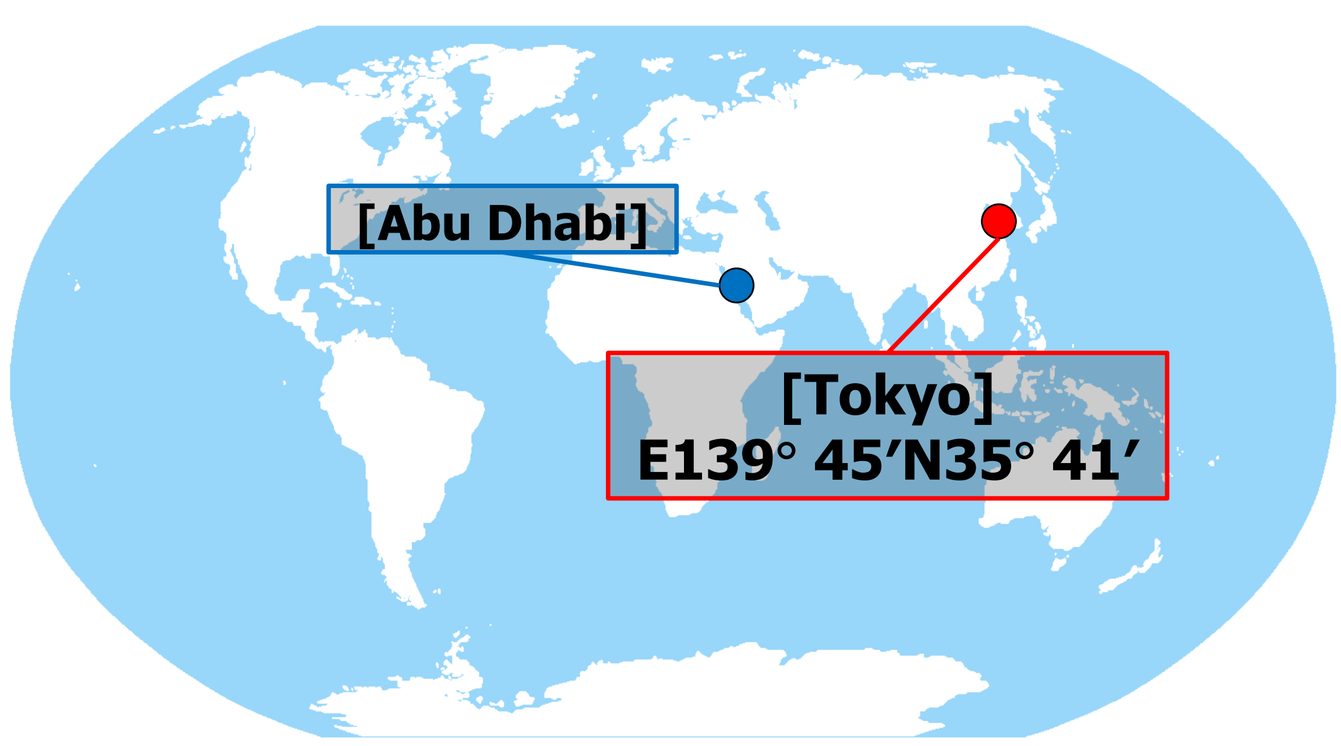
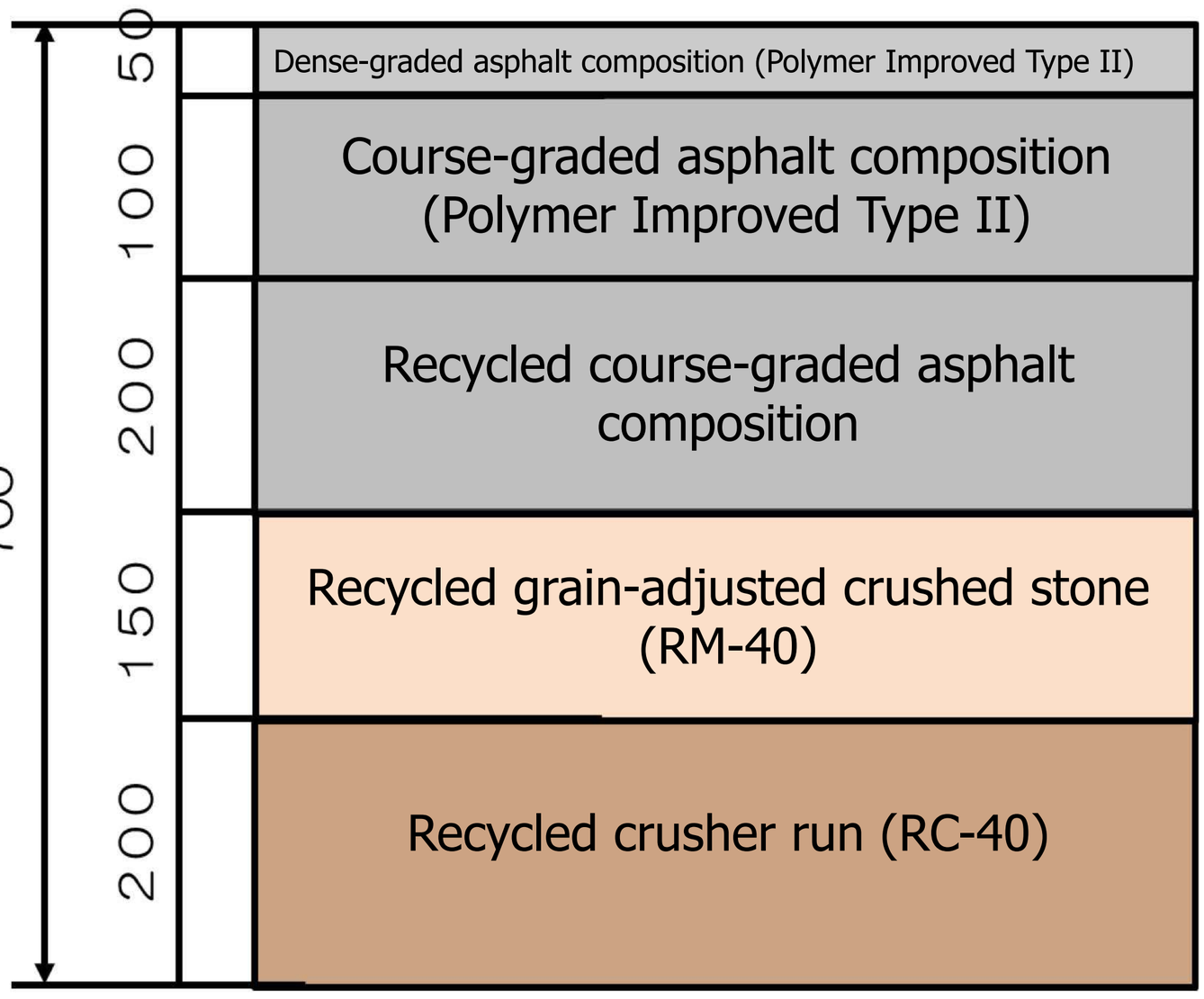
Road Network of Tokyo Metropolitan Government

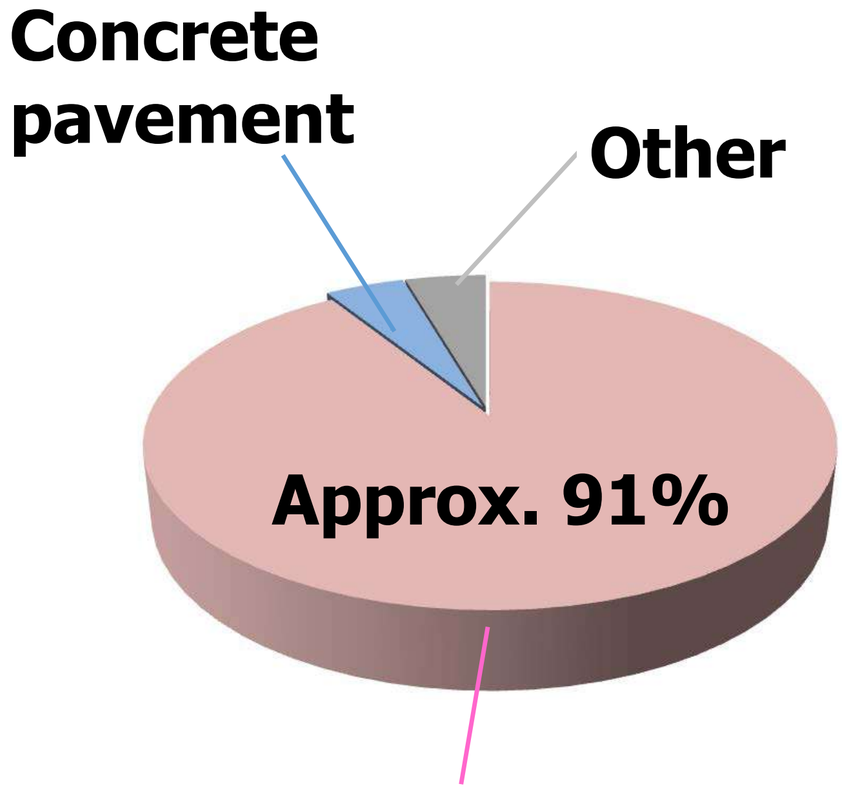
طرق طوكيو

About Tokyo Metropolitan Government

- Population: Approx. 13,784,000
- Area: Approx. 2,193 km^2
- Total prefectural road network: 2,371 km
  (Asphalt: Approx. 91% Concrete: Approx. 4%)
- Typical pavement structure: See the figure below
  (design traffic volume of 3,000 vehicles/day, in one or more directions)







*The ratio between asphalt and concrete estimated from a road surface property survey result.

Environmental pavement implementation history

1995: Full-scale introduction of low-noise paving on prefectural roads designated under "Act on Improvement of Areas Along Trunk Roads"
2005: Standardization and full-scale introduction of double-layer low-noise paving
2005: Started a full-scale implementation of water-retaining paving
2008: Started a full-scale implementation of heat-blocking paving
2014: Heat-blocking paving designated as an official heat control measure for prefectural roads including those to be used for the Tokyo 2020 Olympic and Paralympic Games marathon routes, under the "Tokyo Metropolitan Government Long-term Vision"
2015: Heat-blocking paving installation started as a heat control measure for prefectural roads including those to be used for Tokyo 2020 Olympic and Paralympic Games marathon routes

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Car Road Paving Policy of Tokyo Metropolitan Government

نظام تعبيد طرق السير في طوكيو

Diverse needs of various Tokyo residents including road users and people living near main thoroughfares, etc.

Control-required areas

- **Areas where road traffic noise control is required. Areas where road drainage measure is required**
  - ○ Areas where the road traffic noise level exceeds the environmental threshold
  - ○ Areas where noise control is urgently required
  - ○ Newly constructed major roads
  - ○ Areas where road drainage measure is urgently required

- **● Areas where urban heat island effect control is required**

- **● Areas with heavy traffic where a prolonged road surface repair is difficult to accommodate**

- **● Areas prone to road flatness impairment**

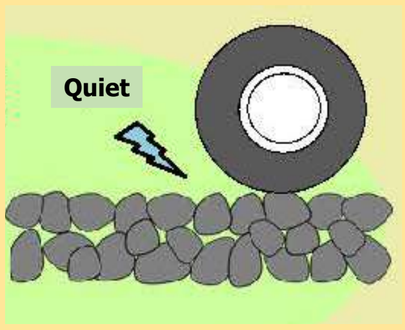
General areas other than the above

Applicable pavement types

Additional functionality

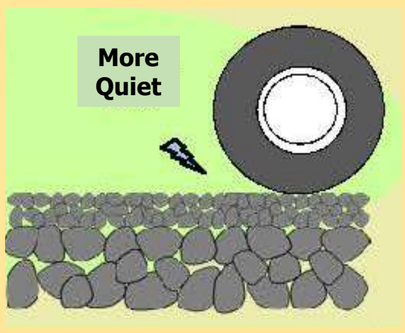
★ Low-noise (water-draining) pavement

Pavement with noise reduction and rainwater splashing reduction functionality



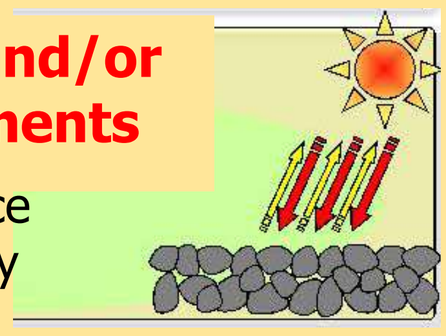
★ Double-layer low noise pavement

Pavement with even greater noise reduction functionality



★ Water-retaining and/or heat-blocking pavements

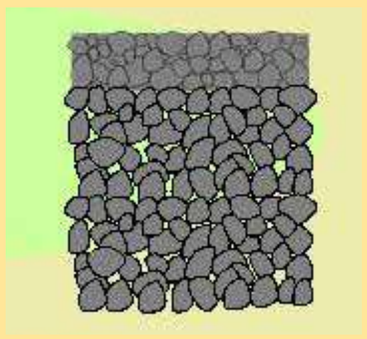
Pavement with road surface heat reduction functionality



Overall structure Durability improvement — Road surface

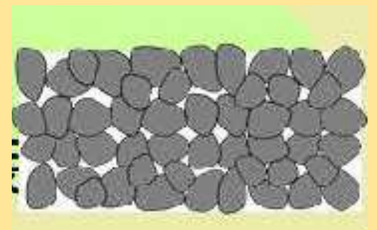
★ Long service life pavement

Pavement with long-term durability *1



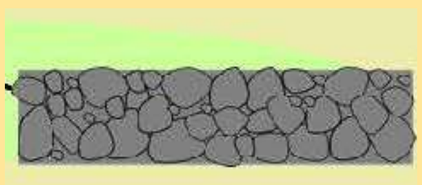
★ Polymer-improved asphalt pavement

Pavement with rutting resistance



Standard pavement (dense-graded asphalt pavement)

Dense-graded asphalt pavement (Common pavement)



*1. High-durability paving that does not require repairs for a long period of time

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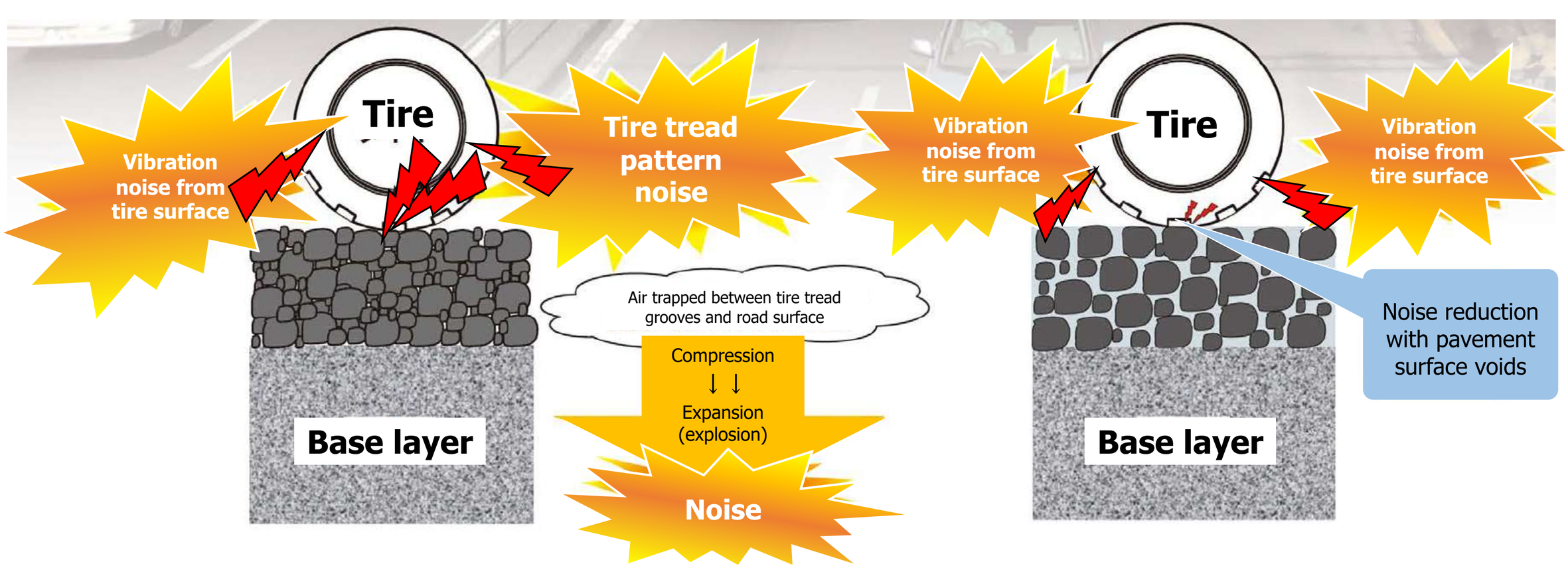
Double-layer Low Noise Paving for Noise Control

تدابير الضوضاء
تعبيد الطرق بطبقتين خافضتين للضوضاء

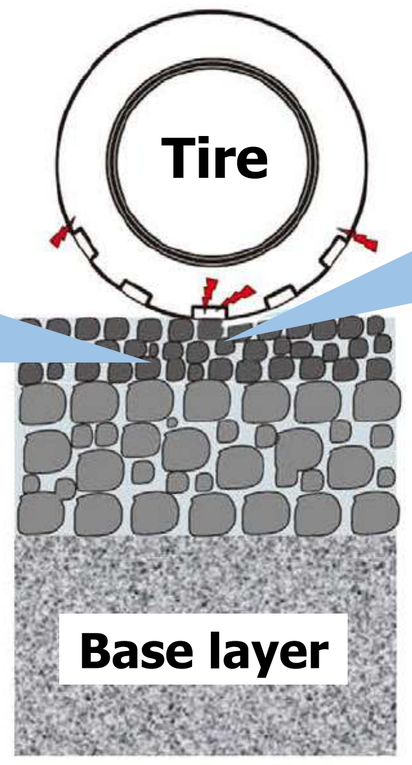
Dense-graded asphalt pavement (Common pavement)

Common low-noise pavement



Double-layer low noise pavement

Fine-grain, high-void-ratio pavement to reduce tire surface vibration noise



Noise reduction with pavement surface voids

How a double-layer low noise pavement works

Two types of high void ratio (approx. 20%) porous asphalt compositions with different maximum grain diameters are layered, with the finer-grain composition placed on top of the coarser-grain composition. This provides greater noise reduction effect than that of normal low-noise pavement.
Double-layer low noise pavement has been applied to road sections where noise control is urgently required, including Ring Roads 7 and 8.

Parameter

	Double-layer low noise pavement	Existing low-noise pavement	Common pavement
Surface layer	**Upper layer**: Smaller maximum aggregate diameter of 5 mm Air void ratio of 18% to 25% **Lower layer**: Larger maximum aggregate diameter of 13 mm Air void ratio of 16% to 22%	**Maximum aggregate diameter**: 13 mm **Air void ratio**: 16% to 22%	**Maximum aggregate diameter**: 13 mm **Air void ratio**: 3% to 6%
Tire noise	**86 dB**	**89 dB**	**96 dB**

* Tire noise measured according to the procedure described in “Paving Performance Evaluation Method” (issued by Japan Road Association).
* Tire noise measured as part of the Tokyo Metropolitan Government trial paving project

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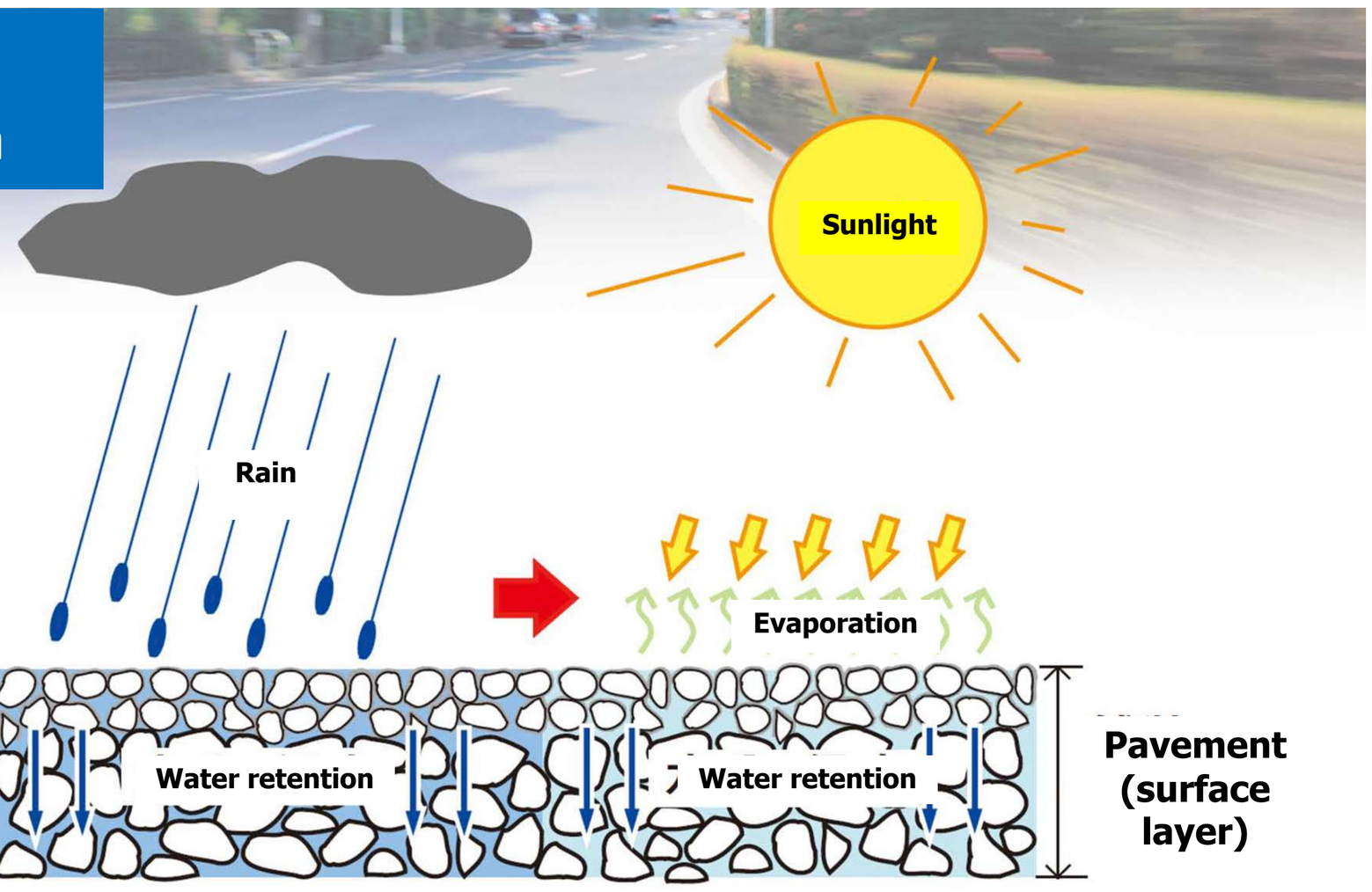
Water-retaining Paving for Heat Control

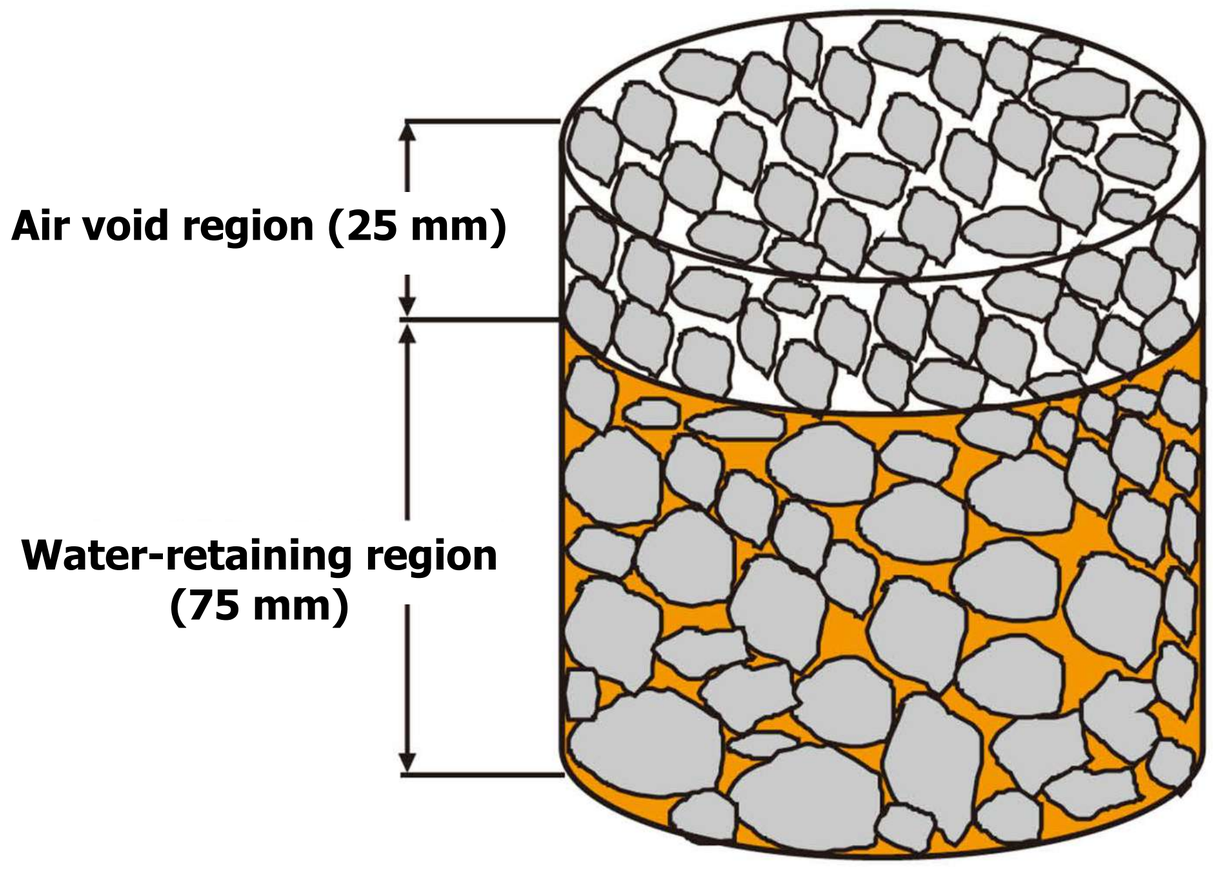
تدابير الحرارة
تعبيد الطرق الحافظة للماء

Water-retaining pavement mechanism



Tokyo-type water-retaining pavement

The upper layer offers noise reduction effect while the lower layer provides road surface heat reduction effect.



Water-retaining pavement

Water-retaining material, injected into the voids in the pavement, absorbs and retains rainwater and other incoming water. The heat of vaporization of this retained water when it evaporates under sunlight reduces road surface heat so that less heat is radiated from the pavement into the atmosphere.

Performance requirements

	Parameter	Immediately after road completion
Water-retaining pavement	Road surface heat reduction	Indoor irradiation test result: Heat reduced by 4°C or greater
	Water retention capacity	Measured after submerged under water for 24 hours 5.0 kg/m^2 or greater
	Road surface skid resistance	Pendulum-type skid resistance tester 60 BPN or greater
	Water penetration through the road surface	On-site permeation test 500 ml/15 s or greater

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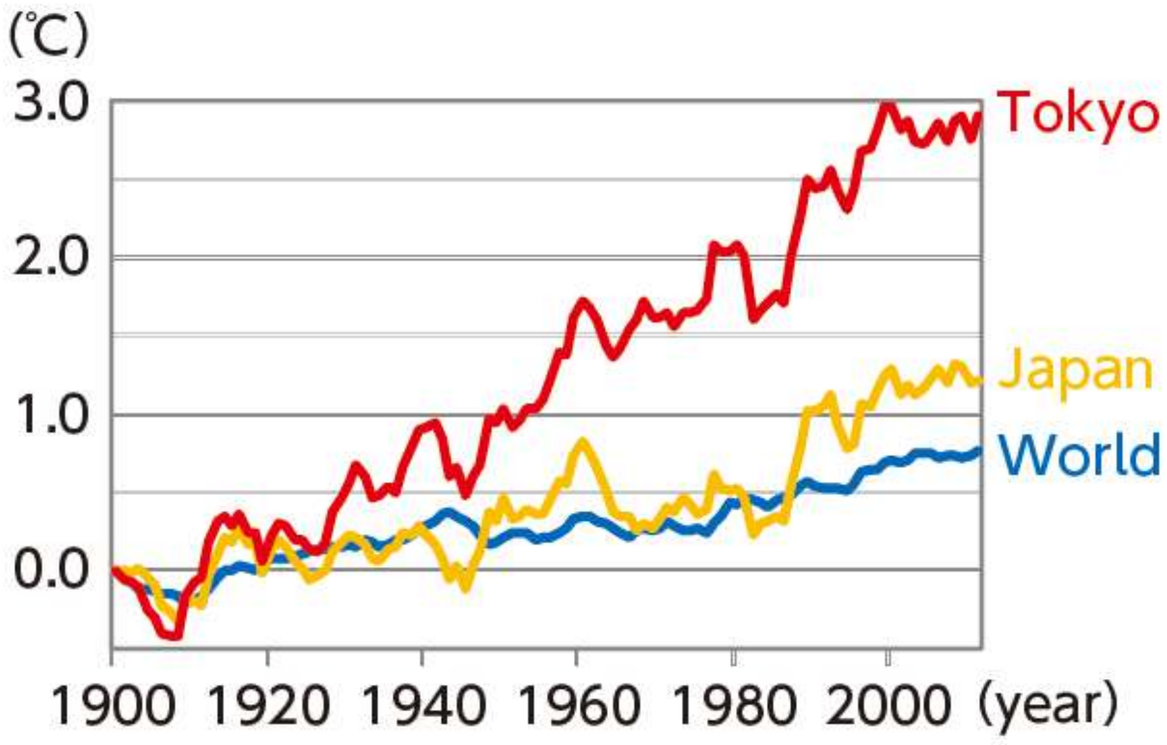
Heat and Urban Heat Island Effect in Tokyo

ظاهرة الجزر الحرارية الحضرية والحرارة في طوكيو

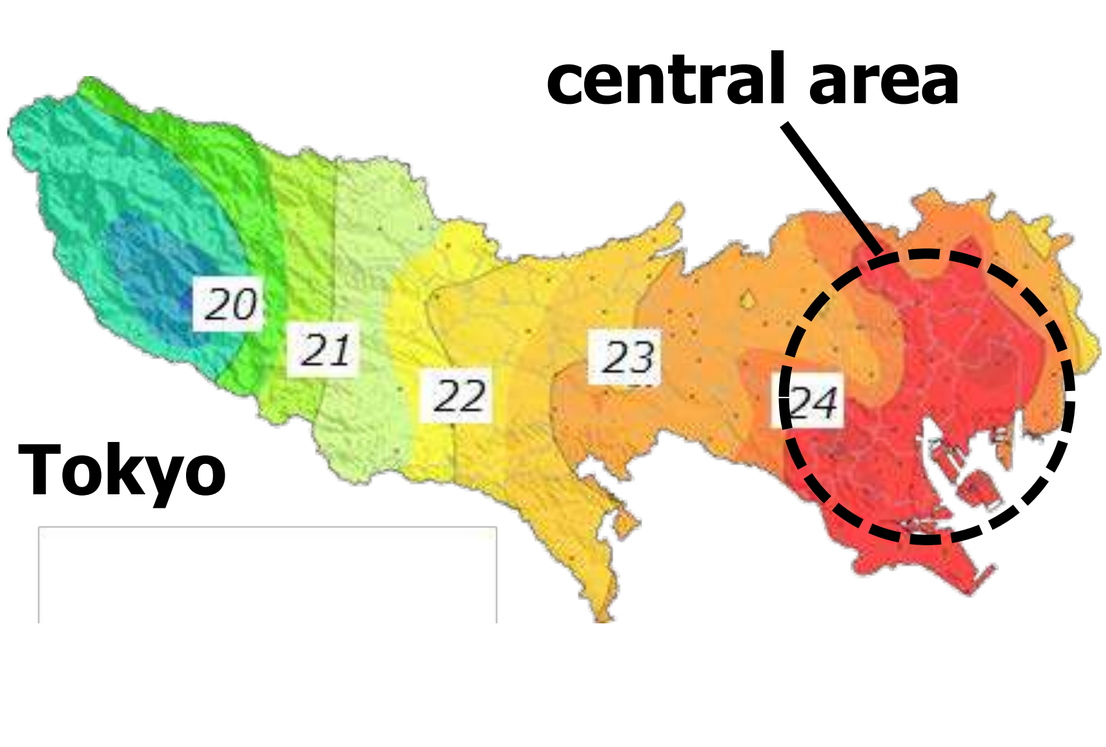
Urban heat island effect in Tokyo

- Tokyo's temperatures are rising
- Temperatures are especially high in central Tokyo
- Necessary to comprehensively advance measures including heat island countermeasures to improve Tokyo's thermal environment



Source: Handbook to Summer Heat Control" (issued by Bureau of Environment, Tokyo Metropolitan Government)

Annual average temperature deviations for Tokyo, Japan, and the world



Source: Handbook to Summer Heat Control" (issued by Bureau of Environment, Tokyo Metropolitan Government)

Distribution of average daily lows (°C) (July 1, 2013 - September 30, 2013)

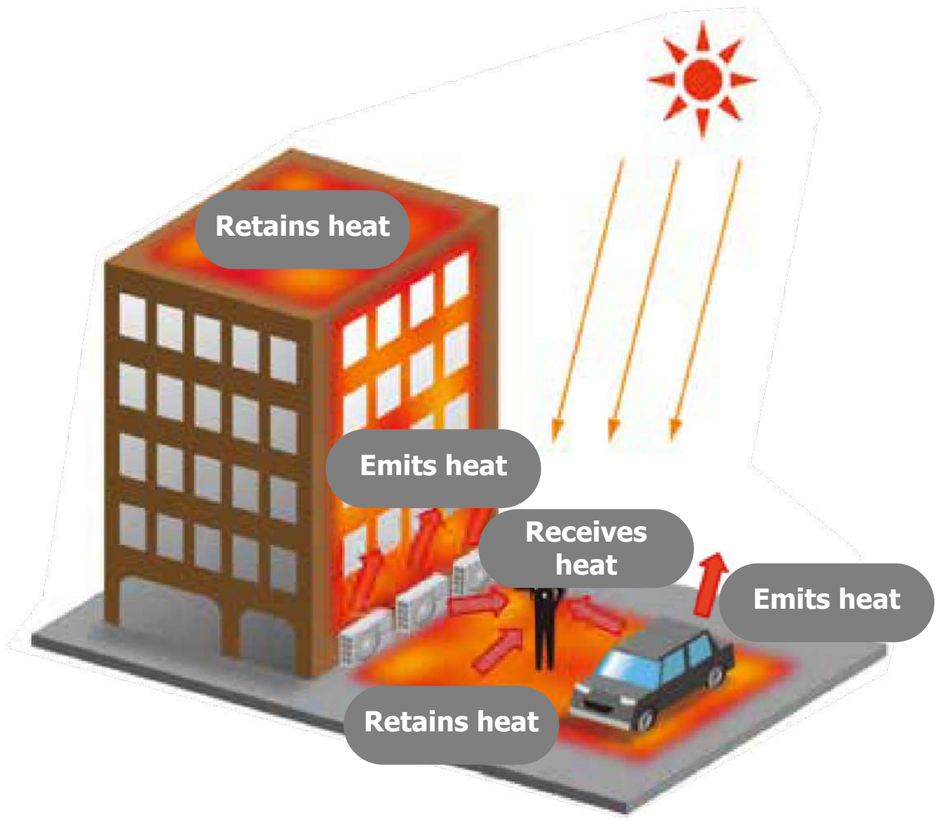
Heat-causing factors and their effects

Heat-causing factors in urban areas can be classified into the following two types:

○ Heat emission from air conditioners and cars
○ Heat retention in buildings and the ground

In addition to the above, people are affected by heat (heatstroke) as a result of:

● Heat reception from sunlight and also from the above-described heat sources



Source: "Handbook to Summer Heat Control" (issued by Bureau of Environment, Tokyo Metropolitan Government)

Heat control principles

To alleviate heat in an urban area, it is important to make effort:

○ not to emit heat by reducing energy usage.
○ not to retain heat by improving the building surface and the ground by having greenery, using water and employing other assisting technologies.

In addition to the above, to alleviate heat impact on people, make effort:

● not to receive heat by using sunshades, or spraying dry (fine) mist

Source: "Handbook to Summer Heat Control" (issued by Bureau of Environment, Tokyo Metropolitan Government)

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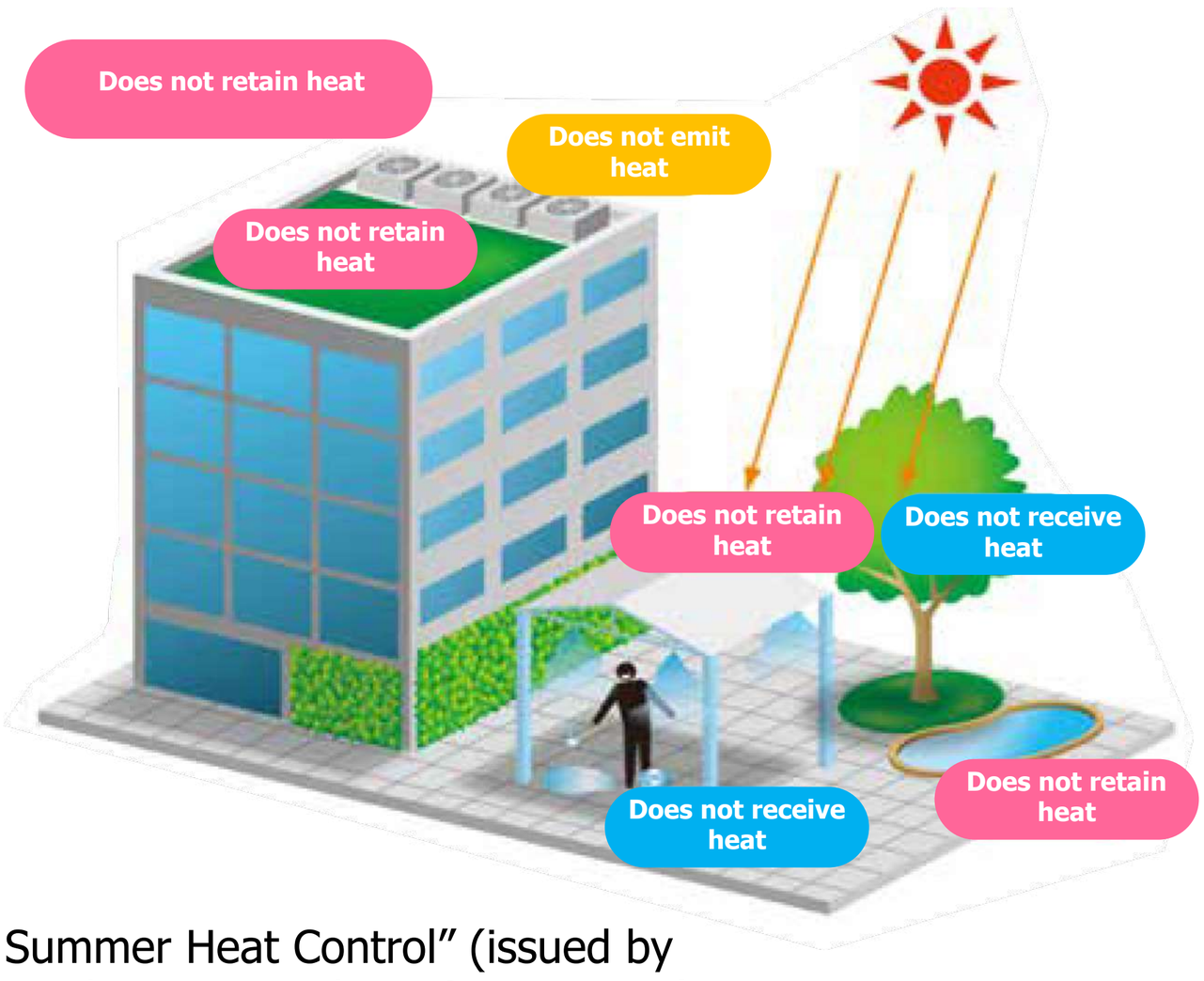
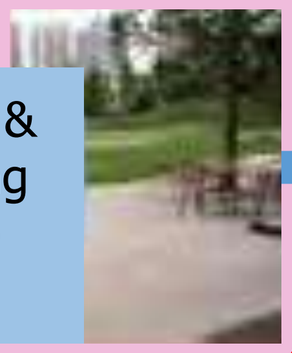
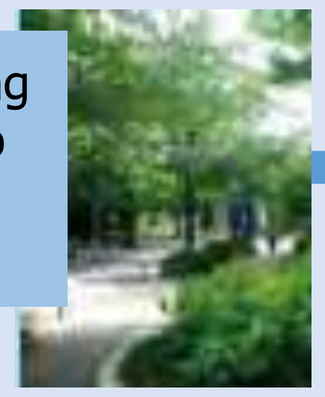
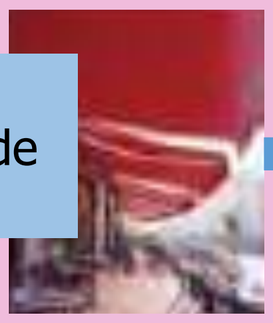
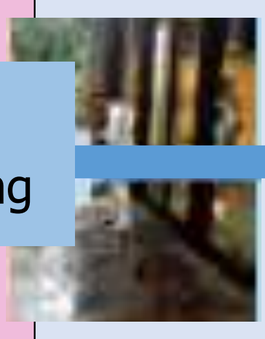
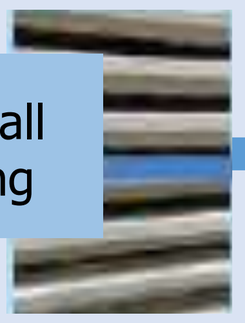
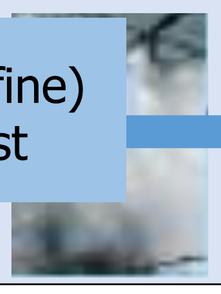
Heat Control Principles and Techniques

طريقة التفكير في تدابير الحرارة وتقنيتها



Source: "Handbook to Summer Heat Control" (issued by Bureau of Environment, Tokyo Metropolitan Government)

Does not emit heat	**Does not** retain heat	**Does not** receive heat
Energy saving, reduction of exhaust heat, etc.	Heat-blocking & water-retaining road surface design 	Plant trees along streets, etc. to have ground greenery 
Heat insulation		
Rooftop and wall greenery 		
Heat-blocking building design Note 1		
		Retroreflective surface to bounce heat back
Shade over the windows	Sunshade 	Water sprinkling  Sidewall cooling 
Heat-blocking & water-retaining road surface design		Dry (fine) mist 

Source: "Handbook to Summer Heat Control" (issued by Bureau of Environment, Tokyo Metropolitan Government)

Note 1: Heat-blocking buildings may potentially become a heat emission source in wintertime (by increasing the amount of exhaust heat).

*This document should not be considered as an evidence to validate the heat-blocking and water retention effects on the urban heat island effect.

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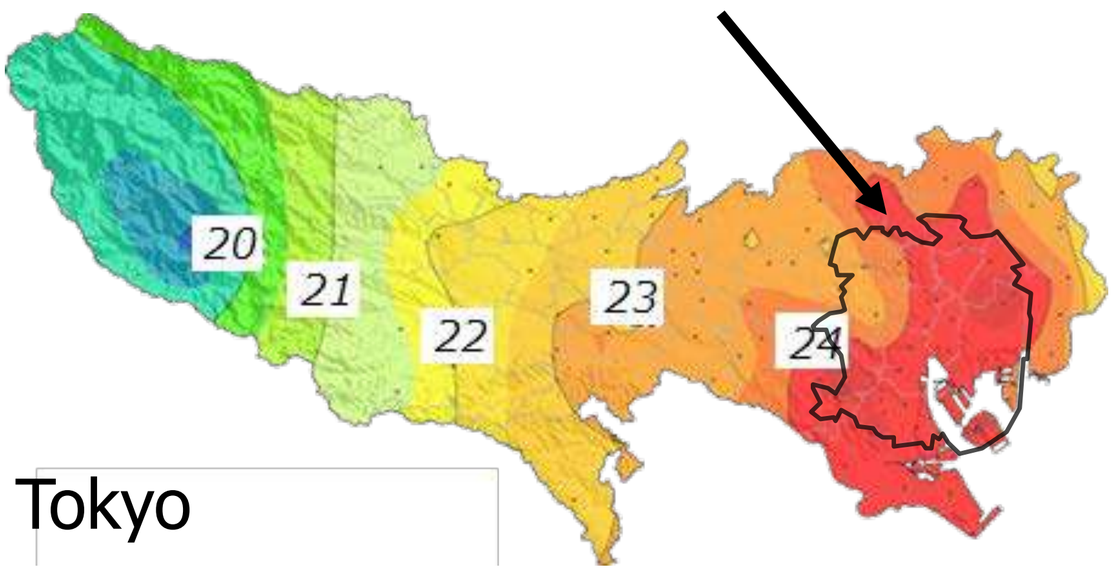
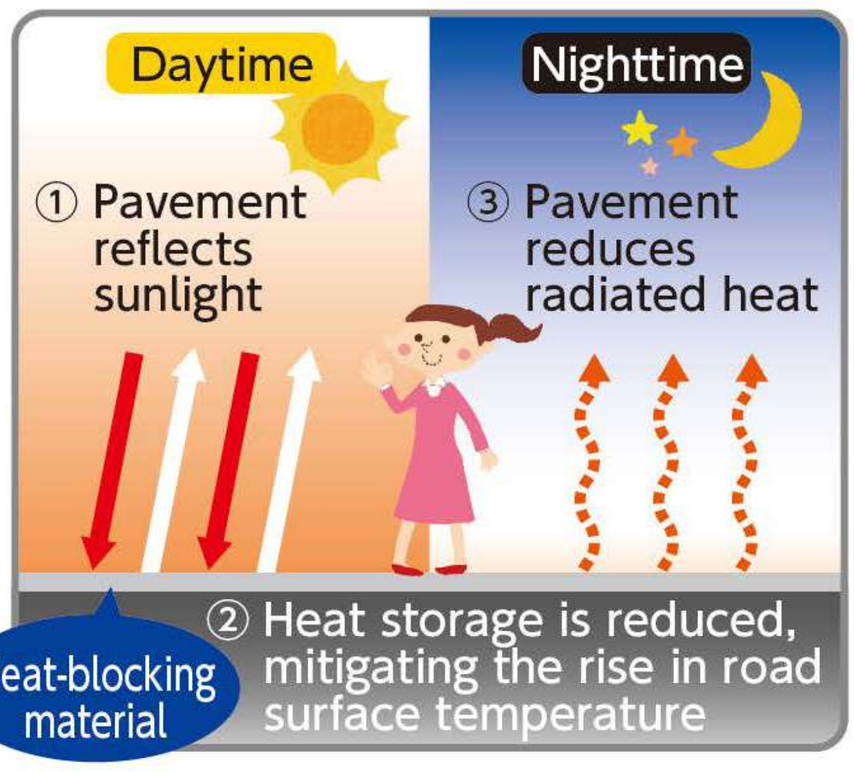
Solar Heat-Blocking Pavement

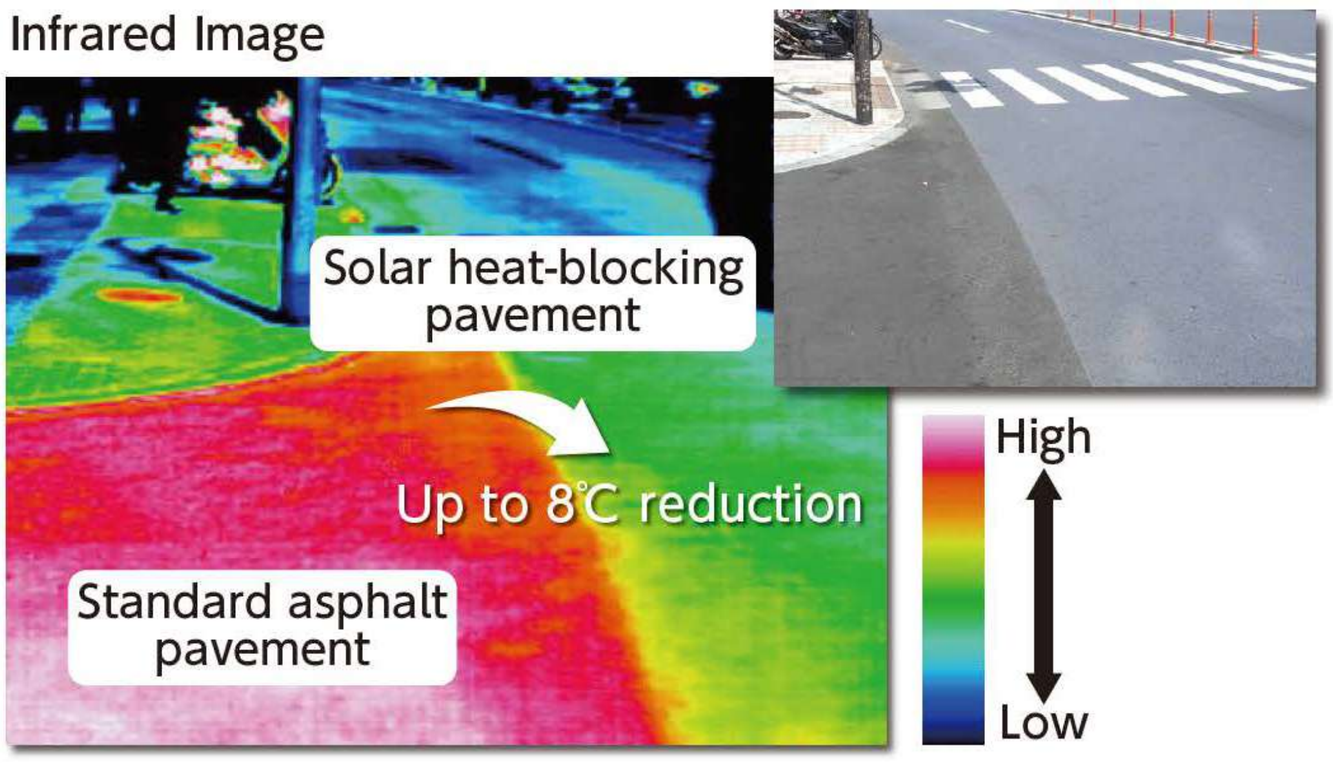
تعبيد الطرق المانع لحرارة الشمس



Effects of Solar Heat-Blocking Pavement

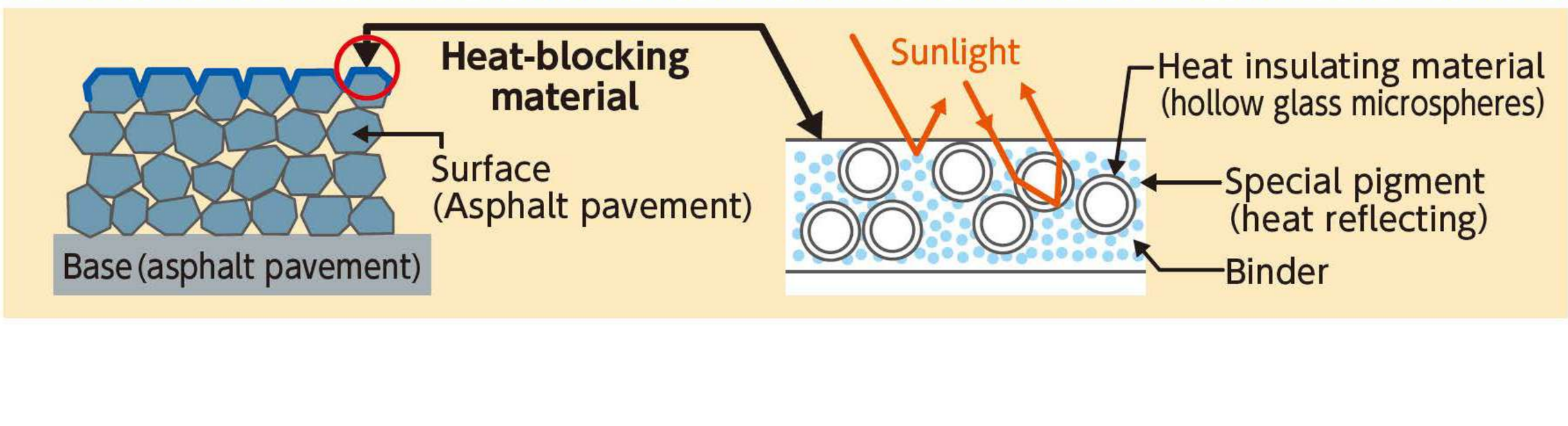
Mitigates the rise in road surface temperatures by up to 8℃ compared to standard asphalt





Structure

A coating of special paint (heat-blocking material) that reflects the sun's near-infrared rays is applied to the surface of the pavement



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Solar Heat-Blocking Pavement

تعبيد الطرق المانع لحرارة الشمس

Construction Flow

START

Construction of asphalt pavement

Preparation (Grinding/Cleaning・masking)

Road surface grinding

1st layer / 2nd layer
- Application of heat-blocking material
- Spraying of anti-slip aggregate

Application of heat-blocking material

Spraying of anti-slip aggregate

Application of heat-blocking material

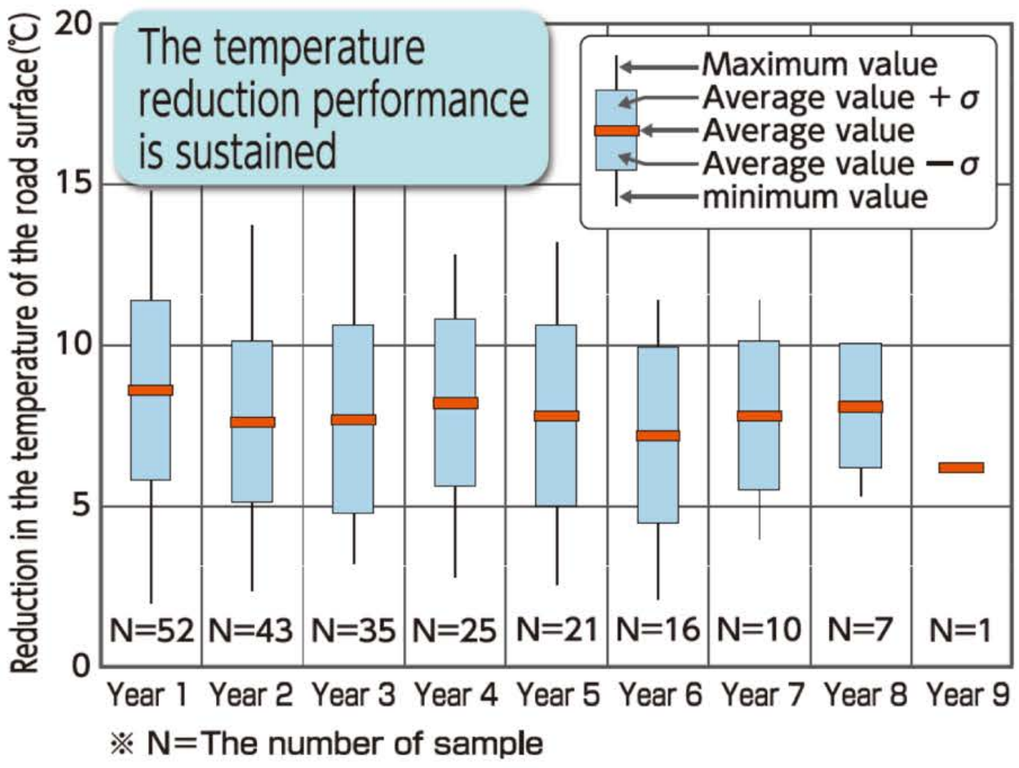
Application of heat-blocking material (Scattering prevention cover use)

Curing

FINISH

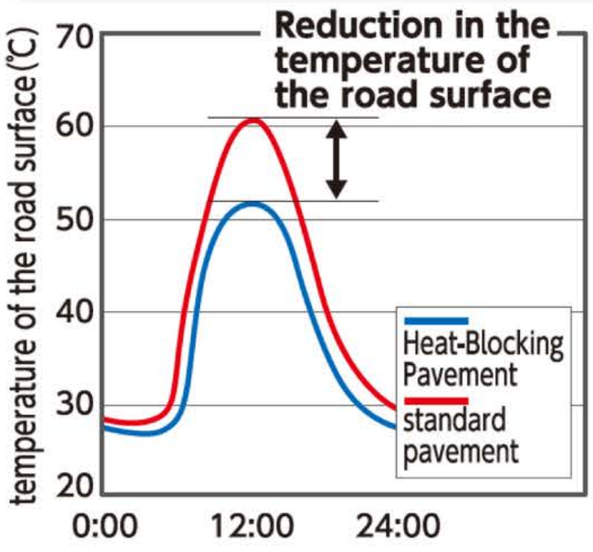
Substantivity of performance

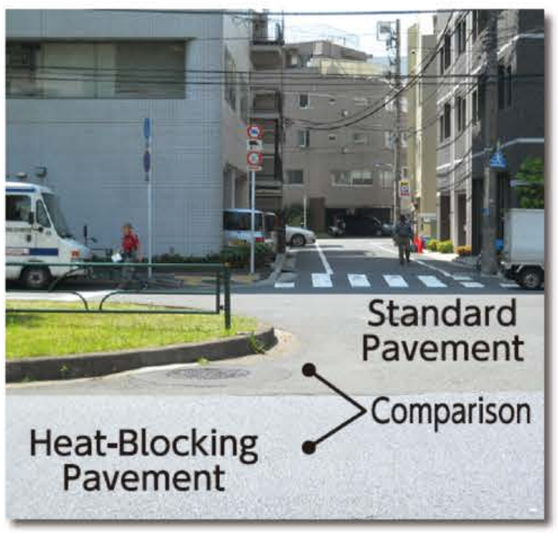
The temperature reduction performance is sustained



※ N=The number of sample

Reduction in the temperature of the road surface (℃)
= (standard pavement daily maximum road surface temperature ℃)
− (heat-blocking pavement daily maximum road surface temperature ℃)





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