1195.7	491.	2.42				
		2	1182.6	705.8	1185.4	479.	2.46				
		3	1187.5	707.3	1189.6	482	2.46				
Average							**2.452**	**2.574**	**17.63**	**4.74**	**31.46**
		1	1190.2	709.5	1192.3	482.	2.46				
		2	1189.2	708.2	1191.8	483.	2.45				

3	5.80	3	1190.6	709.2	1192.7	483.	2.46				
Average							**2.462**	**2.570**	**17.38**	**4.20**	**31.18**
4	5.90	1	1186.7	709.2	1188.2	479.	2.47				
		2	1184.9	708.6	1187.6	479.	2.47				
		3	1185.4	704.8	1188.7	483.	2.45				
Average							**2.467**	**2.566**	**17.30**	**3.86**	**31.04**
5	6.00	1	1189.4	704.8	1191.3	486.	2.44				
		2	1185.8	706.8	1187.5	480.	2.46				
		3	1187.3	711.4	1189.6	478.	2.48				
Average							**2.465**	**2.562**	**17.45**	**3.79**	**31.09**

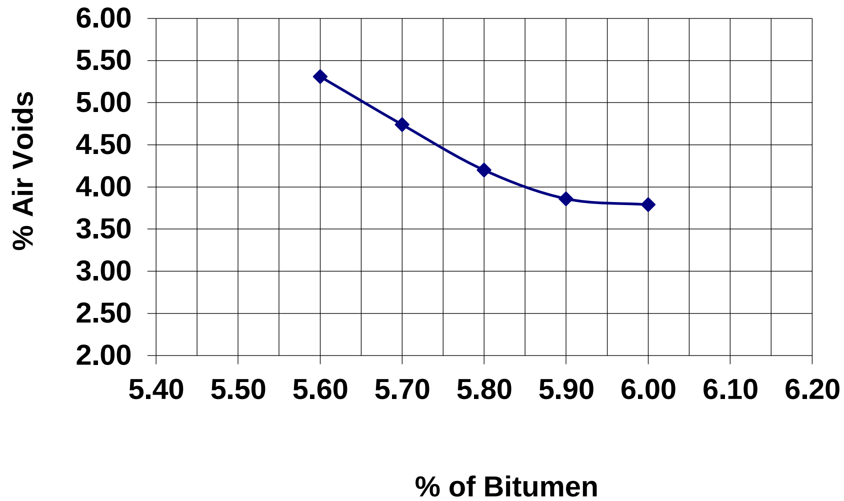
2.6 Graphical Representation of Marshall Parameters for Optimum Binder on 4.0 percent of Air Voids.

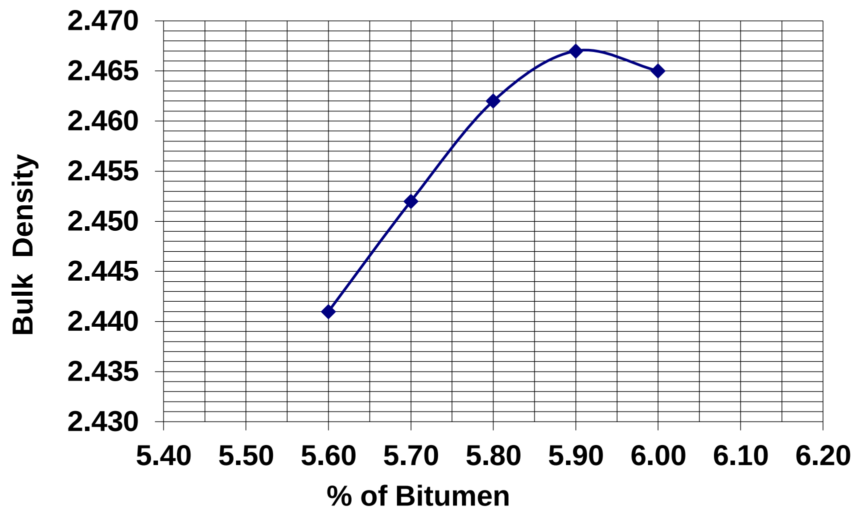
Table : 9 Graphical Representation for SMA Mix-Design.

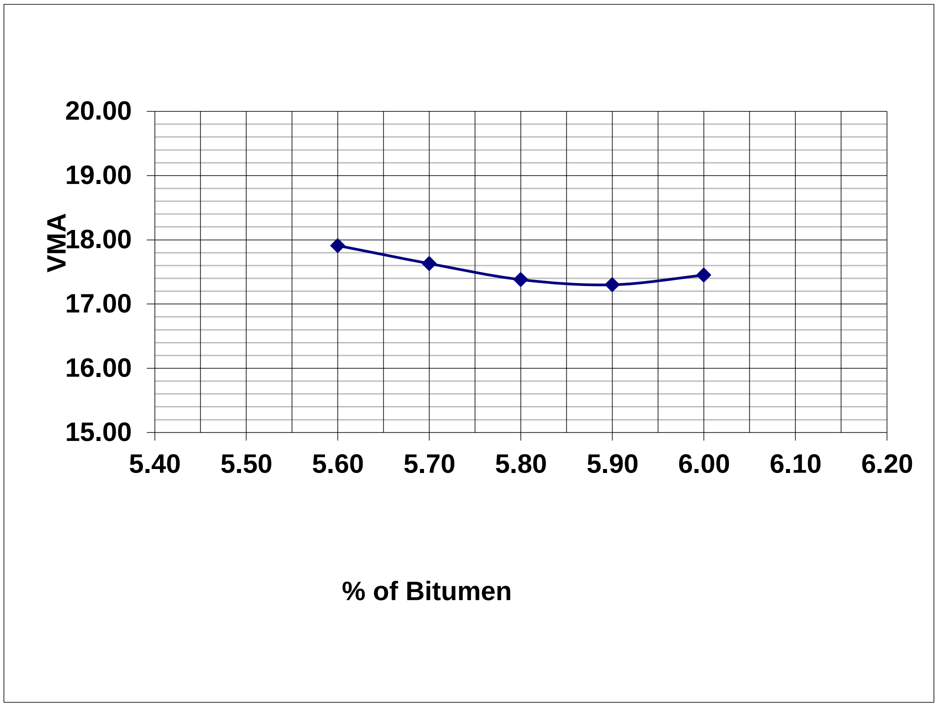
GraphicalRepresentationofMarshallParamaters(SMA)

	%ofBitume	**Bulk Dens**	**%AirVo**	**VM**
MARSHALLPROPERTIES	5.60	2.44	5.31	17.9
	5.70	2.45	4.74	17.6
	5.80	2.46	4.20	17.3
	5.90	2.46	3.86	17.3
	6.00	2.46	3.79	17.4

BitumenVsDensityBitumenVsAirVoids Bitumen Vs VMA


6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
% Air Voids
5.40
5.50
5.60
5.70
5.80
5.90
6.00
6.10
6.20
% of Bitumen


2.470
2.465
2.460
2.455
2.450
2.445
2.440
2.435
2.430
Bulk Density
5.40
5.50
5.60
5.70
5.80
5.90
6.00
6.10
6.20
% of Bitumen



- Hence the Optimum Binder content as per graphical data on 4.0 percent Air voids achieved – 5.85 %

2.7 Ensuring of all the recommended parameter as per Specifications on optimum Binder Content – 5.85 %

Table : 10 Marshall Test Data at OBC for SMA Mix-Design.

MarshallTestData on Optimum Binder Content(SMA)AsperMS-2			
BulkSp.Gr.ofTotalAggregate	**:2.807**	**RammerWeigh**	**: 4.5kg**
EffectiveSp.Gr.ofTotalAggregate	**:2.835**	**CompactionBlo**	**: 50**
ApparentSp.Gr.ofAggregate (Gsa)	**:2.863**	**MaterialMixing**	**: 165**
BulkSp.Gr.OfCoarseAggregate	**:2.826**	**Proportionsof**	**: 12 : 62 : 5 : 11 : 10**
Sp.GravityofBitumen (Gb)	**:1.02**	**TypeofBitumen /Source**	**:VG-40**

Sr.No	%ofBitumen	Mould No	Wt.inAir(gm)	Wt.inWater(gm	SSD Weigh	BulkVolume	BulkSp. Gr.ofSp	Theoritical	VoidsinMinera	AirVoids	Voidsin Coarse
	Pb		Wa	Ww	Wssd	Bv=Wssd-	Gmb= Wa / Bv	Gmm=100	VMA =100 -	Va=100x (Gmm	VCA=100-(Gmb×
1	5.85	1	1186.4	705.6	1188.2	482.6	2.458				
		2	1191.6	710.3	1193.5	483.2	2.466				
		3	1185.3	707.5	1187.1	479.6	2.471				
Average							**2.465**	**2.56**	**[illegible]**	**[illegible]**	**[illegible]**
2	5.85	1	1188.7	707.8	1190.2	482.4	2.464				
		2	1186.7	704.6	1188.6	484.0	2.452				
		3	1190.8	711.2	1192.9	481.7	2.472				
Average							**2.463**	**2.56**	**17.39**	**4.05**	**31.15**
					Average=		**2.464**	**2.56**	**17.35**	**4.01**	**31.12**

4.2Construction Methodology :

<u>Methodology for Stone Matrix Asphalt</u>

The work must be the equivalent of laying a single layer of fiber-stabilized Stone Matrix Asphalt as a surface course over an existing bituminous bound layer, in accordance with the prescribed lines and grades.

4.2.1 Equipment's -

1. 1 Capable of generating sufficient crushing forces for summing up
2. Hot-Mix-Plant, No. 2
3. Three-way detector paver
4. With the proper amount of heft, steel tandem breakers
5. Bitumen Sprayer, No. 5
6. Dumbers, number 6.
7. 7-Volt Air Compressor

8. points for arranging events 8
9. Broom (Mechanical)
10. Conciseness (No. 10)
11. Eleven. Thermometers (range: 0 to 250 degrees Celsius)
12. Method for measuring uniformity
13. Twelfth: a surveying tool
14. 14 Tape recording measurement (essence)
15. Core cutter, model no. 15

4.2.2 Construction Operation -

- Limitations due to climate and time of year Laying work is not permitted to begin during dust storms, heavy rain, fog, or temperatures below 10 degrees Celsius (as specified by the standards).

4.2.3 Preparation of Base –

- Using an air jet, a mechanical system, or any other sanctioned apparatus, you must clean the bituminous layer of any debris. All the holes and cracks need to be patched and sealed.

4.2.4 Tack Coat –

- This shall be as per specifications(0.200 to0.300 kg/ Sqm).

Fig : 16Tack coat spreading.

4.2.5 Preparation of Mix –

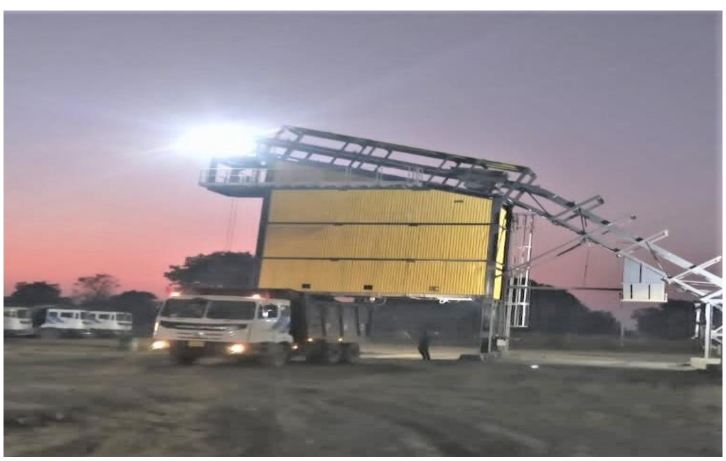
- The Stone Matrix Suggested For best results, asphalt should be mixed in a certified batch mix hot mix facility with sufficient capacity that can consistently produce a uniform blend that fully covers the asphalt surface. Blending temperatures should be between 150 and 165 degrees Celsius when using bitumen with a high viscosity. The factory must be calibrated periodically to ensure a consistent mix quality.

Fig : 17 SMA Mix.

4.2.6 Transportation of Mix –

- All trucks used to deliver Stone Matrix Asphalt should be spotless, well-insulated, and weatherproof. To prevent the mix material from adhering and to lubricate for readily discharge, a release agent for Hot Mix asphalt may be used to the inside of the trucks without affecting the mixing process.

Fig : 18 SMA Production and Transportation.



4.2.7 Spreading –

- There should be no delay in supplying the paver with the material and getting it placed as soon as feasible when it appears at the location. In order to keep the paver running well, the pace at which it receives mix material must be controlled. To avoid dragging, ripping, and isolating the bituminous material as it flows over the screed, the paver's trip rate and operating system must be adapted.

Fig : 19 SMA Mix Spreading.

4.2.8 Rolling & Compaction –

- Before the temperature goes below 100 °C, compaction must begin immediately after laying and be completed. The rolling of the longitudinal joints should be done in a discrete manner that follows the pavement work. Rolling should start at the edge and go toward the centre, with the exception of areas with unidirectional camber, when rolling should be from lower edge to higher edge.

Fig : 20 SMA Rolling & Compaction.

Before the first rolling begins, the attendant who is standing behind the paver must repair all of the newly laid face. An 8-10 tonne tandem roller with a vibrator configuration is ideal for the first or breakdown rolling. For the intermediate rolling, an 8- to 10-ton roller is recommended. Implicit volley concerns make curvaceous rolling inappropriate for usage on Stone Matrix Asphalt. Use a smooth wheel Roller that weighs between 6 and 8 tonnes to do the final rolling. All comber markings must be erased from the face before rolling may stop, and the field viscosity must meet or exceed the minimum stated value.

Longitudinally rolling the Stone Matrix Asphalt Mixture as near as possible to the paver will provide the best results. One third of the hinder wheel's travel distance should be used for the imbrication on successive passes. The comber's maximum permitted speed is 5 kilometres per hour. Incompletely compacted pavement is not safe for the comber to stand on. Oil paint, grease, gasoline, and other potentially dangerous substances should not be allowed to spill into the street. With the water or spray system provided with the machine, keep the wheel of the breakers damp to prevent the admixture from adhering to the bus. Bus and admixture adhesion may be improved with low humidity, although standing water should be avoided at all costs on unfinished roads.

4.2.9 Opening to Traffic -

- Businesses are not permitted on the SMA face until the whole paved pad has cooled to room temperature.

4.2.10 Surface Finish and Quality of work -

- The finished building's exterior must meet the standards set by the quality of the accessories and the workmanship.

6.1 REFERENCE –

AASHTO Standards

1. MPS Standard Specification for Designing Stone Matrix Asphalt.

2. PP41 Standard Practice for Designing Stone Matrix Asphalt.

3. T 166 Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens. 4. T 283 Resistance of Compacted Bituminous Mixture to Moisture-Induced Damage ASTM Standards.

5. C29 BulkDensity ("Unit Weight") and Voids in Aggregate.

6. D 2041 Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.

7. D 6390 Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures Asphalt Institute Publications.

8. MS-2 Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types(Sixth Edition) National Asphalt Pavement Association.

9. Quality Improvement Series 122. Designing and Constructing SMA Mixtures: State-of-the-Practice by RS.Kandhal, March 2002.

10. IS:2386 Physical Properties Test of Aggregate.

11. IS:1201-1220 Bitumen Test.