PD-9

Sieve Analysis

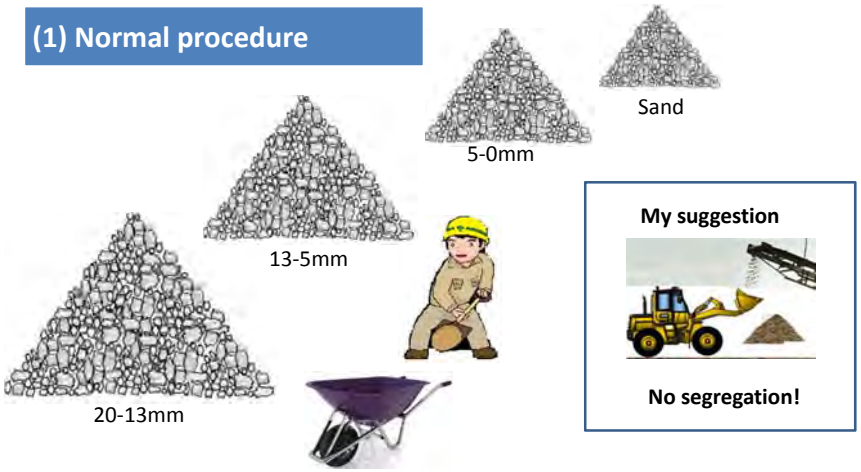
1.Sampling. -Page1

Minimum weight of the sample

Nominal Maximum Aggregate Size, mm	Minimum Weight for Test Sample, kg
9.5	1
12.5	2
19	5
25	10
37.5	15

1.Sampling.-Page2

(1) Normal procedure



My suggestion

No segregation!

2.Preparations.-Page1

Samples

Quartering device

Sieve sets

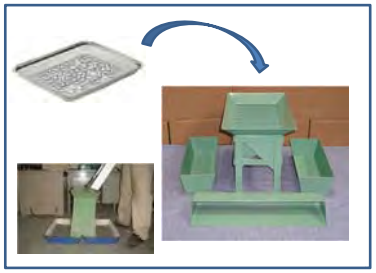
Tray

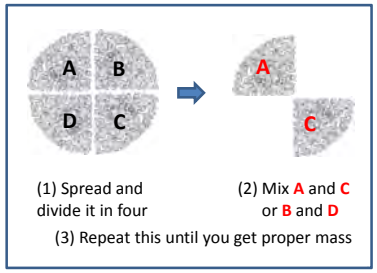
Electric balance

2.Preparations.-Page2

(1) Get the proper weight of sample

Quartering by quartering device or Quartering by manual





(1) Spread and divide it in four

(2) Mix A and C or B and D

(3) Repeat this until you get proper mass

(2) Put the sample in the oven to dry it up(110℃±)

2.Preparations.-Page2

(3).After drying, measure and record the mass of the sample

(4).Start sieving by manual for sufficient time.

We do not have sieving machine

(5). Continue sieve until the particles fall down to next sieve decrease in less than 1%.

(6).Weigh each size of particle.

(7). Record the weighing data.

How to make Stability test specimen.

Stability test.

At Asphalt plant

1.Take samples from dump track.

Tray

or

Wheel borrow

Laboratory

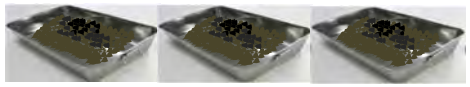
2.Weigh the sample.

1200g

*1. This mass is depend on the HMA design.

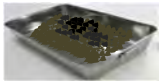
*2

1200g 1200g 1200g



+1

1200g



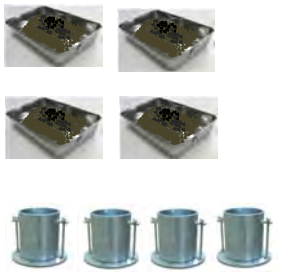
*1. We do not have any design In case of this project because we do not have test equipment.

*2. Thickness of specimen shall be near to 63.5mm.
By this mass, you can 63.5mm ±thick specimen.

3. Keep the mixture in the oven.

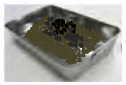
Mixture and Mold

At 145℃±5



4. Make specimen.

Take one sample and mold from the oven.



Put the paper in the mold.

Put the material in the mold.

Shape .the top of material and put the paper on the top.

5. Compaction.-(Page1)

Set the mold to the compaction machine or hand tamper.

Compact both side.

or

5. Compaction.-(Page2)

Compact both side. Number of blows are depends on specification.(**50**,65, 75both side)

We apply 50 blows both side.

How to revers?

a. Remove the top.(Collar)

b. Upside down the mold

c. Attach the collar again.

6. Preparation for Marshall Test-(Page1)

Remove the specimen from mold.

Remove the edge before check the thickness.

Check the thickness. 4 section.

Weigh the surface dry specimens in the water.

Immerse the specimens in water about 1 minute or more.

Weigh the mass of dry condition.

6. Preparation for Marshall Test-(Page2)

Take sample from water bath. Then, remove the water from surface.

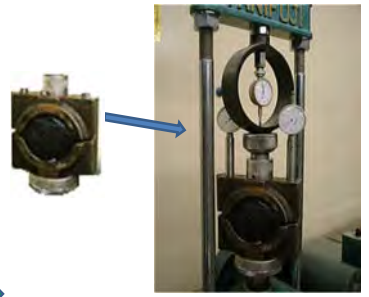
Weigh the mass of surface dry condition.

7. Marshall Test-Page1

Immerse the specimens in the thermostatic bath at 60℃±1 for 30 to 40 minutes.

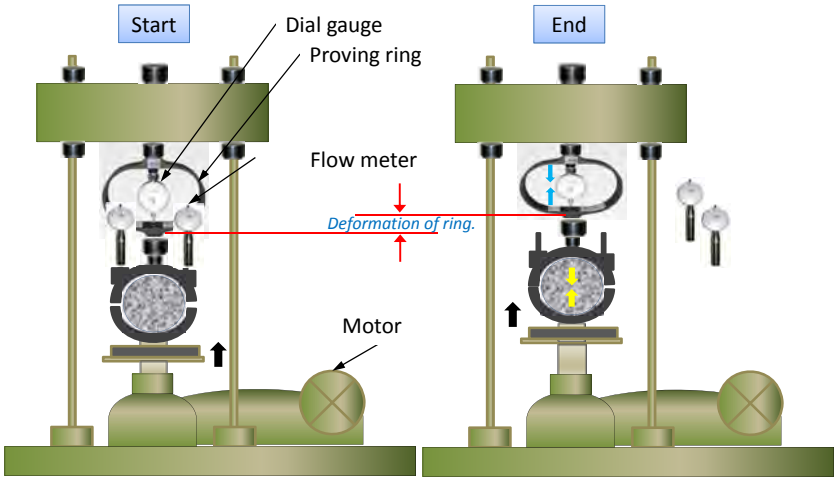
Set a **test specimen** on the testing head.

Set the **testing head** to testing machine. And set the flow meter(s)



Start the test.

7.Marshall Test-Page2



Marshall Test

1. Push the button to Start the equipment.

Cylinder of jack will constantly raise at 50±5 mm per minute.

2. Stop the equipment just when specimen has broken.

Needle of Dial gauge in ring will suddenly come down.

3-1. **Memory** the max. deformation of proving ring.(Dial gauge shows)

3-2. Remove flow meter just same timing of 2.

Flow meter should be kept by hand.

All proving ring has calibrated. All proving ring has it's own **conversion facter** and graph.

4. Read the deformation of specimen.(Flow meter shows)

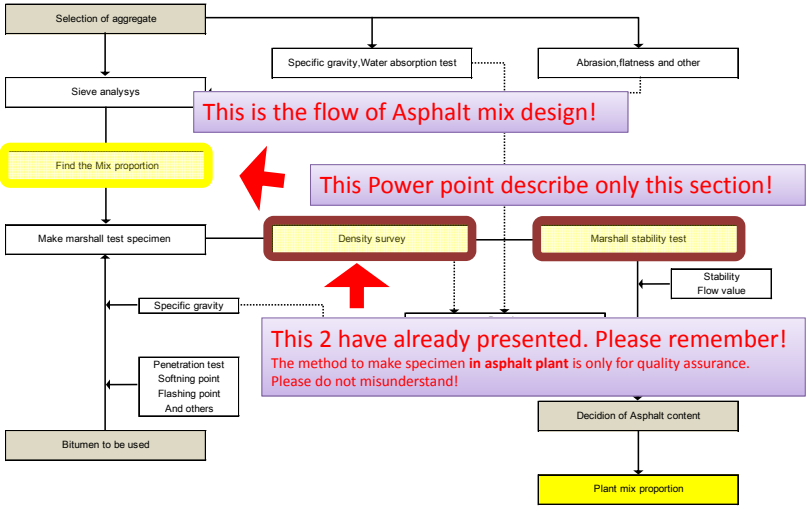
5. Record the all value in the form.

6. Calculation.

5. How to get mixing proportion

Example

FLOW OF ASPHALT MIX DESIGN



Explanation will be presented
according to the following materials

Table 5-1 Example of Sieve Result

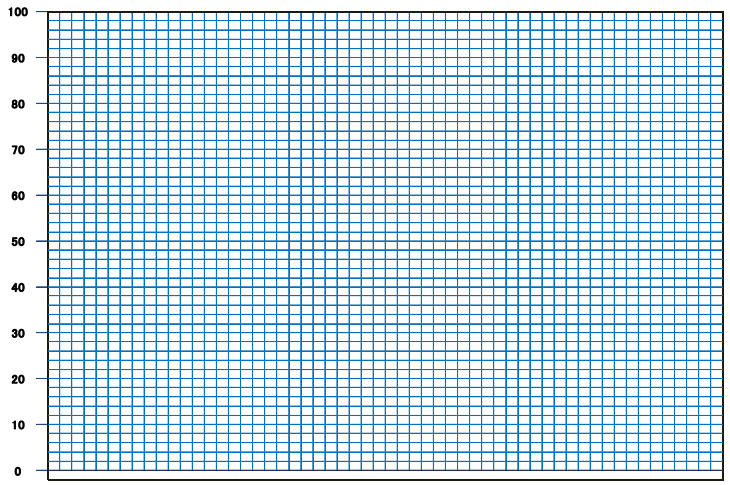
Material	Sieve size								
	25	20	13	5	2.5	0.63	0.315	0.16	0.075
20-13mm	100.0	93.5	8.0	1.4	0.3	0	0	0	0
13-5mm	100.0	100	97.2	8.6	2.1	0.8	0	0	0
5-2.5mm									
5-0mm	100.0	100	100	98.3	77.3	45.9	31.2	19.5	10.8
sand	100.0	100.0	100.0	95.1	91	76	21	10.1	2.3
Filler	100.0	100	100	100	100	99	94.1	89.5	80.3

Table 5-2 expected grading

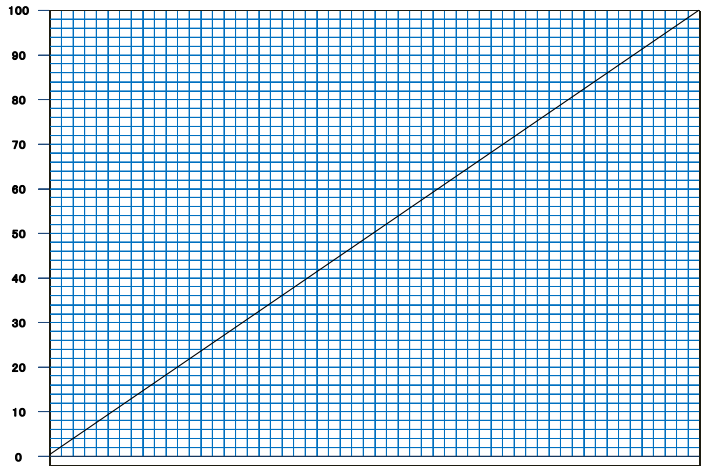
Sieve size	25	20	13	5	2.5	0.63	0.315	0.16	0.075
Combined grading	100	97.5	82.5	55	42.5	24	15.5	11	6

1 Draw the graph

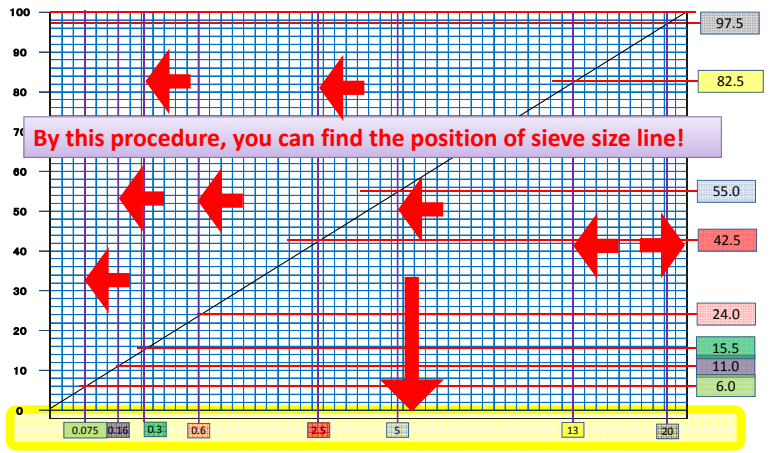
1. Draw the square on the Graph paper



2. Draw the Diagonal Line from upper light to lower left.

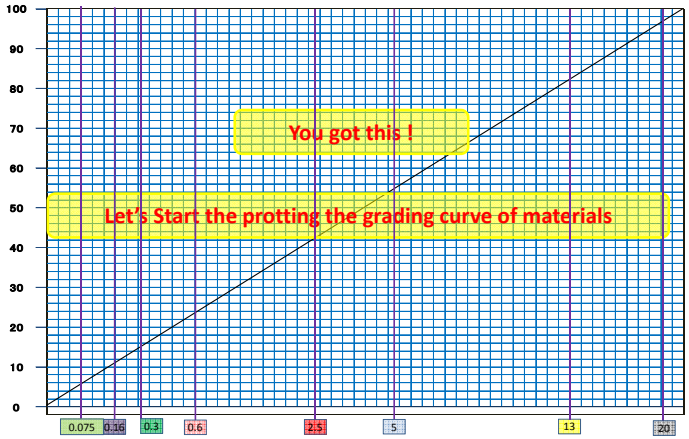


3. Find the Position of sieve size



Sieve size	25	20	13	5	2.5	0.63	0.315	0.16	0.075
Combined grading	100	97.5	82.5	55	42.5	24	15.5	11	6

4. Plot the Grading curve of aggregate, sand and filler.-1



4. Plot the Grading curve of aggregate, sand and filler.-2

This is the Sieve Result

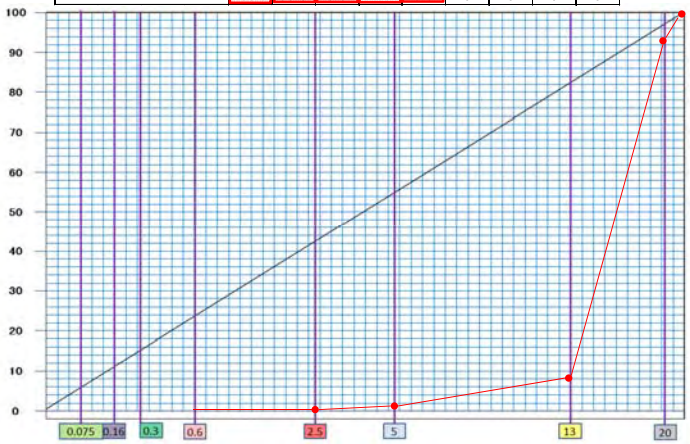
Let's start the plotting.

Material	Sieve size								
	25	20	13	5	2.5	0.63	0.315	0.16	0.075
20-13mm	100.0	93.5	8.0	1.4	0.3	0	0	0	0
13-5mm	100.0	100	97.2	8.6	2.1	0.8	0	0	0
5-2.5mm									
5-0mm	100.0	100	100	98.3	77.3	45.9	31.2	19.5	10.8
sand	100.0	100.0	100.0	95.1	91	76	21	10.1	2.3
Filler	100.0	100	100	100	100	99	94.1	89.5	80.3

4. Draw the Grading curve of aggregate, sand and filler.-3

This is the Sieve Result of 20-13mm

Material	Sieve size								
	25	20	13	5	2.5	0.63	0.315	0.16	0.075
20-13mm	100.0	93.5	8.0	1.4	0.3	0	0	0	0



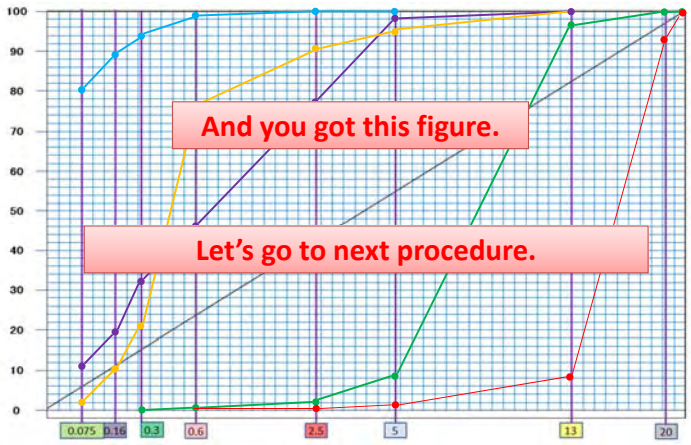
4. Draw the Grading curve of aggregate, sand and filler.-4

This is the Sieve Result of 13-05mm

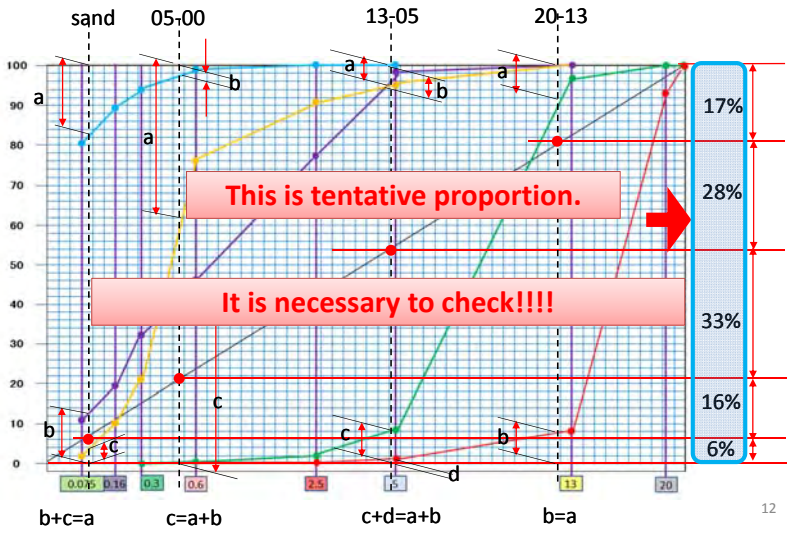
Material	Sieve size								
	25	20	13	5	2.5	0.63	0.315	0.16	0.075
13-5mm	100.0	100	97.2	8.6	2.1	0.8	0	0	0

4. Draw the Grading curve of aggregate, sand and filler.-5

Please repeat same procedure for another materials.



5. Find out the mix proportion!



6. Check the Grading.

This is the Grading of each materials!

Material	Sieve size								
	25	20	13	5	2.5	0.63	0.315	0.16	0.075
20-13mm	100.0	93.5	8.0	1.4	0.3	0	0	0	0
13-5mm	100.0	100	97.2	8.6	2.1	0.8	0	0	0
5-0mm	100.0	10							
sand	100.0	100.0	100.0	95.1	91	51.8	21	10.1	2.3
Filler	100.0	100	100	100	100	96.1	94.1	89.5	80.3

Do you remember? How to get this table?

This is the Combined grading with the proportion from plotting!

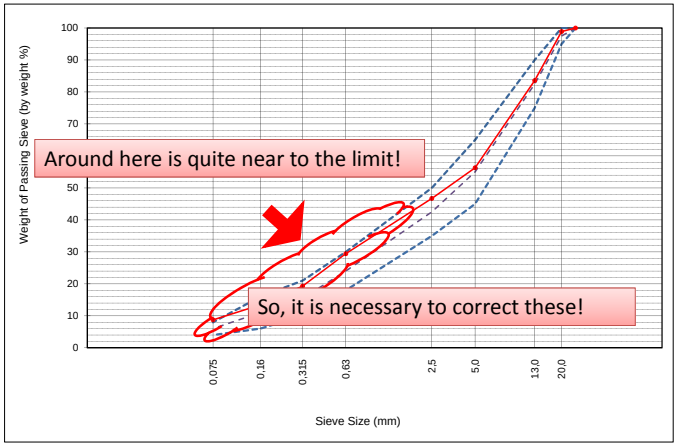
Calculating of combined grading (Center Grading)

Material	Proportion	25	20	13	5	2.5	0.63	0.315	0.16	0.075
20-13mm	17	17.0								
13-5mm	28	28.0								
5-0mm	33	33.0	33.0	33.0	32.4	25.5	15.1		.4	3.6
sand	16	16.0	16.0	16.0	15.2	14.6	8.3	3	1.6	0.4
Filler	6	6.0	6.0	6.0	6.0	6.0	5.8		5.4	4.8
Total	100									
Combined grading		100.0	98.9	83.6	56.3	46.7	29.4	19.3	13.4	8.8
Range of grading		100	95	75	45	35	18	10	6	4
		~	~	~	~	~	~	~	~	~
		100	100	90	65	50	30	21	16	8
Target passing		100.0	97.5	82.5	55.0	42.5	24.0	15.5	11.0	6.0

You shall see the grading curve of this!

No good!!

This is the combined Grading curve come from plotting mathod!



7. Adjust the proportion.

Calculating of combined grading (Center Grading)

Material	Proportion	25	20	13	5	2.5	0.63	0.315	0.16	0.075
20-13mm	17	17.0	15.9	1.4	0.2	0.1	0.0	0.0	0.0	0.0
13-5mm	28	28.0	28.0	27.2	2.4	0.6	0.2	0.0	0.0	0.0
5-0mm	33	33	33							
sand	16	16.0	16.0							
Filler	6	6.0	6.0	6.0	6.0	6.0	5.8	5.6	5.4	4.8
Total	100									
Combined grading		100.0	98.9	83.6	56.3	46.7	29.4	19.3	13.4	8.8
Range of grading		100	95	75	45	35	18	10	6	4
		~	~	~	~	~	~	~	~	~
		100	100	90	65	50	30	21	16	8
Target passing		100.0	97.5	82.5	55.0	42.5	24.0	15.5	11.0	6.0

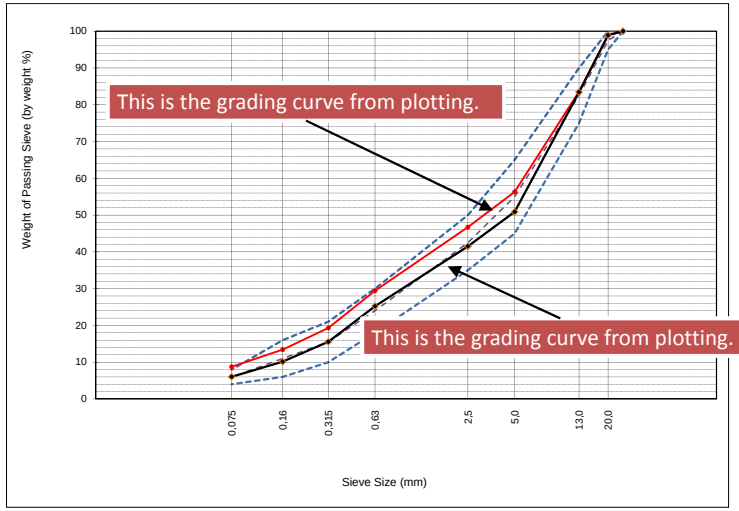
This is the proportion from plotting.

Calculating of combined grading (Corrected)

Material	Proportion	25	20	13	5	2.5	0.63	0.315	0.16	0.075
20-13mm	17	17.0	15.9	1.4	0.2	0.1	0.0	0.0	0.0	0.0
13-5mm	34	34.0	34.0	33.0	2.9	0.7	0.3	0.0	0.0	0.0
0										
5-0mm	30	30.	30.							
sand	16	16.0	16.							
Filler	3	3.0	3.0	3.0	3.0	3.0	2.9	2.8	2.7	2.4
Total	100									
Combined grading		100.0	98.9	83.4	50.9	41.5	25.2	15.5	10.2	6.0
Range of grading		100	95	75	45	35	18	10	6	4
		~	~	~	~	~	~	~	~	~
		100	100	90	65	50	30	21	16	8
Target passing		100.0	97.5	82.5	55.0	42.5	24.0	15.5	11.0	6.0

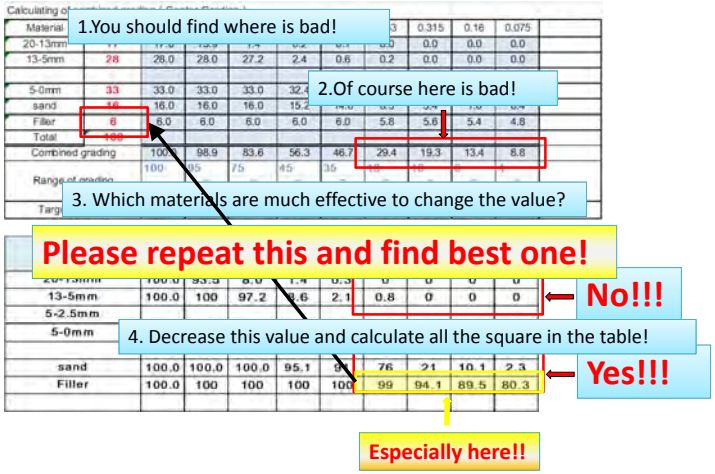
This is the proportion adjusted.

8. Check the adjusted grading.



9. How Adjust the proportion?

At first, which portion do you want to change?



10. How Adjust the proportion?

This is the final proportion!

Calculating of combined grading (Corrected)

Material	Proportion	25	20	13	5	2.5	0.63	0.315	0.16	0.075
20-13mm	17	17.0	15.9	1.4	0.2	0.1	0.0	0.0	0.0	0.0
13-5mm	34	34.0	34.0	33.0	2.9	0.7	0.3	0.0	0.0	0.0
0										
5-0mm	30	30.0	30.0	30.0	29.5	23.2	13.8	9.4	5.9	3.2
sand	16	16.0	16.0	16.0	15.2	14.6	8.3	3.4	1.6	0.4
Filler	3	3.0	3.0	3.0	3.0	3.0	2.9	2.8	2.7	2.4
Total	100									
Combined grading		100.0	98.9	83.4	50.9	41.5	25.2	15.5	10.2	6.0
Range of grading		100	95 ~ 100	75 ~ 90	45 ~ 65	35 ~ 50	18 ~ 30	10 ~ 21	6 ~ 16	4 ~ 8
Target passing		100.0	97.5	82.5	55.0	42.5	24.0	15.5	11.0	6.0

Please go to next step.

Is presented

Asphalt Mix design part-2

Find the optimum asphalt content

Proceed under the following condition.

1.Material's Characteristics are satisfactory.

2.Material's specific gravity is the following.

Material	Proportion
20-13mm	2.730
13-5mm	2.740
5-0mm	2.732
sand	2.670
Filler	2.710
Asphalt	1.030

Find the optimum asphalt content

1.Trial compaction.-1

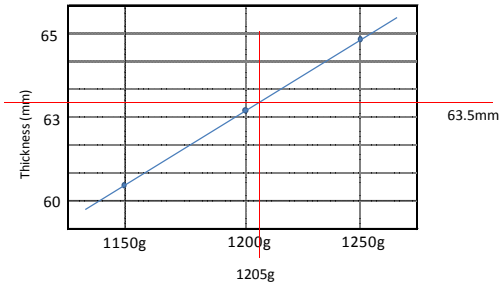
We know that about 1200g of mixture will give us the specimen which have the thickness of 63mm by experience.

Make of 3specimen by the mass of the following table.

Material	Proportion	Weight of 3 specimen		
20-13mm	17	185.7	193.8	201.9
13-5mm	34	371.5	387.6	403.8
5-0mm	30	327.8	342.0	356.3
sand	16	174.8	182.4	190.0
Filler	3	32.8	34.2	35.6
Total	100	1,092.5	1,140.0	1,187.5
Asphalt		57.5	60.0	62.5
Total		1,150.0	1,200.0	1,250.0

1.Trial compaction.-2

By the trial compaction. You can get the graph as below.



This graph shows **1205g** of materials mix will give us 63.5mm specimen.

2. Preparation of materials -1

1205g X(100-5)/100 = 1145g of aggregates, sand and filler are required for 1 specimen.

Material	Proportion	Asphalt content(%)				
		4.00%	4.50%	5.00%	5.50%	6.00%
20-13mm	17	185.4	185.4	185.4	185.4	185.4
13-5mm	34	370.8	370.8	370.8	370.8	370.8
5-0mm	30	327.1	327.1	327.1	327.1	327.1
sand	16	174.5	174.5	174.5	174.5	174.5
Filler	3	32.7	32.7	32.7	32.7	32.7
Total	100	1145	1145	1145	1145	1145
Asphalt		47.7	54.0	60.3	66.6	73.1
Total		1,192.7	1,199.0	1,205.3	1,211.6	1,218.1

This table is the required mass for 5 types of specimen which have different asphalt content.

Each type should be 3 piece to take average .

2. Preparation of materials - 2

Please prepare enough mass of each material.

Put the materials in the tray.

Put the Tray in the convection oven for through night at 110℃±.

2. Preparation of materials - 3

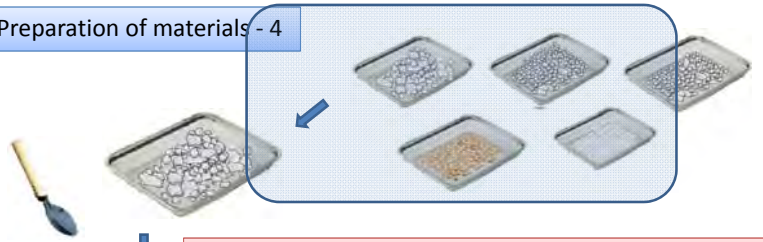
a. Take out all materials from oven.

b. Put the tray on the digital balance.

c. Adjust the reading to zero.

d. Then, start the weighing according to the weight on the table.

2. Preparation of materials - 4



a. Shift the 20-13 materials according to the mass in the table .

b. Cumulatively shift all materials in the tray.

c. Total 3 x 5 As.content =15 trays will be prepared.

2. Preparation of materials - 5

d. Heat up all of these in the oven.

3. Mixing and compaction.-1

a. Shift the weighed materials in the mixing pan.

b. Add the heated asphalt according to the table.

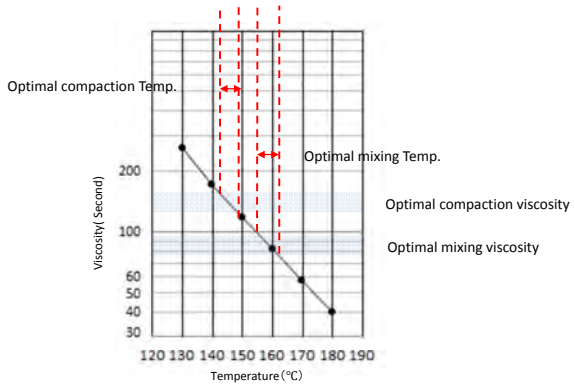
3. Mixing and compaction.-2

c. Mix the materials and asphalt enough until it get to the expected temperature.

d. Immediately after mixing, compact this mixture by the blow specified.

e. Repeat it and get 3peaces x 5 types = 15 pieces of specimen.

Mixing and compaction temperature can be obtained from “temperature – viscosity figure” like below.



Asphalt temperature-Viscosity - relation graph

3. Mixing and compaction.-3

Please open the another Power point titled Marshall Stability Test. And start from page 5 named (4.Make specimen.)

4. Optimum asphalt content

By the result of this, you can get the optimum asphalt content.

Please open another Power point named “Mix design of AC” and present from the page no.14. (Value and others are different but procedure is same)

PD-10

Sieve Analysis

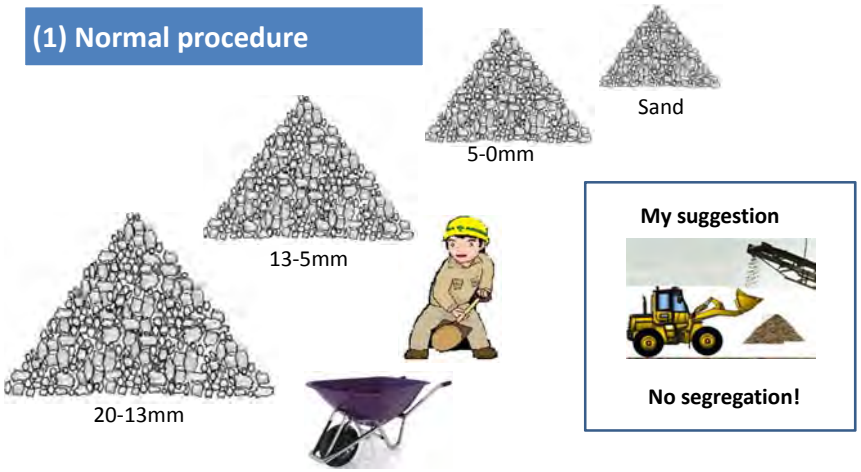
1.Sampling. -Page1

Minimum weight of the sample

Nominal Maximum Aggregate Size, mm	Minimum Weight for Test Sample, kg
9.5	1
12.5	2
19	5
25	10
37.5	15

1.Sampling.-Page2

(1) Normal procedure



My suggestion

No segregation!

2.Preparations.-Page1

Samples

Quartering device

Sieve sets

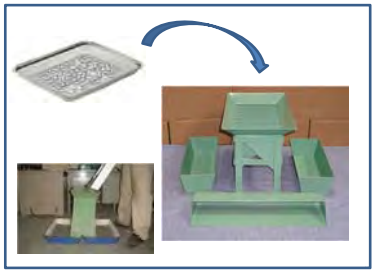
Tray

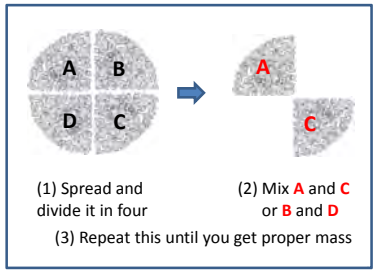
Electric balance

2.Preparations.-Page2

(1) Get the proper weight of sample

Quartering by quartering device or Quartering by manual





(1) Spread and divide it in four

(2) Mix A and C or B and D

(3) Repeat this until you get proper mass

(2) Put the sample in the oven to dry it up(110℃±)

2.Preparations.-Page2

(3).After drying, measure and record the mass of the sample

(4).Start sieving by manual for sufficient time.

We do not have sieving machine

(5). Continue sieve until the particles fall down to next sieve decrease in less than 1%.

(6).Weigh each size of particle.

(7). Record the weighing data.

How to make Stability test specimen.

Stability test.

At Asphalt plant

1.Take samples from dump track.

Tray

or

Wheel borrow

Laboratory

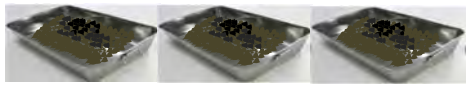
2.Weigh the sample.

1200g

*1. This mass is depend on the HMA design.

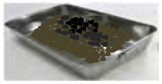
*2

1200g 1200g 1200g



+1

1200g



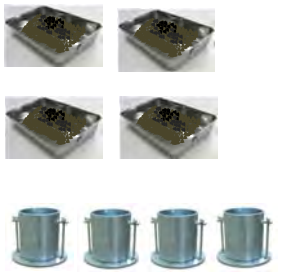
*1. We do not have any design In case of this project because we do not have test equipment.

*2. Thickness of specimen shall be near to 63.5mm.
By this mass, you can 63.5mm ±thick specimen.

3. Keep the mixture in the oven.

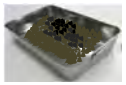
Mixture and Mold

At 145℃±5



4. Make specimen.

Take one sample and mold from the oven.



Put the paper in the mold.

Put the material in the mold.

Shape .the top of material and put the paper on the top.

5. Compaction.-(Page1)

Set the mold to the compaction machine or hand tamper.

Compact both side.

or

5. Compaction.-(Page2)

Compact both side. Number of blows are depends on specification.(**50**,65, 75both side)

We apply 50 blows both side.

How to revers?

a. Remove the top.(Collar)

b. Upside down the mold

c. Attach the collar again.

6. Preparation for Marshall Test-(Page1)

Remove the specimen from mold.

Remove the edge before check the thickness.

Check the thickness. 4 section.

Weigh the surface dry specimens in the water.

Immerse the specimens in water about 1 minute or more.

Weigh the mass of dry condition.

6. Preparation for Marshall Test-(Page2)

Take sample from water bath. Then, remove the water from surface.

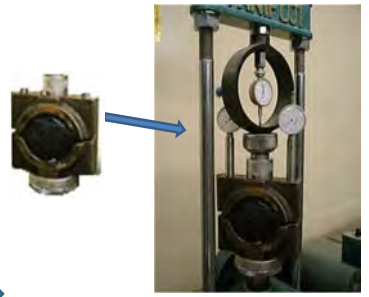
Weigh the mass of surface dry condition.

7. Marshall Test-Page1

Immerse the specimens in the thermostatic bath at 60℃±1 for 30 to 40 minutes.

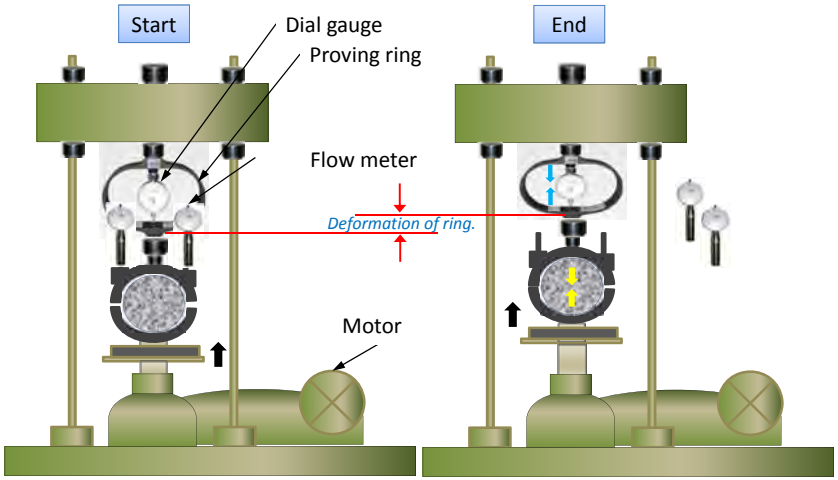
Set a **test specimen** on the testing head.

Set the **testing head** to testing machine. And set the flow meter(s)



Start the test.

7.Marshall Test-Page2



Marshall Test

1. Push the button to Start the equipment.

Cylinder of jack will constantly raise at 50±5 mm per minute.

2. Stop the equipment just when specimen has broken.

Needle of Dial gauge in ring will suddenly come down.

3-1. **Memory** the max. deformation of proving ring.(Dial gauge shows)

3-2. Remove flow meter just same timing of 2.

Flow meter should be kept by hand.

All proving ring has calibrated. All proving ring has it's own **conversion facter** and graph.

4. Read the deformation of specimen.(Flow meter shows)

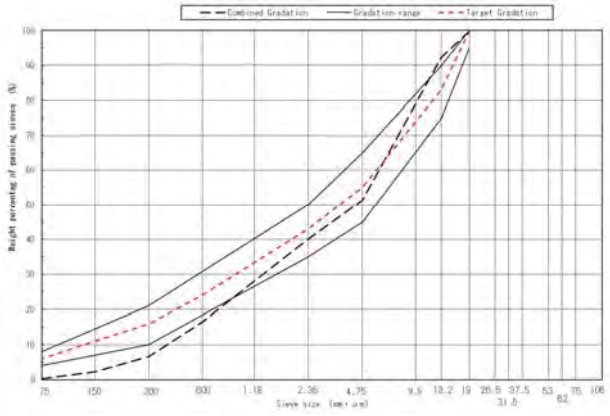
5. Record the all value in the form.

6. Calculation.

Quality Control of Asphalt Mixture By DailyData

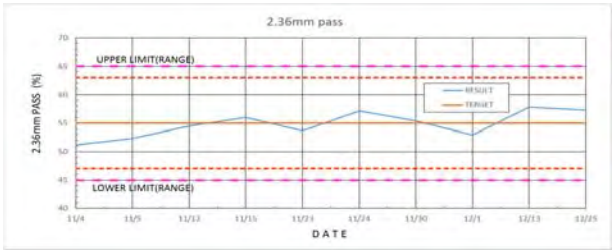
RESULT OF TEST

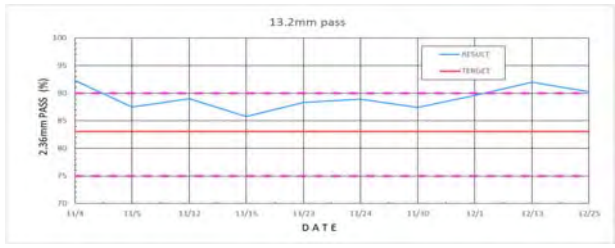
Type of material		1 1bin	2 2bin	3 3bin	4	5	6	Calculation of Combined Gradation 1bin	2bin	3bin	4	5	6	Combined Gradation	Target gradation	Gradation range
Mix proportion (%)		46.5	40.9	12.6												
Weight percentage of passing sieves (%)	Sieve size															
	53															
	37.5															
	31.5															
	26.5			100.0						12.6				100.0		
	19.0		100.0	98.8					40.9	12.4				99.8	100.0	95~100
	13.2	100.0	92.8	61.7				46.5	38.0	7.8				92.3	**83.0**	75~90
	9.5	99.7	62.5	3.3				46.4	25.6	0.4				72.4		
	4.75	98.6	13.2	0.1				45.8	5.4	0.0				51.2	**55.0**	45~65
	2.36	85.9	0.4					39.9	0.2					40.1	43.0	35~50
	1.18	65.9						30.6						30.6		
	600μm	35.5						16.5						16.5	24.0	18~30
	300	14.3						6.6						6.6	16.0	10~21
	150	4.9						2.3						2.3	11.0	6~16
	75	0.7						0.3						0.3	6.0	4~8

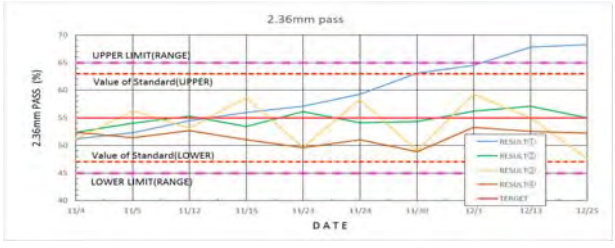


Line graph analysis

DATE	11/4	11/5	11/12	11/15	11/23	11/24	11/30	12/1	12/13	12/25
RESULT (2.36mm)	51.2	52.3	54.5	56.0	53.7	57.1	55.4	52.9	57.8	57.3
RESULT (13.2mm)	92.3	87.5	89.0	85.8	88.3	88.9	87.4	89.6	92.0	90.3

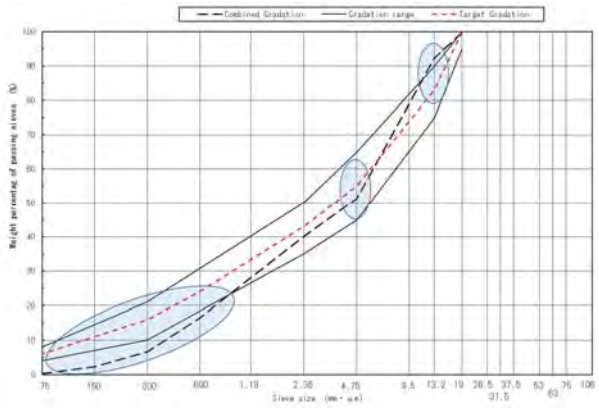






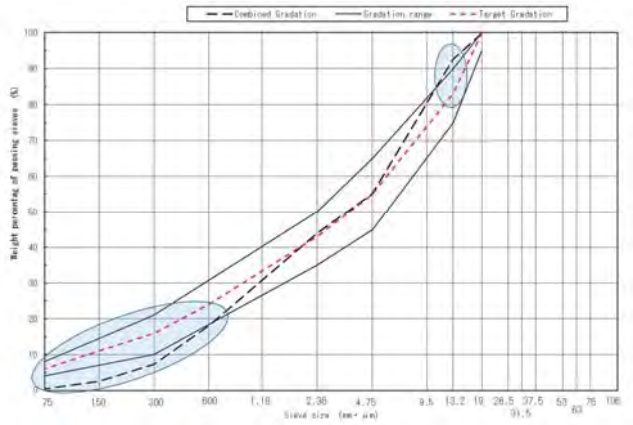
RESULT OF TEST

Type of material		1 1bin 0~5	2 2bin 5~13	3 3bin 13~20	4	5	6	Calculation of Combined Gradation 1bin	2bin	3bin	4	5	6	Combined Gradation	Target gradation	Gradation range
Mix proportion (%)		46.5	40.9	12.6												
Weight percentage of passing sieves (%)	Sieve size															
	53															
	37.5															
	31.5															
	26.5			100.0						12.6				100.0		
	19.0		100.0	98.8					40.9	12.4				99.8	100.0	95~100
	13.2	100.0	92.8	61.7				46.5	38.0	7.8				92.3	**83.0**	75~90
	9.5	99.7	62.5	3.3				46.4	25.6	0.4				72.4		
	4.75	98.6	13.2	0.1				45.8	5.4	0.0				51.2	**55.0**	45~65
	2.36	85.9	0.4					39.9	0.2					40.1	43.0	35~50
	1.18	65.9						30.6						30.6		
	600μm	35.5						16.5						16.5	24.0	18~30
	300	14.3						6.6						6.6	16.0	10~21
	150	4.9						2.3						2.3	11.0	6~16
	75	0.7						0.3						0.3	6.0	4~8



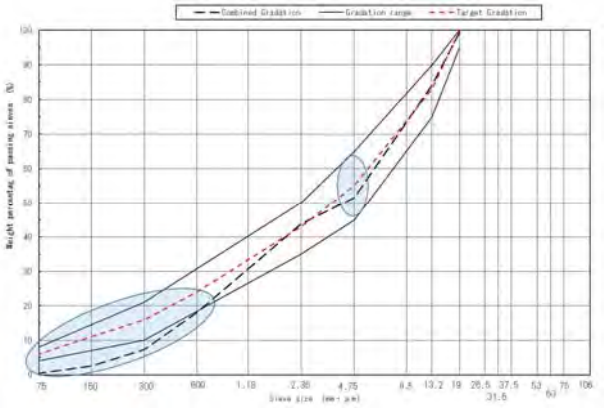
STEP1 FOR CORRECTION

Type of material	1 1bin	2 2bin	3 3bin	4	5	6	Calculation of Combined Gradation 1 1bin	2bin	3bin	4	5	6	Combined Gradation	Target gradation	Gradation range
Mix proportion (%)	51.0	36.4	12.6		100.0										
Weight percentage of passing sieves (%) Sieve size															
53															
37.5															
31.5															
26.5			100.0						12.6				100.0		
19.0		100.0	98.8					36.4	12.4				99.8	100.0	95~100
13.2	100.0	92.8	61.7				51.0	33.8	7.8				92.6	83.0	75~90
9.5	99.7	62.5	3.3				50.8	22.8	0.4				74.0		
4.75	98.6	13.2	0.1				50.3	4.8	0.0				55.1	55.0	45~65
2.36	85.9	0.4					43.8	0.1					43.9	43.0	35~50
1.18	65.9						33.6						33.6		
600μm	35.5						18.1						18.1	24.0	18~30
300	14.3						7.3						7.3	16.0	10~21
150	4.9						2.5						2.5	11.0	6~16
75	0.7						0.4						0.4	6.0	4~8



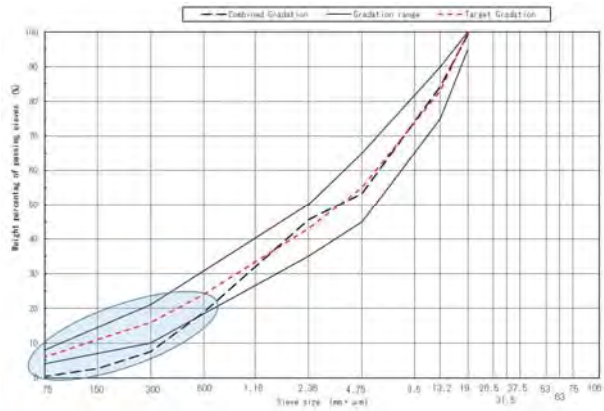
STEP2 FOR CORRECTION

Type of material	1 1bin	2 2bin	3 3bin	4	5	6	Calculation of Combined Gradation 1 1bin	2bin	3bin	4	5	6	Combined Gradation	Target gradation	Gradation range
Mix proportion (%)	51.0	9.0	40.0		100.0										
Weight percentage of passing sieves (%) Sieve size															
53															
37.5															
31.5															
26.5			100.0						40.0				100.0		
19.0		100.0	98.8					9.0	39.5				99.5	100.0	95~100
13.2	100.0	92.8	61.7				51.0	8.4	24.7				84.1	83.0	75~90
9.5	99.7	62.5	3.3				50.8	5.6	1.3				57.7		
4.75	98.6	13.2	0.1				50.3	1.2	0.0				51.5	55.0	45~65
2.36	85.9	0.4					43.8	0.0					43.8	43.0	35~50
1.18	65.9						33.6						33.6		
600μm	35.5						18.1						18.1	24.0	18~30
300	14.3						7.3						7.3	16.0	10~21
150	4.9						2.5						2.5	11.0	6~16
75	0.7						0.4						0.4	6.0	4~8



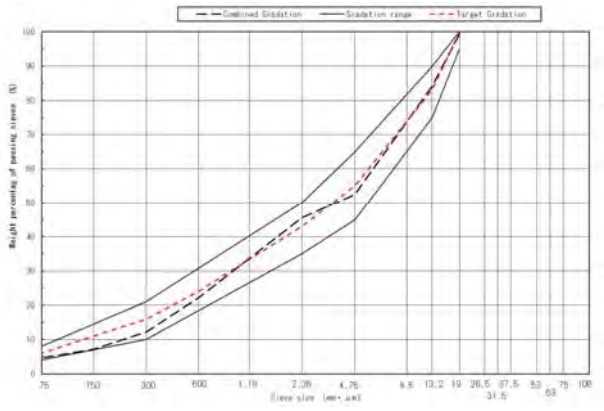
STEP3 FOR CORRECTION

Type of material	1 1bin	2 2bin	3 3bin	4	5	6	Calculation of Combined Gradation 1 1bin	2bin	3bin	4	5	6	Combined Gradation	Target gradation	Gradation range
Mix proportion (%)	53.0	7.0	40.0		100.0										
Weight percentage of passing sieves (%) Sieve size															
53															
37.5															
31.5															
26.5			100.0						40.0				100.0		
19.0		100.0	98.8					7.0	39.5				99.5	100.0	95~100
13.2	100.0	92.8	61.7				53.0	6.6	24.7				84.2	83.0	75~90
9.5	99.7	62.5	3.3				52.8	4.4	1.3				58.5		
4.75	98.6	13.2	0.1				52.3	0.9	0.0				53.2	55.0	45~65
2.36	85.9	0.4					45.5	0.0					45.5	43.0	35~50
1.18	65.9						34.9						34.9		
600μm	35.5						18.8						18.8	24.0	18~30
300	14.3						7.6						7.6	16.0	10~21
150	4.9						2.6						2.6	11.0	6~16
75	0.7						0.4						0.4	6.0	4~8



(STEP4 FOR CORRECTION)

Type of material	1 1bin	2 2bin	3 3bin	4 Filler	5	6	Calculation of Combined Gradation 1 1bin	2bin	3bin	4	5	6	Combined Gradation	Target gradation	Gradation range
Mix proportion (%)	46.0	8.0	40.0	6.0	100.0										
Weight percentage of passing sieves (%) Sieve size															
53															
37.5															
31.5															
26.5			100.0						40.0				100.0		
19.0		100.0	98.8					8.0	39.5				99.5	100.0	95~100
13.2	100.0	92.8	61.7	100.0			46.0	7.4	24.7	6.0			84.1	83.0	75~90
9.5	99.7	62.5	3.3				45.9	5.0	1.3	6.0			58.2		
4.75	98.6	13.2	0.1	100.0			46.4	1.1	0.0	6.0			52.5	55.0	45~65
2.36	85.9	0.4					39.5	0.0		6.0			45.5	43.0	35~50
1.18	65.9			100.0			30.3			6.0			36.3		
600μm	35.5			99.0			16.3			5.9			22.2	24.0	18~30
300	14.3			94.1			6.6			5.6			12.2	16.0	10~21
150	4.9			81.0			2.3			4.9			7.2	11.0	6~16
75	0.7			72.9			0.3			4.4			4.7	6.0	4~8



PD-11

Draft Specifications

for

New Application of Kumsangir Origin Bitumen for Road Repair (25 June 2014)

The specifications have been prepared to mix MG70-130 Bitumen produced by Salosa in a hot mix asphalt plant to produce a cold mixture to be used by SEHMs for road repair purpose,

1． Aggregate Mixture

(1) For the aggregate mixture, comply with specification requirements used for the hot mix asphalt.

(2) The aggregate particle size is subject to manufacturing process of each crushing plant. The aggregate formulation shall be in compliance with the applicable GOST standards. However, in case the aggregate formulation does not comply with the said standards, the aggregate formulation in compliance with the coarse-graded (20mm) asphalt concrete or dense-graded (13mm) asphalt concrete, of Japan standards shall be accepted.

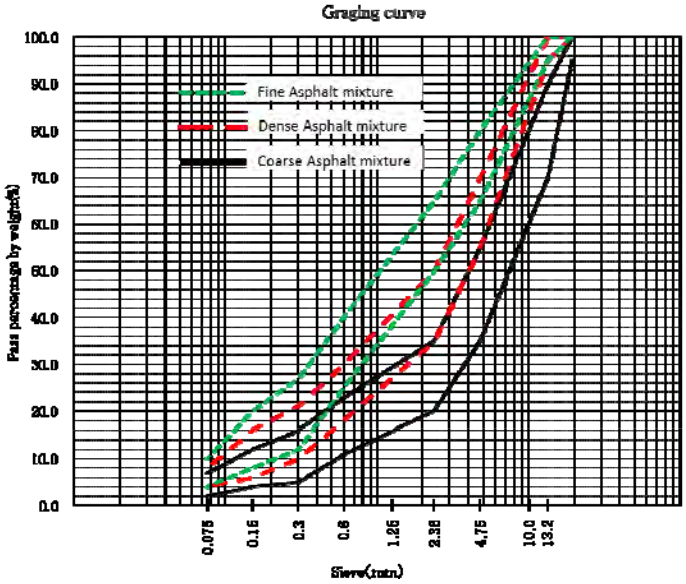
(3) The asphalt content shall be determeind upon determination of the aggregate mixture as indicated in (1) and (2). Use the method for hot mix asphalt, then increase the asphalt content by 0.1%.

【Explanation】

(1) In comparison, the Kumsangir cold mixture only differs from the hot mix asphalt in the property of the binder in use. Therefore, for aggregate mixture, specification requirements for the hot mix asphalt shall be adopted.

(2) As crushing plants have not commenced operation and the aggregate particle size is subject to manufacturing process of each crushing plant, applicabilty of GOST standards for aggregate formulation can not be determined at this stage. Therefore, adoption of coarse graded (20mm) asphalt concrete or dense graded (13mm) asphalt concrete of Japan is considered. The following is the aggregate formulation curve for coarse-graded (20mm) asphalt and dense-graded (13mm) asphalt concrete typically used in Japan.

Mixture of standard of Japan					
(mm)	Coarse asphalt mixture(20)	Dense asphalt mixture(20)	Dense asphalt mixture(13)	Fine asphalt mixture(13)	Dense gap asphalt mixture
19.0	95-100	95-100	100	100	100
13.2	70-90	75-90	95-100	95-100	95-100
4.75	35-55	45-65	55-70	65-80	35-55
2.36	20-35	35-50	35-50	50-65	30-45
0.6	11-23	18-30	18-30	25-40	20-40
0.3	5-16	10-21	10-21	12-27	15-30
0.15	4-12	6-16	6-16	8-20	5-15
0.075	2-7	4-8	4-8	4-10	4-10



(3) Upon determination of the aggregate formulation, it is necessary to set the optimum asphalt content. As scientific evaluation of a cutback asphalt such as MG70-130 bitumen produced by Salosa is most difficult. It is recommended to determine the asphalt content by referring to the hot mix mixture of the same formulation and increasing the content by 0.1% from the center of the common range.

2. Production Method

(1) The asphalt heating temperature shall be managed so as not to exceed 100 ℃ or more.
(2) The aggregate heating temperature shall be set at a target level of 100 ℃.

【Explanation】

(1) MG70-130 can ensure viscosity at about 90 ℃. In addition, since low flash point is the typical property of a cut-back asphalt, it was decided not to exceed 100 ℃.

(2) To ensure mixing and to remove moisture in the aggregate, aggregate temperature is set at the target level of 100 ℃.

3. Notes on Use

(1) If heavy vehicle traffic volume of 100 vehicles / day or more is expected, this cold mixture shall not be used.

【Explanation】

(1) The mixture proposed has a low stability valus right after production although there is a tendency to increase stability with time. If used right after production on a road with heavy traffic, there maybe damage caused to the repair. The value of 100 vehicles / day or less has been set as a tentative value until suffcient data is available.

New Application of Kumsangir Bitumen for Road Repair

1. Purpose

① It is used in large quantities as a binder for the current cold asphalt mixture.

Table 1 The amount of cold asphalt mixture (2013)

	GISSAR SETM	①COLD AC (t/year)
1	VAKHDAT SEHM	2,400
2	VARZOB SEHM	270
3	RUDAKI SEHM	4,200
4	SHAKHNNAV SEHM	1,480
5	GISSAR SEHM	1,600
6	NUREK SEHM	750
7	ROGUN SEHM	300
8	TORSUNZADE SEHM	2,500
9	FAYZABAD SEHM	180
	Total	**13,680**

	KURGANTYUBE SETM	①COLD AC (t/year)
1	BOKHTAR SEHM	1,200
2	SHAKHRITUZ SEHM	680
3	PYANDZH SEHM	610
4	KUBODIYON SEHM	380
5	DZHAMI SEHM	1,800
6	RUMI SEHM	1,000
7	VAKHSH SEHM	1,200
8	SARBAND SEHM	280
9	KHUSRAV SEHM	180
10	KUMSANGIR SEHM	1,000
11	YAVAN SEHM	1,500
12	DZHILIKUL SEHM	600
13	KHUROSON SEHM	260
	Total	**10,690**

② Use as asphalt mixture is desired, because of its own domestic asphalt.

③ Use as a cold asphalt are less problems with filling of the pothole, but when used as paving, improve the quality of the mixture is desired.

④ By mixing produced by the donor asphalt plant, quality improvement can be expected.

2. Problems in the use of the current situation

① At present, because the cold asphalt is produced in large quantities, you are using it to store long-term (1 month or more), handling is poor and cured.

② The properties of the Kumsangir asphalt, because it has been cut back in oil, even if the properties of the asphalt test, comparison is impossible.

③ Each SEHM use different type of aggregate causing non consistency of mixture.

④ Due to the long-term storage, handling is poor, quality of construction is also deteriorated.

3. Benefits; Production of asphalt plant, delivered to each SEHM by dump truck

① For the production of cold mix asphalt plant, the quality can be ensured.

② By delivery to each SEHM short-term storage component, deterioration of quality is small.

③ When used in the SEHM, because the handling is ensured, the quality of the construction can be secured.

④ Similar to the hot mixture, we can be applied by asphalt finisher, road roller, and tire roller.

⑤ Hot mixture in general, is affected by the quality due to temperature drop delivery time is long, cold asphalt does not affect the construction carrying some time is long.

4. Review method

From comparison of the properties of the asphalt test is difficult, I is evaluated by comparison of the mixture.

If Kumsangiru asphalt is cut-back asphalt, in the following test, that stability, flow value will change with age is expected. However, the rate of this change will vary in age, by the nature of the oil of the cut-back. This test is to compare the properties of the asphalt mixture.

The blending of the mixture, since there is time constraints, is carried out in the tentative formulation as follows.

（1）Asphalt content and aggregate combination

aggregate	S15-5		65%
	S5-0		16%
	W5-0	（sand）	16%
	F	(cement）	3%
Asphalt			5.2%（tentative combination）

Material

aggregate S15-5

aggregate S5-0

W5-0(sand)

Originally, the implementation of the test formulation is desired, but in terms of comparing the mixing properties like unavoidable. However, it should be carried out sieve test of the aggregate and sand being used.

（2）Method

① We will prepare a Marshall specimens at 160 ℃ and 140 ℃ and 120 ℃ the aggregate temperature. And conducted a Marshall test after two months and one month later and after 7 days and one day after the specimen was allowed to stand in a room, to confirm the change stability, the flow value.

② To confirm the basic properties, and carried out in the Marshall test Russian asphalt.

（3）Procedure

① Kumsangiru asphalt

・Marshall 12 specimens produced in 120 ℃ aggregate temperature
(After one day, after 7 days, one month later, two months later)

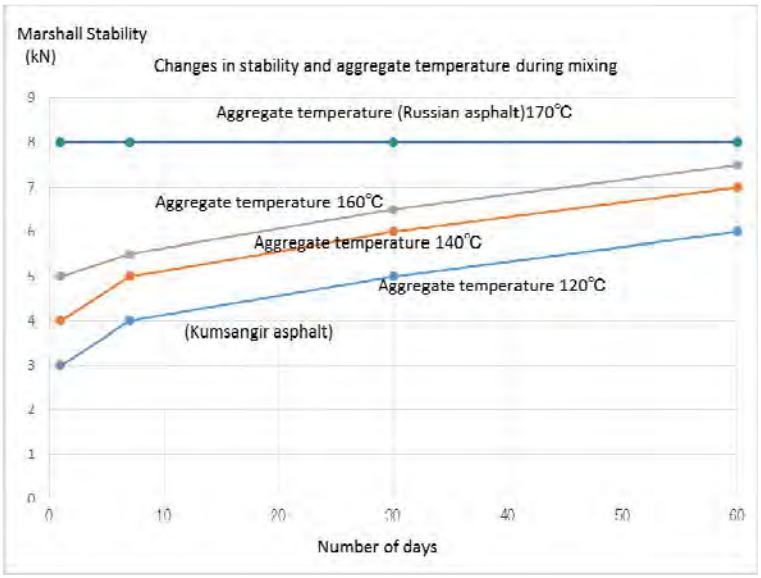
・Marshall 12 specimens produced in 140 ℃ aggregate temperature
(After one day, after 7 days, one month later, two months later)

・Marshall 12 specimens produced in 160 ℃ aggregate temperature
(After one day, after 7 days, one month later, two months later)

② Russian asphalt(60/90)

・Marshall 12 specimens produced in 170 ℃ aggregate temperature
(After one day, after 7 days, one month later, two months later)

Figure estimated



5． Testing and evaluation results

(1) Test situation

Aggregate heating

Asphalt mixer

Asphalt mixture

Specimens prepared

Marshall Tampa

Marshall specimens

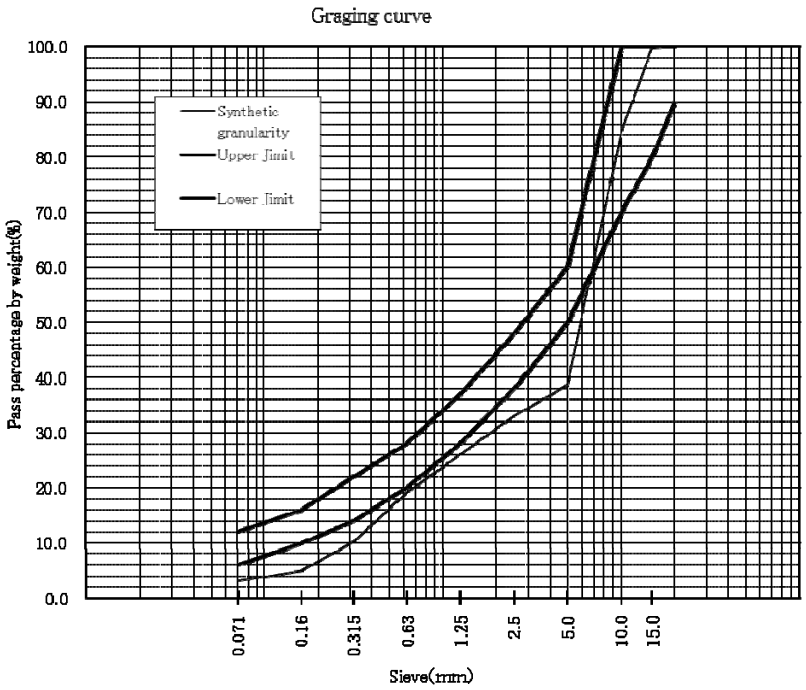
Marshall test

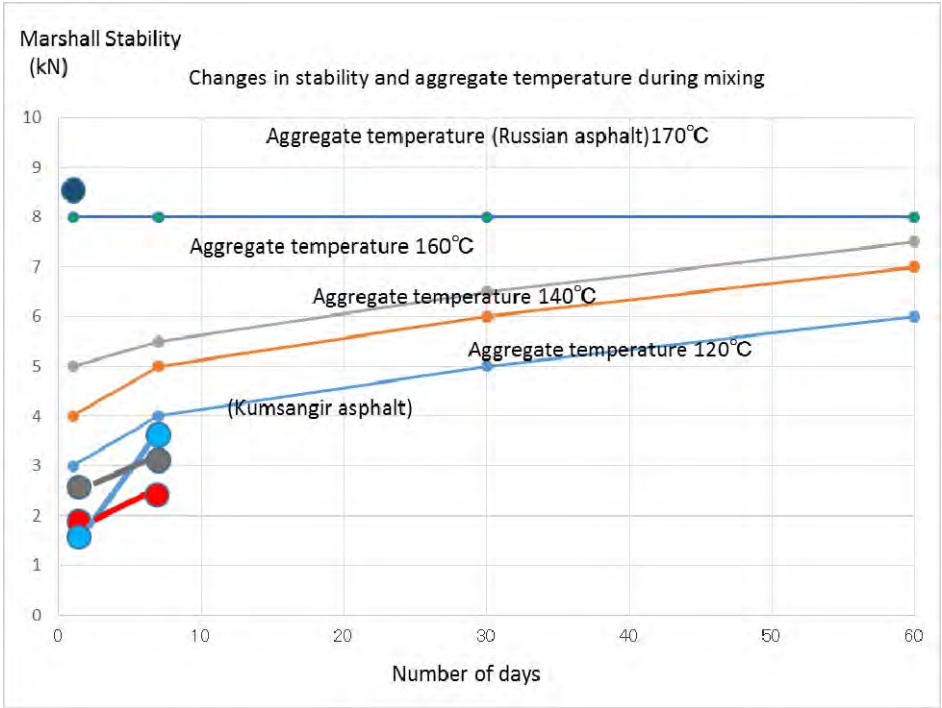
(2) Result

① Gradation

The gradation of the aggregates is shown below.

Standard is “Dense type of GOST9128-2009; Continues graded”.





(3) Evaluation

① The blending granularity, in the gap, is out of the grain size, but because there is 8kN stability of the mixture using the Russian asphalt, it is acceptable as asphalt mixture.

② The test is the same aggregate formulation, the difference in stability is the difference of the asphalt.

③ The asphalt of Kumsangir production, stability is increased with age. This can be determined as a result of oil in the cutback has transpired.

④ On the other hand, poor stability of the initial shows the goodness of handling. During this period, it is considered that a period can be constructed by securing quality.

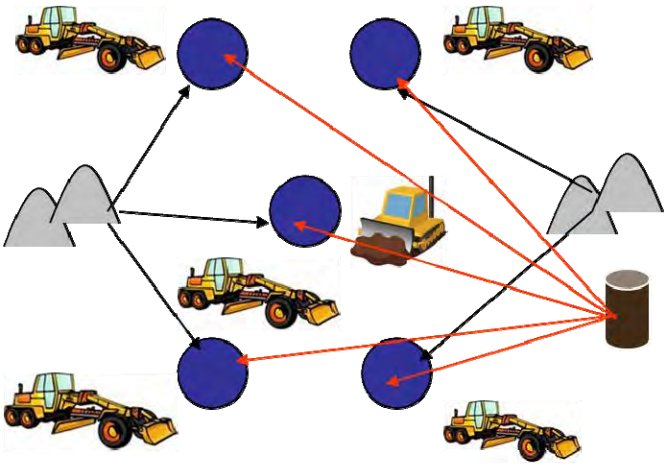
⑤ It is believed that the asphalt mixture can be used, by reviewing the application. From test data after 60 days, I will be a comprehensive evaluation.

6. Operation of cold asphalt

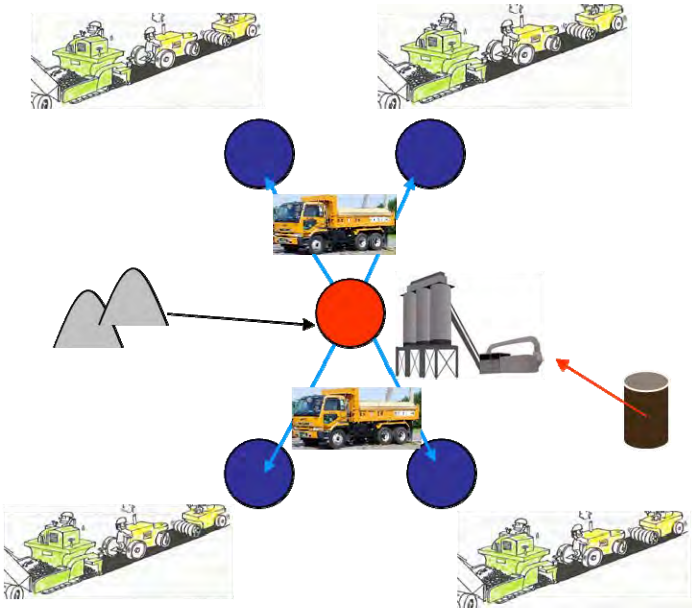
（1）Centralized production of asphalt plant

Aggregate produced by crushing plant near the asphalt plant. Using this, cold asphalt mixture are produced in asphalt plant. And transported to each SEHM by dump truck, cold asphalt mixture produced uses. When performing pavement repairs to large scale, such as the overlay, and construction using asphalt finisher, road rollers, tire rollers. On the other hand, in the case of repair of small scale such as pot holes, it is possible to stock SEHM in the order of 1 cars dump truck, and use of conventional. In this case, I used up in 2-4 weeks handling is poor. It is desirable to replenish new mixture frequently.

Current operations



The new production



（2）Increased costs in the manufacture of asphalt plant

Mixing produced by the asphalt plant, not the workload in each SEHM, and can measure the uniformity of the formulation. However, the fuel costs for heating the aggregate, and cost of transporting the mixture is added from the conventional manufacturing.

Then, the amount of cold asphalt in each SEHM of 2013, and are shown a list of estimates of fuel costs when transporting to each SEHM from the new plant.

However, as personnel of SEHM to use the dump truck, is not calculated the rent of the dump truck, the labor costs of the driver to transport.

Estimates of fuel costs for transportation

		①COLD AC (t/year)	Straight-line distance (km)	distance (km)	Round-trip distance (km)	Fuel consumption (L)	Fuel cost (TJS)	②Fuel costs per mixture of 1t (TJS)	The total amount of mixture ①×② (TJS)
GISSAR SETM									
1	VAKHDAT SEHM	2,400	44	66	132	33.0	182	9.1	21,780
2	VARZOB SEHM	270	48	72	144	36.0	198	9.9	2,673
3	RUDAKI SEHM	4,200	21	32	63	15.8	87	4.3	18,191
4	SHAKHNNAV SEHM	1,480	23	35	69	17.3	95	4.7	7,021
5	GISSAR SEHM	1,600	1	2	3	0.8	4	0.2	330
6	NUREK SEHM	750	83	125	249	62.3	342	17.1	12,839
7	ROGUN SEHM	300	119	179	357	89.3	491	24.5	7,363
8	TORSUNZADE SEHM	2,500	35	53	105	26.3	144	7.2	18,047
9	FAYZABAD SEHM	180	85	128	255	63.8	351	17.5	3,156
	Total	**13,680**							**91,400**
KURGANTYUBE SETM									
1	BOKHTAR SEHM	1,200	54	81	162	40.5	223	11.1	13,365
2	SHAKHRITUZ SEHM	680	38	57	114	28.5	157	7.8	5,330
3	PYANDZH SEHM	610	63	95	189	47.3	260	13.0	7,926
4	KUBODIYON SEHM	380	23	35	69	17.3	95	4.7	1,803
5	DZHAMI SEHM	1,800	77	116	231	57.8	318	15.9	28,586
6	RUMI SEHM	1,000	35	53	105	26.3	144	7.2	7,219
7	VAKHSH SEHM	1,200	58	87	174	43.5	239	12.0	14,355
8	SARBAND SEHM	280	71	107	213	53.3	293	14.6	4,100
9	KHUSRAV SEHM	180	43	65	129	32.3	177	8.9	1,596
10	KUMSANGIR SEHM	1,000	19	29	57	14.3	78	3.9	3,919
11	YAVAN SEHM	1,500	124	186	372	93.0	512	25.6	38,363
12	DZHILIKUL SEHM	600	1	2	3	0.8	4	0.2	124
13	KHUROSON SEHM	260	102	153	306	76.5	421	21.0	5,470
	Total	**10,690**							**132,155**
				1.5 times the straight-line distance		4km/L	TJS5.5/1L	Assumed to 20t / 1 loading units	

If we produce a new plant the cold asphalt, transport and manufacturing a mixture of the same level as last year, Fuel cost is TJS132,155.- in KURGANTYUBE SETM and TJS91,400.- in GISSAR SETM.

Technical Study on Kumsangir Bitumen for Pavement Repair

1. Purpose

① It is used in large quantities as a binder for the current cold asphalt mixture.

Table 1 The amount of cold asphalt mixture(2013)

	GISSAR SETM	①COLD AC (t/year)
1	VAKHDAT SEHM	2,400
2	VARZOB SEHM	270
3	RUDAKI SEHM	4,200
4	SHAKHNNAV SEHM	1,480
5	GISSAR SEHM	1,600
6	NUREK SEHM	750
7	ROGUN SEHM	300
8	TORSUNZADE SEHM	2,500
9	FAYZABAD SEHM	180
	Total	**13,680**

	KURGANTYUBE SETM	①COLD AC (t/year)
1	BOKHTAR SEHM	1,200
2	SHAKHRITUZ SEHM	680
3	PYANDZH SEHM	610
4	KUBODIYON SEHM	380
5	DZHAMI SEHM	1,800
6	RUMI SEHM	1,000
7	VAKHSH SEHM	1,200
8	SARBAND SEHM	280
9	KHUSRAV SEHM	180
10	KUMSANGIR SEHM	1,000
11	YAVAN SEHM	1,500
12	DZHILIKUL SEHM	600
13	KHUROSON SEHM	260
	Total	**10,690**

② Use as asphalt mixture is desired, because of its own domestic asphalt.

③ Use as a cold asphalt are less problems with filling of the pothole, but when used as paving, improve the quality of the mixture is desired.

④ By mixing produced by the donor asphalt plant, quality improvement can be expected.

2. Problems in the use of the current situation

① At present, because the cold asphalt is produced in large quantities, you are using it to store long-term (1 month or more), handling is poor and cured.

② The properties of the Kumsangir asphalt, because it has been cut back in oil, even if the properties of the asphalt test, comparison is impossible.

③ Each SEHM use different type of aggregate causing non consistency of mixture.

④ Due to the long-term storage, handling is poor, quality of construction is also deteriorated.

3. Benefits; Production of asphalt plant, delivered to each SEHM by dump truck

 For the production of cold mix asphalt plant, the quality can be ensured.

 By delivery to each SEHM short-term storage component, deterioration of quality is small.

- When used in the SEHM, because the handling is ensured, the quality of the construction can be secured.
- Similar to the hot mixture, we can be applied by asphalt finisher, road roller, and tire roller.
- Hot mixture in general, is affected by the quality due to temperature drop delivery time is long, cold asphalt does not affect the construction carrying some time is long.

4. Review method

From comparison of the properties of the asphalt test is difficult, I is evaluated by comparison of the mixture.

If Kumsangiru asphalt is cut-back asphalt, in the following test, that stability, flow value will change with age is expected. However, the rate of this change will vary in age, by the nature of the oil of the cut-back. This test is to compare the properties of the asphalt mixture.

The blending of the mixture, since there is time constraints, is carried out in the tentative formulation as follows.

（1）Asphalt content and aggregate combination

aggregate	S15-5		65%
	S5-0		16%
	W5-0	（sand）	16%
	F	(cement）	3%
Asphalt*			5.2%（tentative combination）

* 1)Asphalt from Kumsangir MG30-170

2)Russian bitumen BND 60-90 are used for the laboratory test

Material

aggregate S15-5

aggregate S5-0

W5-0(sand)

Originally, the implementation of the test formulation is desired, but in terms of comparing the mixing properties like unavoidable. However, it should be carried out sieve test of the aggregate and sand being used.

（2）Method

① We will prepare a Marshall specimens at 160 ℃ and 140 ℃ and 120 ℃ the aggregate temperature. And conducted a Marshall test after two months and one month later and after 7 days and one day after the specimen was allowed to stand in a room, to confirm the change stability, the flow value.

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 Kumsangiru asphalt

・Marshall 12 specimens produced in 120 ℃ aggregate temperature
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 Russian asphalt(60/90)

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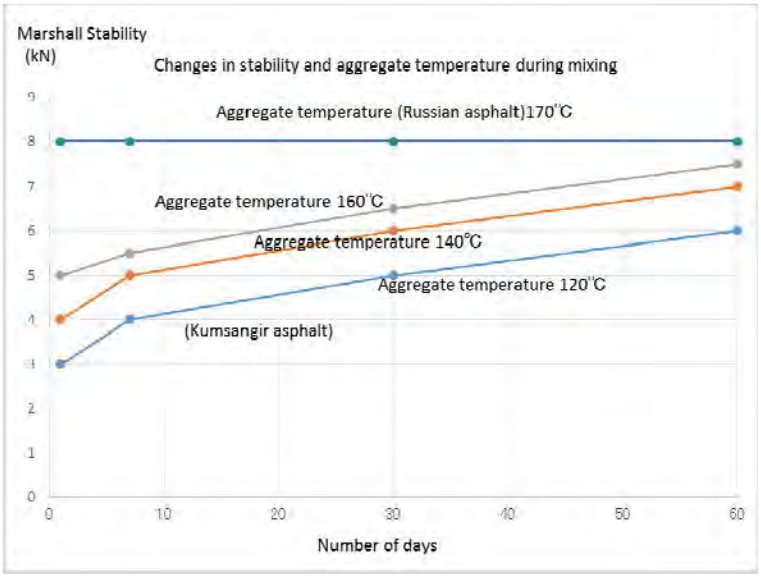
(After one day, after 7 days, one month later, two months later)

Figure (estimated before laboratory test)



5. Testing and evaluation results

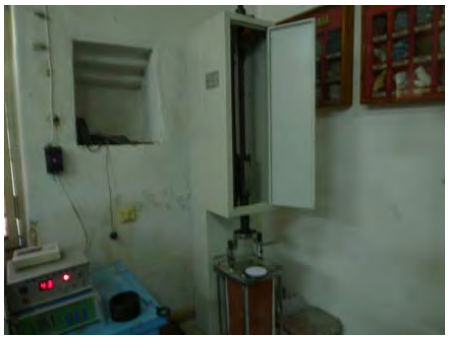
(1) Test situation

Aggregate heating

Asphalt mixer

Asphalt mixture

Specimens prepared



Marshall Tampa

Marshall specimens

Marshall test

(2) Result

Gradation

The gradation of the aggregates is shown below.

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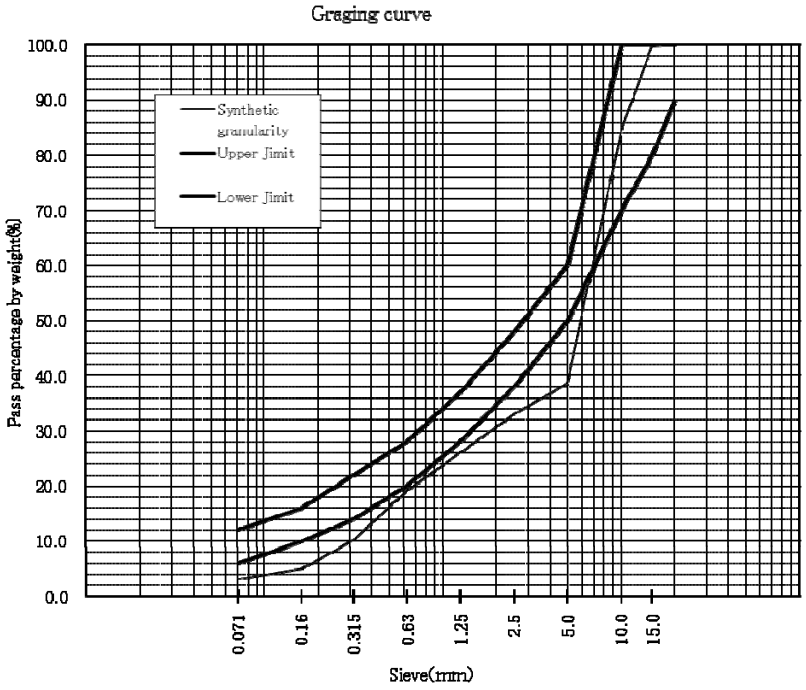

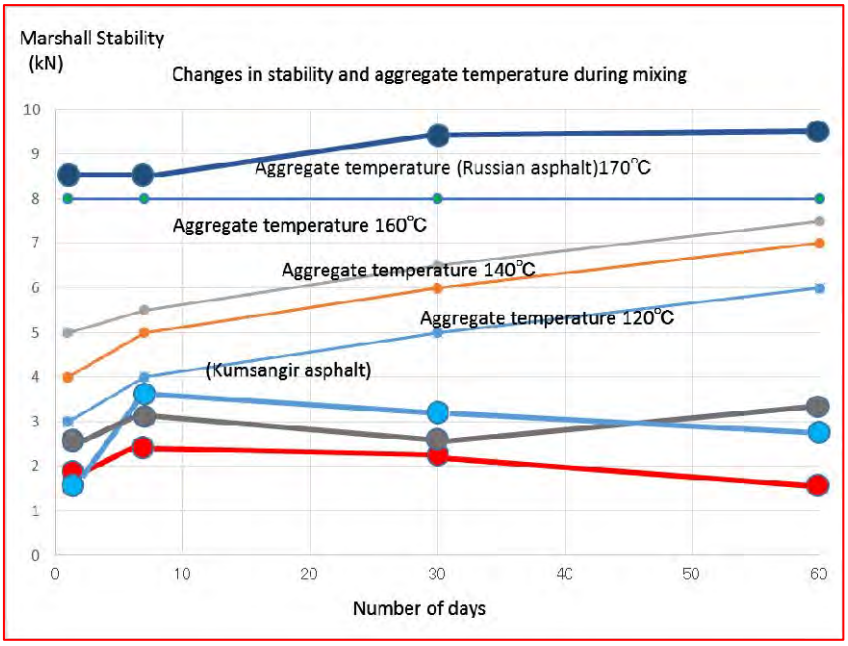

(3) Findings

- The results of the test on Russian asphalt achieved the anticipated Marshall stability of 8kN, which is perfectly acceptable for use as an asphalt concrete.
- The stability of Kumsangir test stays low even in 60 days test result. This is because of oil contents in the products. The transpire speed of such oil seems slow and caused low stability.
- The Experts team believes that the lower than anticipated Marshall stability result on Kumsangir asphalt is related to slow transpiring speed of oil contents in the product. However, the Marshall stability result achieved indicates that the product is acceptable for low volume roads, but not for heavy loaded roads.
- Better stability is expected by removing contaminated oil at crude refining.

(3) Challenges

- Understanding the Cure Period by Trials
  By conducting trials, the cure period required for the product can be ascertained.
- Optimizing the Use of Favorable Weather Conditions
  By understanding the low Marshall stability at the initial stage of the product, trials should be performed in October to November to utilize the temperature condition during the repair work and the ensuing period in winter.
- Understanding the Applicable Locations
  Upon conducting such trials, application to heavy loaded roads, low volume roads and other road conditions may be considered or rejected as the case maybe.
- Owing to the nature and the way of extraction of the Kumsangir asphalt, the product possesses a critical demerit of low Marshall stability at the initial stage. Hence, the following may be pursued.
  1)Removal of cut-back portion during the extraction and refining stage.
  (to be undertaken by the manufacturer)
  2)Development of the material acceptable for use in hot-mix asphalt product.
  (to be undertaken by the manufacturer)

6. Operation of cold asphalt

(1) Centralized production of asphalt plant

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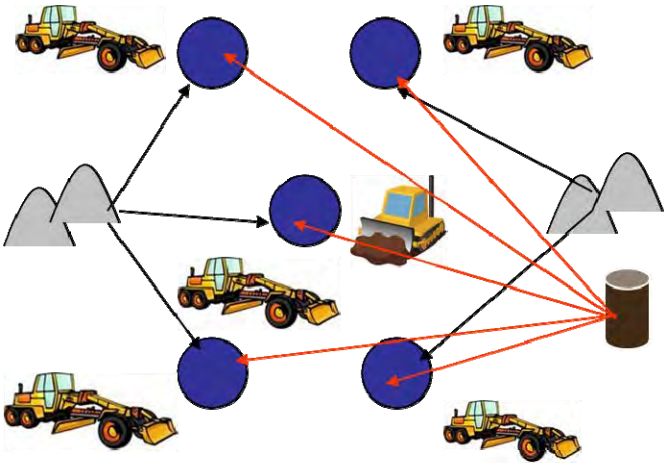
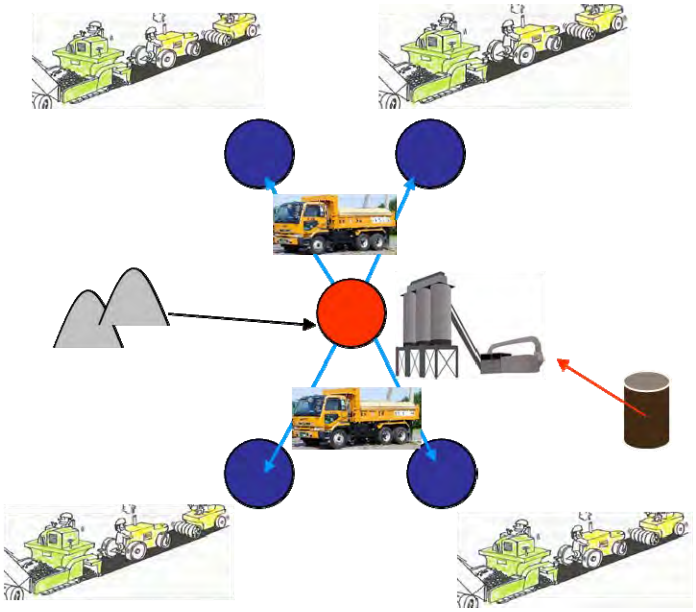


The new production



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PD-12

Hot-mix Material Applicability Map