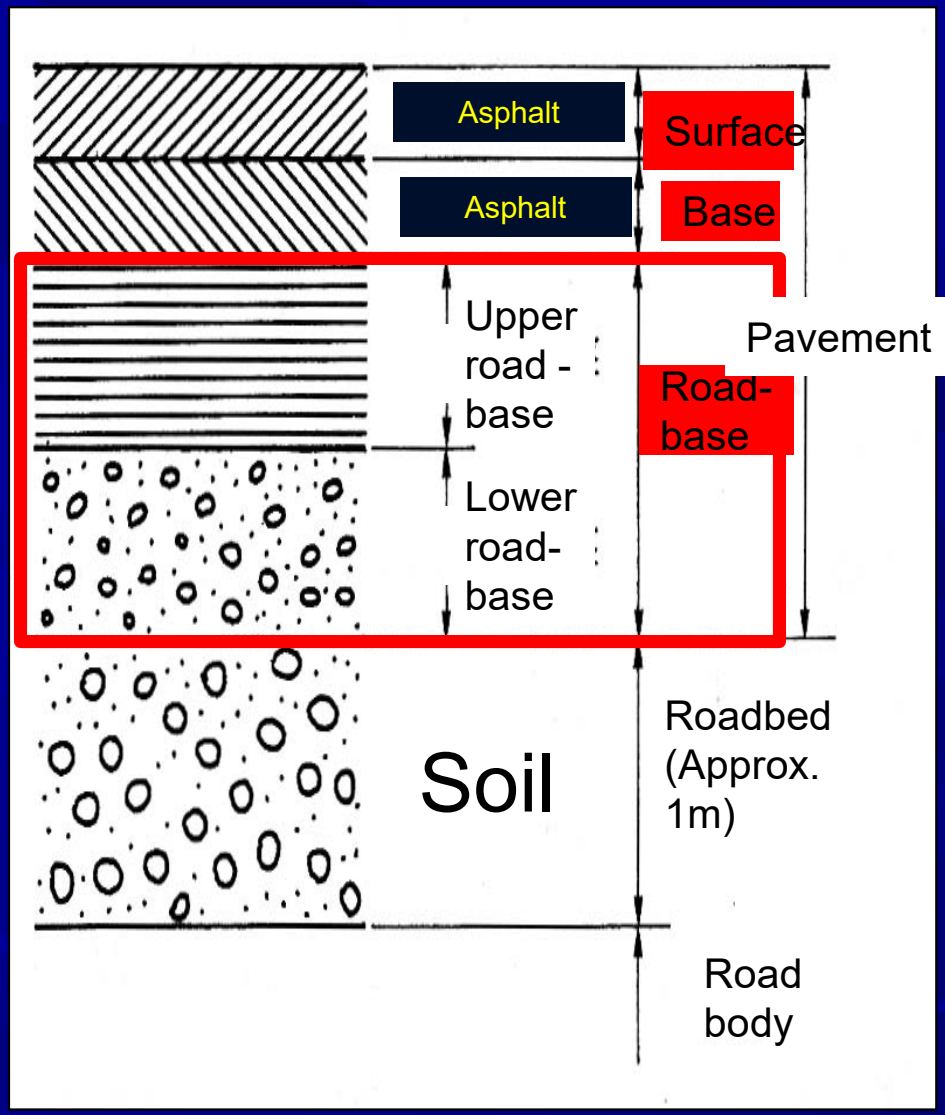
JICA "Road Maintenance and Management" training

How to maintain and manage roads in good condition?

- Build roads with quality paving materials
- Asphalt
- Gravel under asphalt (road-base material)

Standard pavement configuration



Upper road-base

Mined from mine · · · M-40

Recycled road-base material · · · · RM-40

Lower road-base

Mined from mine · · · C-40

Recycled road-base material · · · · RC-40

During Road Building Work

Work site ⇒ Road-base materials should be rolled and compacted.
This is very important.
(It must be firmly and tightly compacted.)

Check the degree of compaction by field density test.
→ Calculate the degree based on density.

⇒ Make sure if you can go to the next step.

Road-base compaction

(93% compaction fulfilled)

Field density test

Test items to confirm quality as road-base material

① Grain size test (aggregate sieving)

② Liquid limit, plastic limit test, plasticity index

③ Abrasion test

④ Density test

⑤ Compaction test

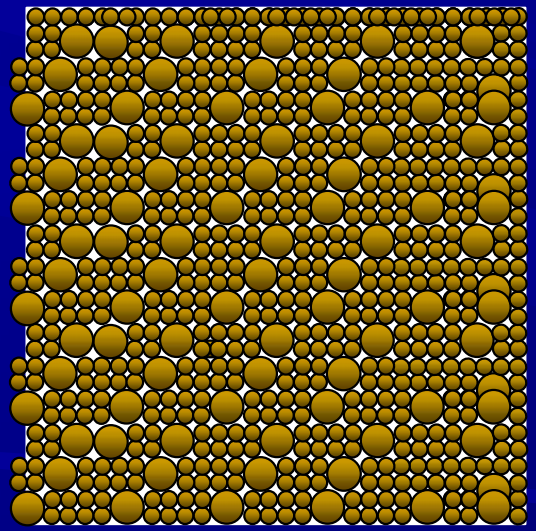
⑥ Indoor CBR test (modified CBR)

① Particle size test

Particle size distribution state

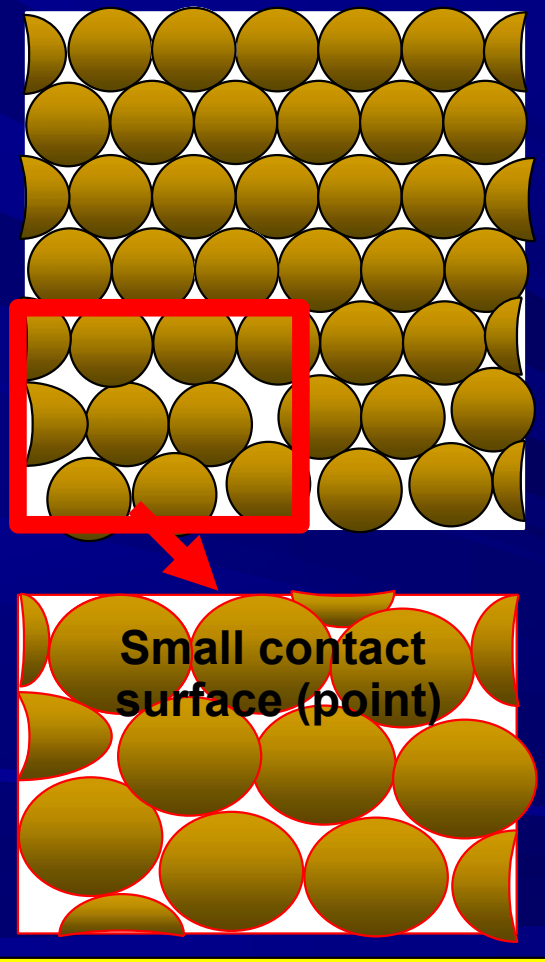
① High in fine particles

A lot of silt and clay content of 75 μm or less, poor compaction properties
Strength → Weak



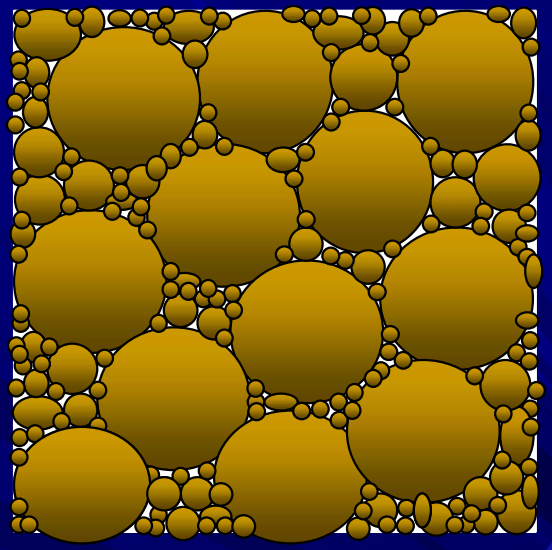
As road-base material x

② Particle size concentrated in narrow range
Poor compaction properties
Strength/durability → Weak



As road-base material x

③ Particle size distributed over wide range.
Good compaction properties
Strength/durability → Strong



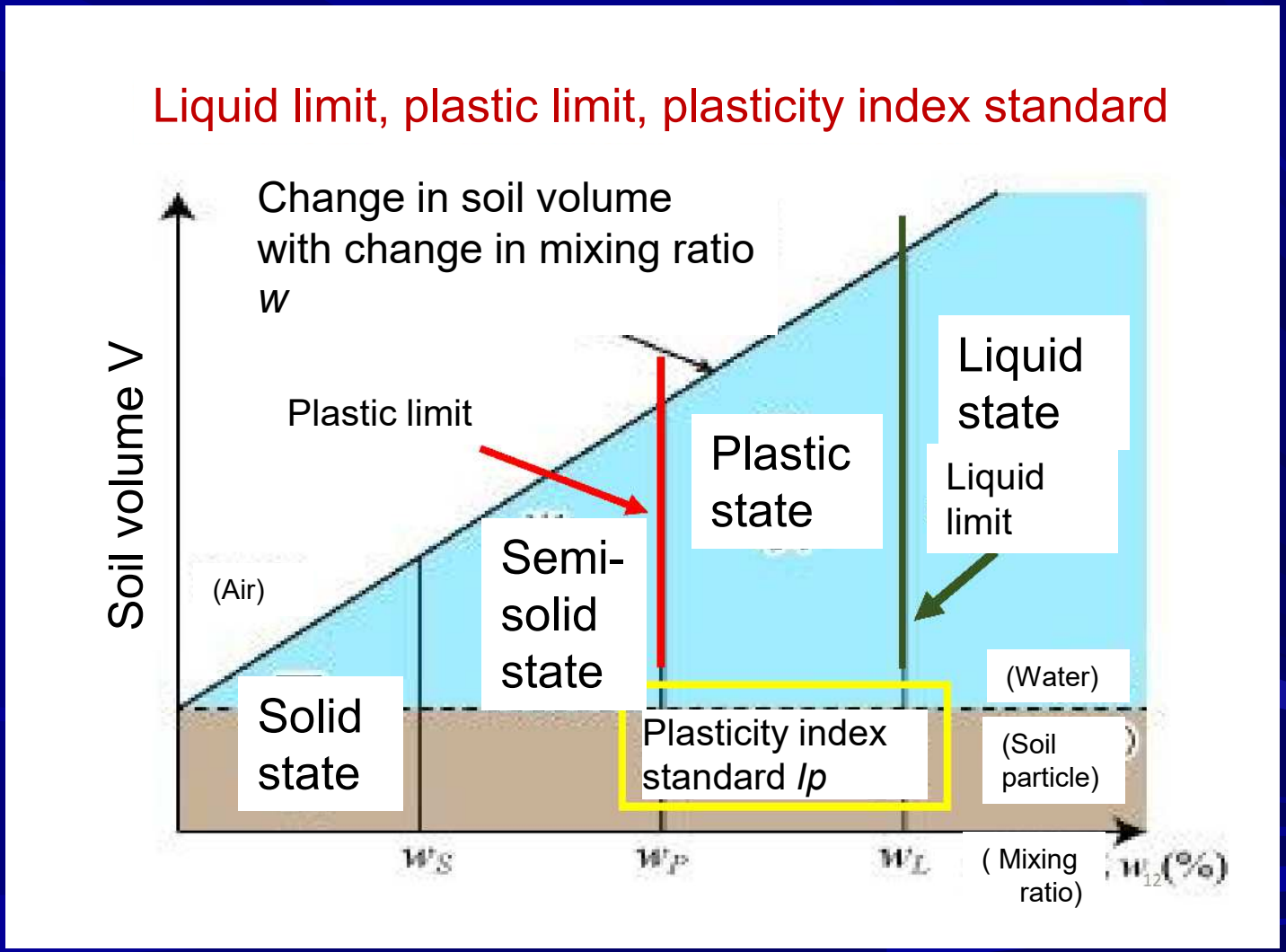
Large contact surface

As road-base material ○

How to check grain size balance

Nominal size			Range of grain size (mm)	Mass percentage of sieved material (%)									
			Sieve opening (mm)	75 μm	425 μm	2.36	4.75	13.2	19	26.5	31.5	37.5	53
Graded crushed stone	Recycled graded crushed stone	M-40 RM-40	40–0 mm	2–10	10–30	20–50	30–65	-	60–90	-	-	95–100	100
		M-30 RM-30	30–0 mm	2–10	10–30	20–50	30–65	-	60–90	-	95–100	100	
		M-25 RM-25	25–0 mm	2–10	10–30	20–50	30–65	55–85	-	95–100	100		
Crusher run	Recycled crusher run	C-40 RC-40	40–0 mm	-	-	5–25	15–40	-	50–80	-	-	95–100	100
		C-30 RC-30	30–0 mm	-	-	5–30	15–45	-	55–85	-	95–100	100	
		C-20 RC-20	20–0 mm	-	-	10–35	20–50	60–90	95–100	100			

②-1 Liquid limit, plastic limit, plasticity index standard



② - 2　Liquid limit, plastic limit, plasticity index standard

※ Road-base materials behave like lubricants when their plasticity exceeds a certain limit.

- **Compaction during construction becomes difficult.**
- **Susceptible to water after paving**

Therefore, strength and durability are reduced.

Plasticity limit test status

【Road-base materials have negative effect when they become plastic.】

Liquid limit test status

【Road-base materials that do not contain clay content (NP non-plastic) are good materials.】

■ **Plasticity index specifications**■

（Upper road-base ≦ 4 , Lower road-base ≦ 6 ）

③ Abrasion weight loss test

Abrasion weight loss test status


Specimen collection

④ Density test

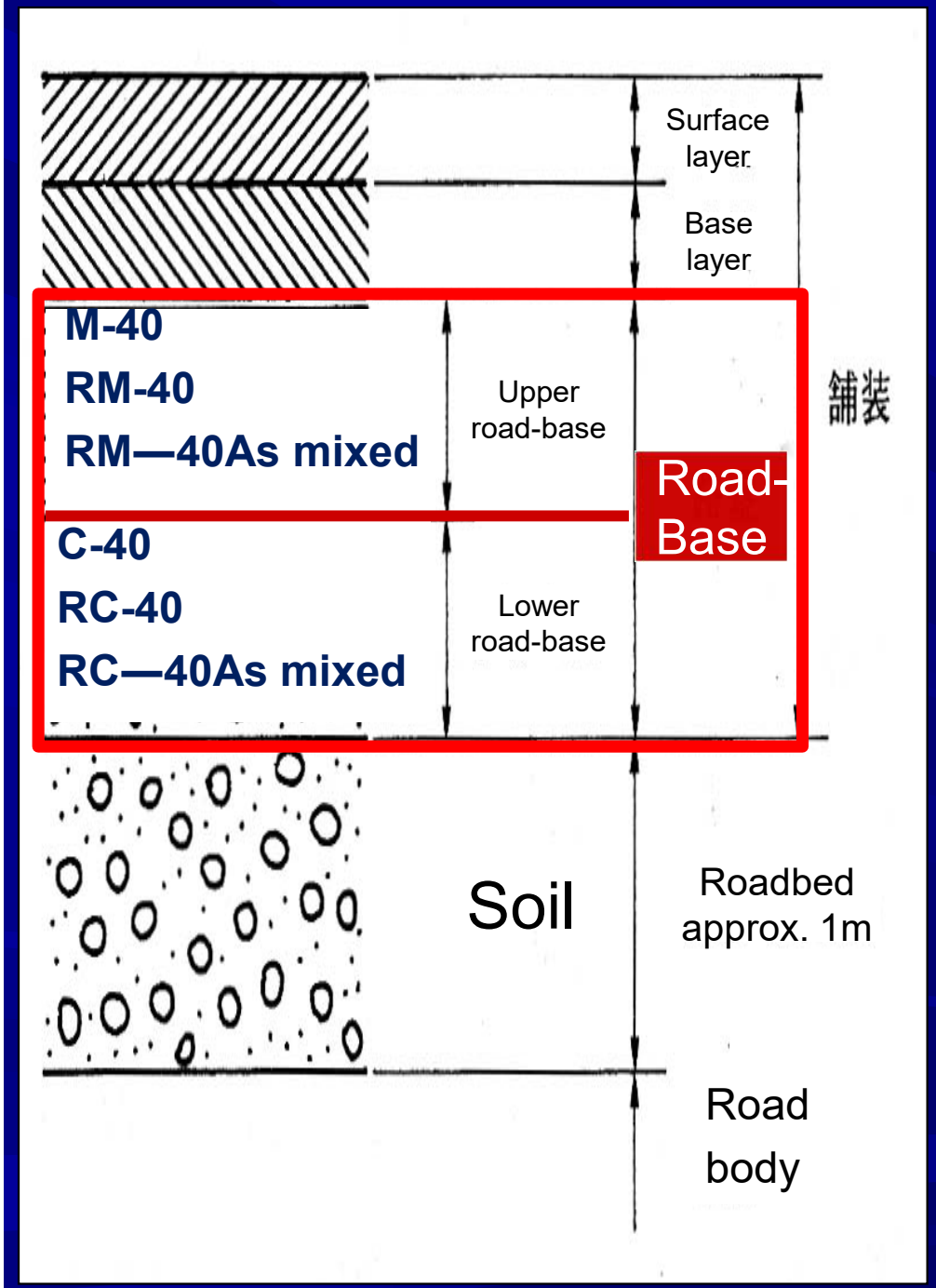
(5) Compaction Test

- Water content ratio when the material is most compacted.
- The level of density measured as above is used to check the degree of compaction.

⑥ Indoor CBR test (modified CBR)

Penetration test for calculating CBR value

Modified CBR standards



Upper road-base

Virgin material · · · ≧ 80%

Recycled material · · ≧ 80%

Recycled material (as mixed) · · · · · ≧ 90%

Lower road-base

Virgin material · · · ≧ 20%

Recycled material · · ≧ 20%

Recycled material (as mixed) · · · · · ≧ 30%

Good quality road-base materials mean:

（Material）

- Good grain size distribution (good balance)
- Does not show a plastic range

  Plasticity index IP is NP (non-plastic) or plasticity index is (≦4 for upper road-base and ≦ 6 for lower road-base)

（At work site）

- To compact near best water content ratio for compaction.

Asphalt test items

① Asphalt extraction test
(Confirmation of asphalt content)

② Aggregate sieving test

③ Marshall test
(Maximum load, stability, deformation flow value)

④ Density test

① Asphalt extraction test

Before extraction

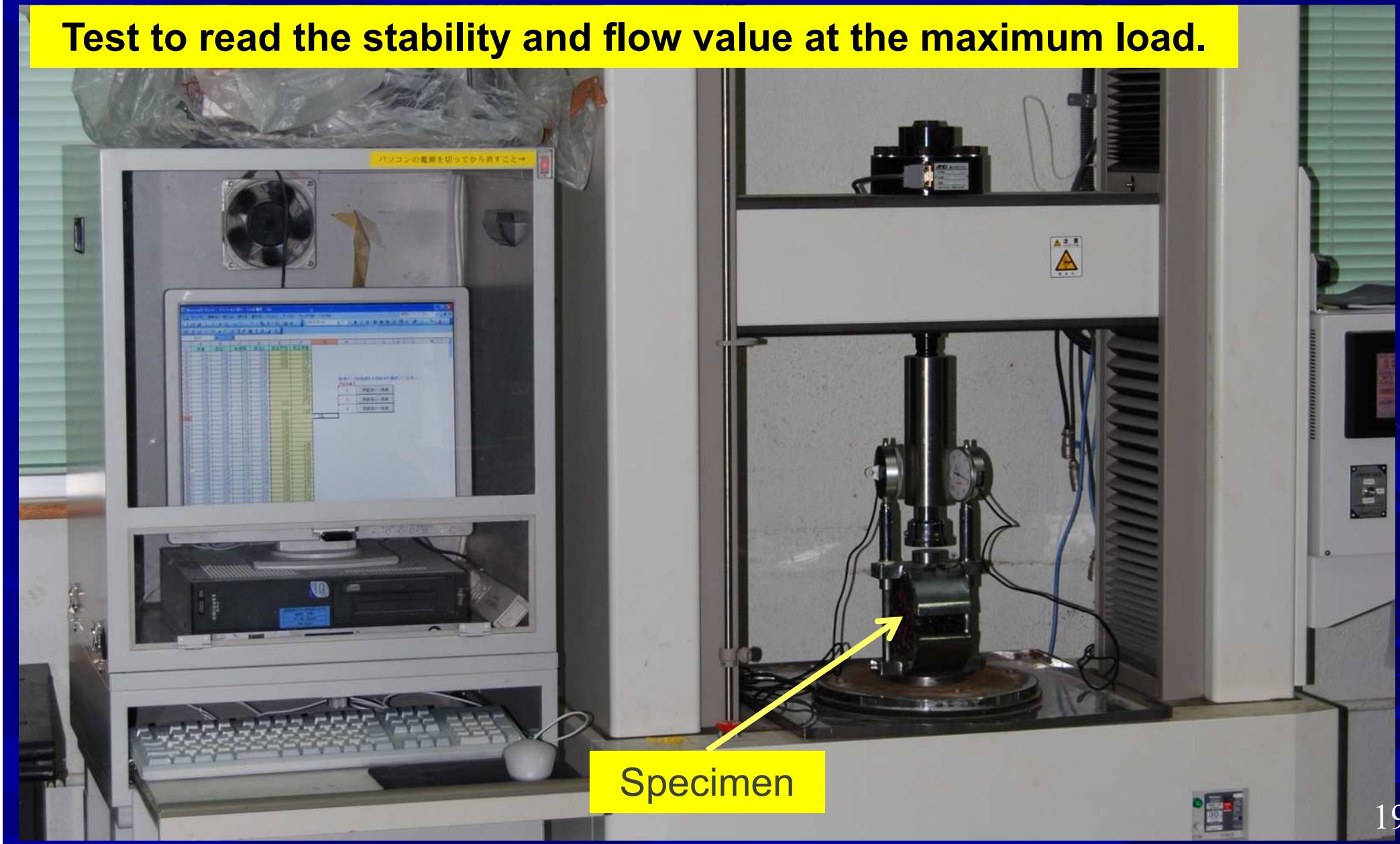
After extraction

Before extraction (mass) - After extraction (mass) = Difference in mass is the amount of asphalt content

② Aggregate sieving test

③ Marshall test status

Test to read the stability and flow value at the maximum load.

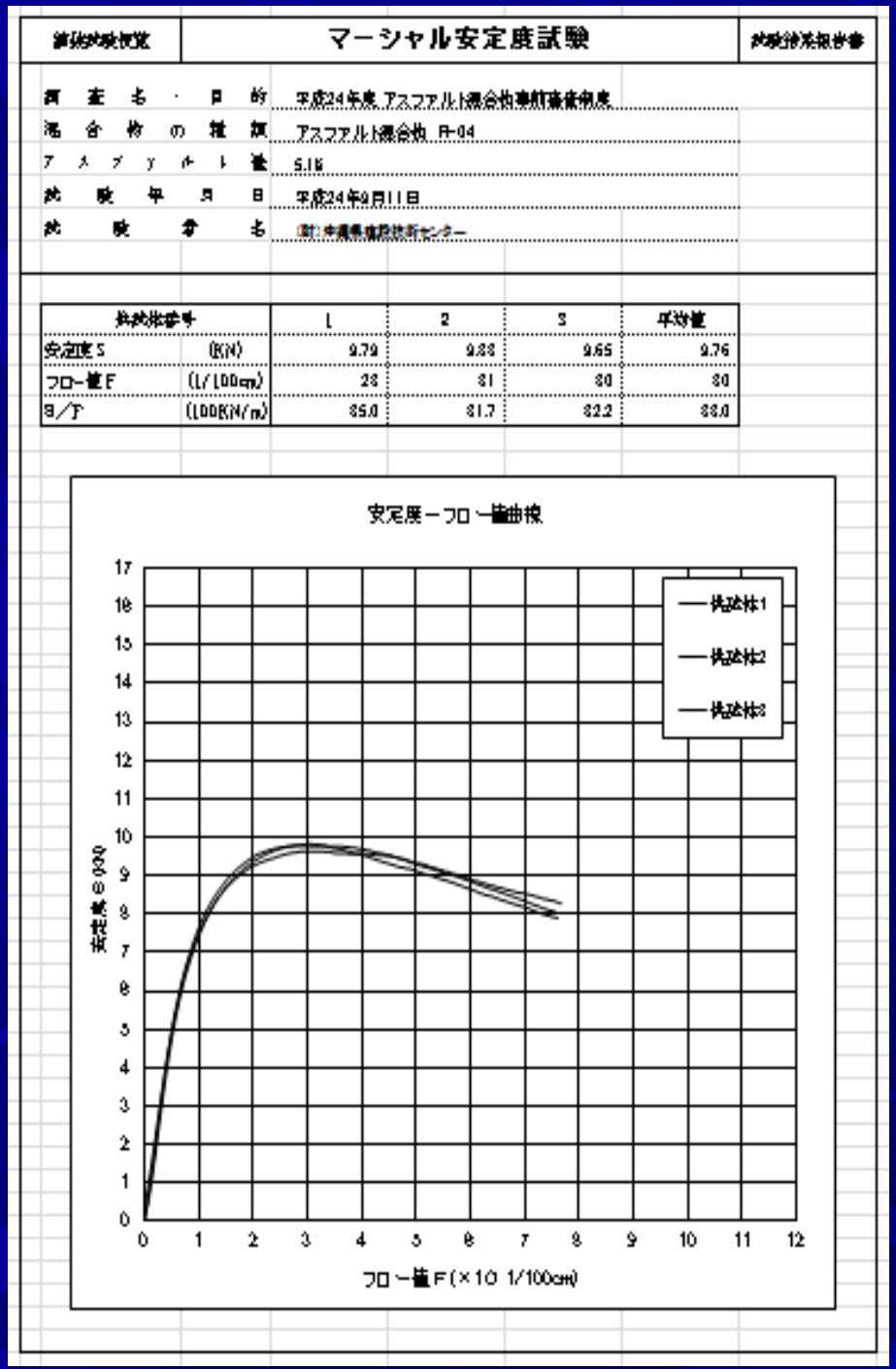


③ Marshall test

Test to determine maximum load, stability, deformation flow value

Stability
Strength of mixture, resistance to flow deformation

Flow value
Deformation at maximum load


マーシャル安定度試験

		1	2	3	平均値
安定度S	(kN)	9.79	9.88	9.65	9.76
フロー値F	(1/100cm)	28	31	30	30
S/F	(100kN/m)	35.0	31.7	32.2	33.0

安定度－フロー値曲線

Specified values of stability and flow value depend on the mixture.

Stability standard value		
Stability level (S) (kN)		
Asphalt stability	3.43	kN or higher
Coarse grain	4.90	kN or higher
Density of grains [50]	4.90	kN or higher
Density of grains [75]	7.35	kN or higher
Open grains	3.43	kN or higher
Porous	3.43	kN or higher

Flow standard value	
Flow (F) (1/100 cm)	
Asphalt stability	10～40
Coarse graded	20～40
Dense gap-graded	20～40
Dense gap-graded	20～40
Open graded	20～40
Porous	No standard

④ Density test

The density is calculated by measuring the mass in air, mass in water, and surface dry mass of the cylindrical specimen at four points of thickness.

- **Mass in air**
- **Mass in water**
- **Surface dry mass**

Quality control of paving materials

① Road-base materials

② Asphalt

END

Thank you very much for your attention.