Asphalt Pavement Maintenance Technology

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1. Types of Damage and Main Causes

Road pavement …

- Structure that receives external factors from traffic load, natural environment and so on.
- Damage to pavement progresses as soon as roads are opened to traffic.

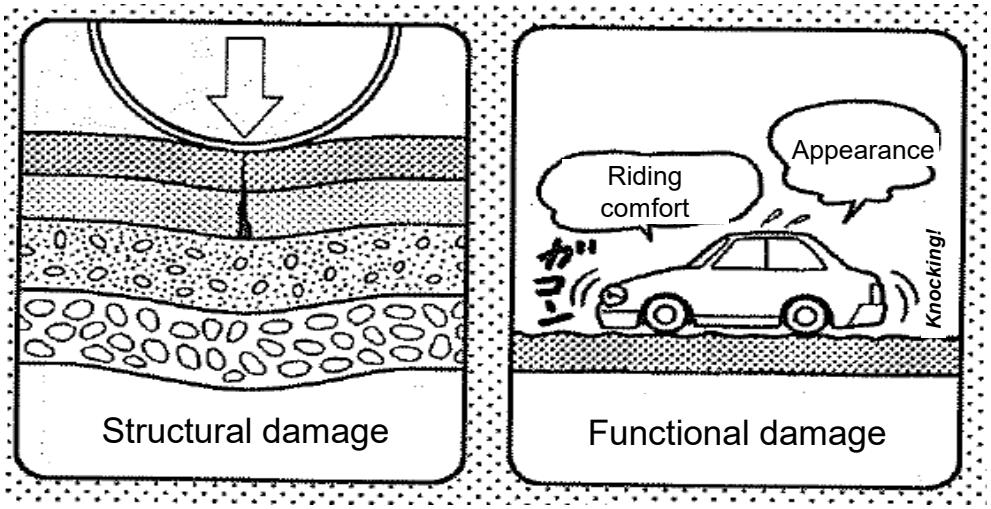
Asphalt pavement …

- Service life of around 10 years.
- Repair is needed at relatively short cycles.

Repairs …

- Grasp the types and causes of damage.
- Take steps in consideration of economy, roadside environment, and urgency of repairs.

Damage to Asphalt Pavement



- Functional damage

  This damage doesn't arise from decline in the pavement strength. It is often limited to damage of the asphalt mixture on the surface course and binder course.

- Structural damage

  This damage arises from decline in the pavement strength. It often extends to the base course and subgrade.

1.1 Rutting

1.1.1 Rutting Caused by Subgrade and Base Course Settlement

Settlement rutting

- Decline in bearing capacity caused by the effects of groundwater
- Insufficient compaction of base course
- Excessive traffic load imparted on the pavement structure

1.1.2 Flow Rutting

Flow rutting

- Internal factors — Blend of the asphalt mixture
- External factors — Traffic load and temperature

- Fluidizing of the asphalt mixture caused by high temperatures and heavy traffic
- Cases arising from the pavement structure
- Impact of traffic congestion in line with increase in traffic volume

1.1.3 Abrasion Rutting

Abrasion rutting

- This occurs when tire chains, etc. on running vehicles during the winter season scrape the surface of asphalt pavement in their tracks.

1.2 Cracking

1.2.1 Tortoise Shell Cracking

(1) Cracking caused by decline in bearing capacity of subgrade and base course

- The linear cracks develop into a tortoise shell pattern.

- Settlement arising in line with decline in bearing capacity of subgrade and base course caused by groundwater, etc.
- Cracking caused by insufficient compaction of base course and long-term decline in quality, etc.
- In many cases, cracks mainly occur in running tracks due to compound causes with traffic load.

(2) Cracking caused by degradation and deterioration of asphalt mixture

- Cracking arises from the degradation of asphalt caused by ultraviolet rays, the long-term deterioration of asphalt, improper quantity of asphalt and so on.

2.2.2 Linear Cracking

(1) Rutting

(2) Cracking caused by floor slab deflection

- Linear cracking occurs on floor slabs.
- Decline in the ability of mixture to follow localized deformation of floor slabs.
- Cracking arising from lack of flexure due to the long-term decline in quality of mixture.

(3) Temperature stress cracking

- This linear type of cracking occurs at almost uniform intervals in the lateral direction. It is caused by contraction of the pavement structure in line with fall in temperature.

(4) Hairline cracks

- Fine linear cracks occurring in the lateral direction when the asphalt mixture is set
- Poor quality of asphalt mixture
- Temperature control of mixture
- Paving speed by the asphalt finisher
- Roller compaction method
- Cases caused by environmental impacts (temperature, wind speed), etc.

(5) Reflexive cracking

- Triggered by binder course joints and cracks and cracking in the stabilized base course, cracks occur in the asphalt mixture directly above.

  If the binder course is made of concrete slabs, cracks will arise around the slab joints.

(6) Work joint cracking

- Linear cracking occurring along placing joints
- Insufficient adhesion at joints
- Insufficient compaction of mixture

(7) Cracking caused by uneven settlement



- Linear cracking caused by uneven settlement at boundaries of cutting and banking sections, etc.
- Uneven settlement caused by differences in bearing capacity of banking earth and ground
- Decline in bearing capacity caused by faulty compaction in narrow parts, infiltration of rainwater and so on
- Cracking caused by consolidation settlement, etc. of subgrade and roadbed

1.3 Deterioration of Surface Smoothness

1.3.1 Corrugation

- This undulating irregularity occurs continuously at relatively short pitches in the longitudinal direction.
- Deterioration in stability of the asphalt mixture in the summer.

1.3.2 Depression

- Areas of the asphalt surface become lower than the surrounding area, due to localized lowering of the subgrade and base course, long-term static load and inadequate mixture.

1.3.3 Veering

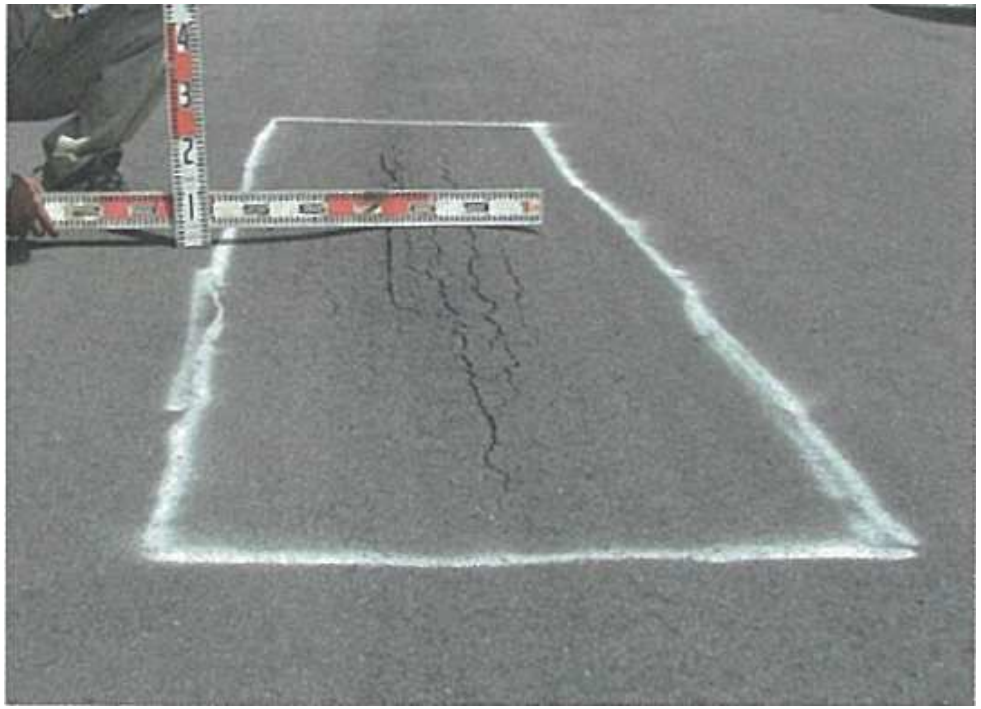
- Localized bulging of the asphalt pavement surface.
- This results from the excessive or non-uniform application of emulsion.

1.3.4 Grade Difference

- Sudden vertical displacement in the pavement surface in the road lateral direction.
- Where there are box culverts, approach cushion slabs, and underground structures, disparities arise in the settlement of subgrade and base course, leading to uneven settlement and grade differences in the pavement surface.

1.3.5 Blistering

- This is a phenomenon whereby increased temperature of water content inside the pavement body causes the water to evaporate and vaporize, thereby imparting pressure inside the pavement and causing circular bulges to appear on the surface.



1.4 Decline of Skid Resistance

1.4.1 Flushing (Bleeding)

This occurs when asphalt bleeds out onto the surface, causing the surface to shine. It is caused by having too much asphalt in the mixture and aggregate granularity problems such as a low air gap ratio, etc.

1.4.2 Polishing

Running of vehicles leads to equal wearing down of coarse aggregate and mortar, causing the pavement surface to have reduced skid resistance.

Use of limestone or other easily worn coarse aggregate is the cause.

1.5 Destruction of Porous Asphalt Pavement

1.5.1 Choking

In this phenomenon, air gaps in porous asphalt pavement become choked with sand, mud and dust, etc.

Sediment, etc. drops off the tires of passing vehicles, and sand and dust blow from the roadside.

1.5.2 Clogging

This is the phenomenon whereby porous asphalt pavement becomes compacted by passing traffic and the air gaps become clogged.

This is caused by fluidization of mixture due to increase in temperature, and increase in traffic volume.

1.5.3 Aggregate Fly-off

This is the phenomenon whereby the external pressure of passing traffic on the coarse aggregate of porous asphalt mixture causes the aggregate to detach and fly off.

This occurs on intersections and in areas such as entrances/exits to roadside facilities where torsion shearing force of vehicles arises, and on roads where vehicles run with tire chains attached.

1.5.4 Peeling of Binder from the Binder Course Mixture

In cases where only the existing surface course is replaced with porous asphalt pavement, the binder course mixture that is directly exposed to rainfall, etc. peels and flow rutting occurs in parts on the binder course.

This phenomenon sometimes progresses in a short time and is caused by the interaction of water percolation from the binder course, high temperatures and traffic load pressure.

Measures to prevent base layer peeling

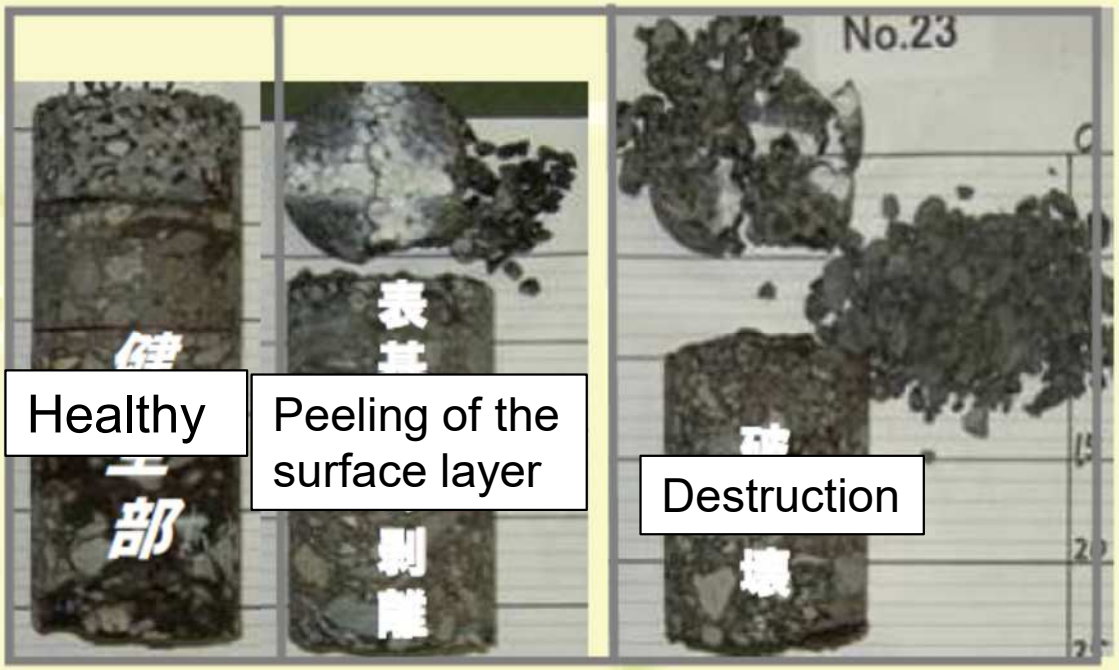
- When only the existing surface course is replaced with porous asphalt pavement, the base course, which is now directly exposed to rainwater, may delaminate.
- Local deformation occurs on the surface.
- The interaction of moisture, traffic load, etc. is thought to be the cause.

Peeling of the base layer - Peeling condition -

Base layer peeling

- Damage specific to drainage pavement -

When adhesion between the surface layer and the base layer is poor or waterproofing below the base layer is inadequate, the base layer and areas below it rapidly deteriorate.

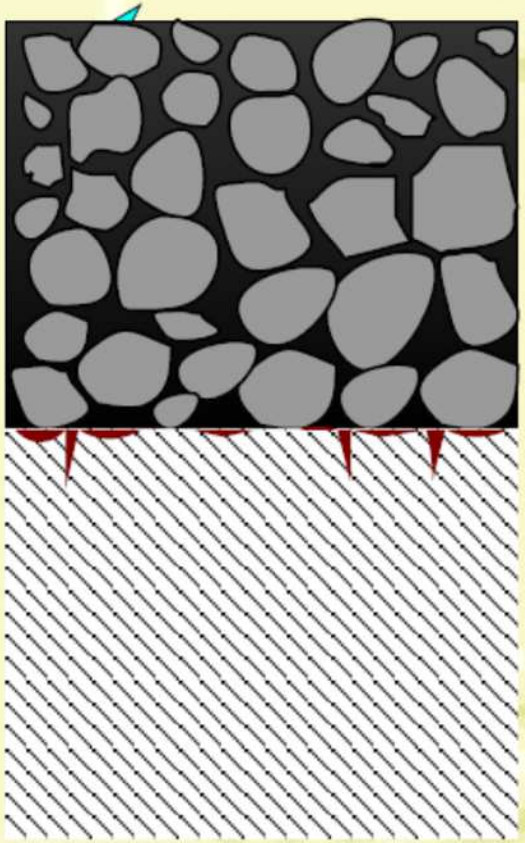


<Progress of destruction>

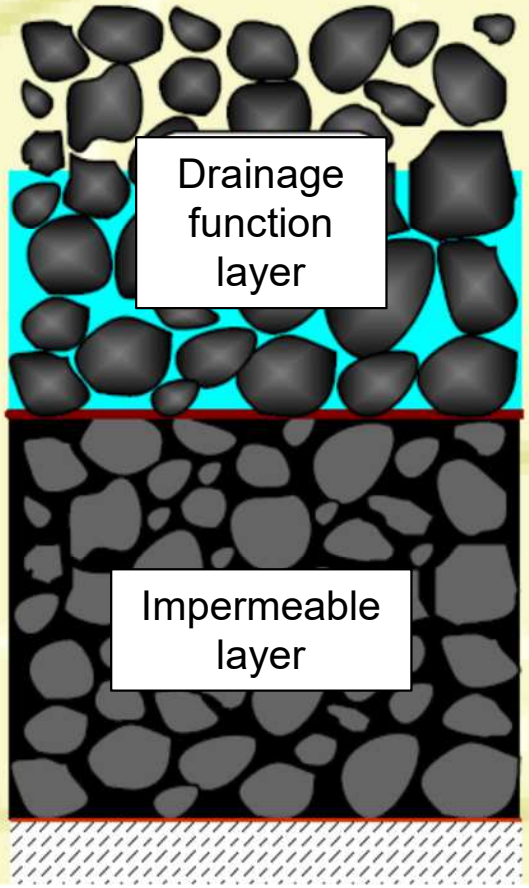
Water-shielding method under the drainage functional layer

General pavement

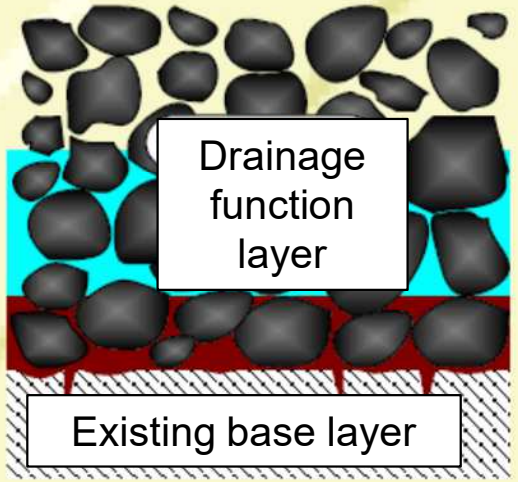
Rainwater flow



Drainage pavement



Water-impermeable and drainage pavement



Drainage function

- Water-blocking function
- Strengthened adhesion
- Stress relief

1.6 Other Damage

1.6.1 Pothole

This is the localized flaking of asphalt mixture on the asphalt surface.

Potholes can be caused by localized insufficient bearing capacity of the base course, poor joining of coarse aggregate with the asphalt, poor blending of the mixture, and insufficient asphalt in the mixture and so on.


Pothole

1.6.2 Pumping

This is the phenomenon whereby water or base course materials, etc. pump out from cracks in the pavement surface.

This is caused by the passing of vehicles over base course materials that have been eroded by spring water or water infiltration from the surface.

1.6.3 Slippage

This is the phenomenon whereby shearing force between courses arising from traffic load causes the asphalt mixture to slip, leading to occurrence of cracks and irregularity in the pavement surface.

It is mainly caused by poor adhesion between pavement courses, deterioration of adhesion due to infiltration of water between pavement courses, insufficient application of emulsion and so on.

Asphalt pavement damage

Hair crack

Linear crack

Difference in level

Asphalt pavement damage

Reflection crack

Cracks caused by structure

Construction joint cracks

Asphalt pavement damage

← Cracks on steel floorboard stringers

Rut cracking →

Asphalt pavement damage

Cracking caused by subsidence

Cracks caused by displacement

Cracks caused by freezing

Asphalt pavement damage

Mesh-like cracks

Cracks caused by surface displacement

Pumping

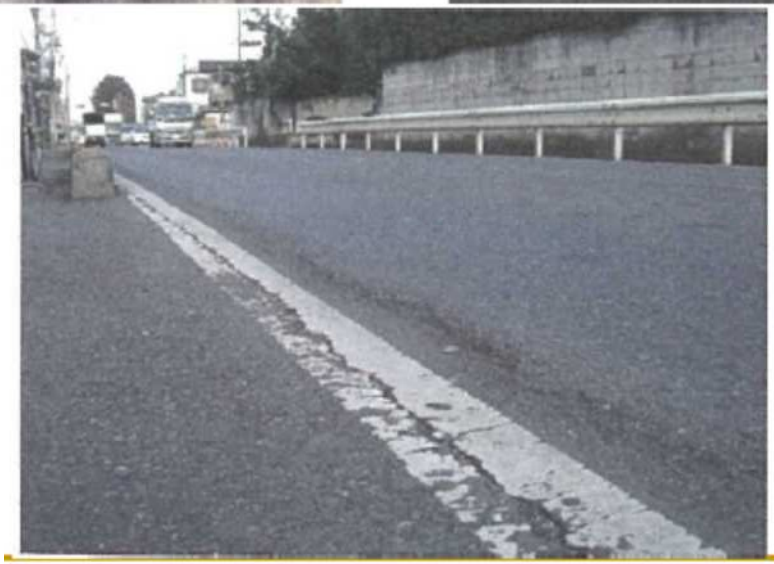
Asphalt pavement damage

← Rutted excavation due to deformation of pavement strip

Rutting due to abrasion of asphalt mixture →

Asphalt pavement damage

Fluid ruts



Road Maintenance Center Foundation
Asphalt pavement maintenance technology

Asphalt pavement damage

Corrugation

Pothole

Close wave

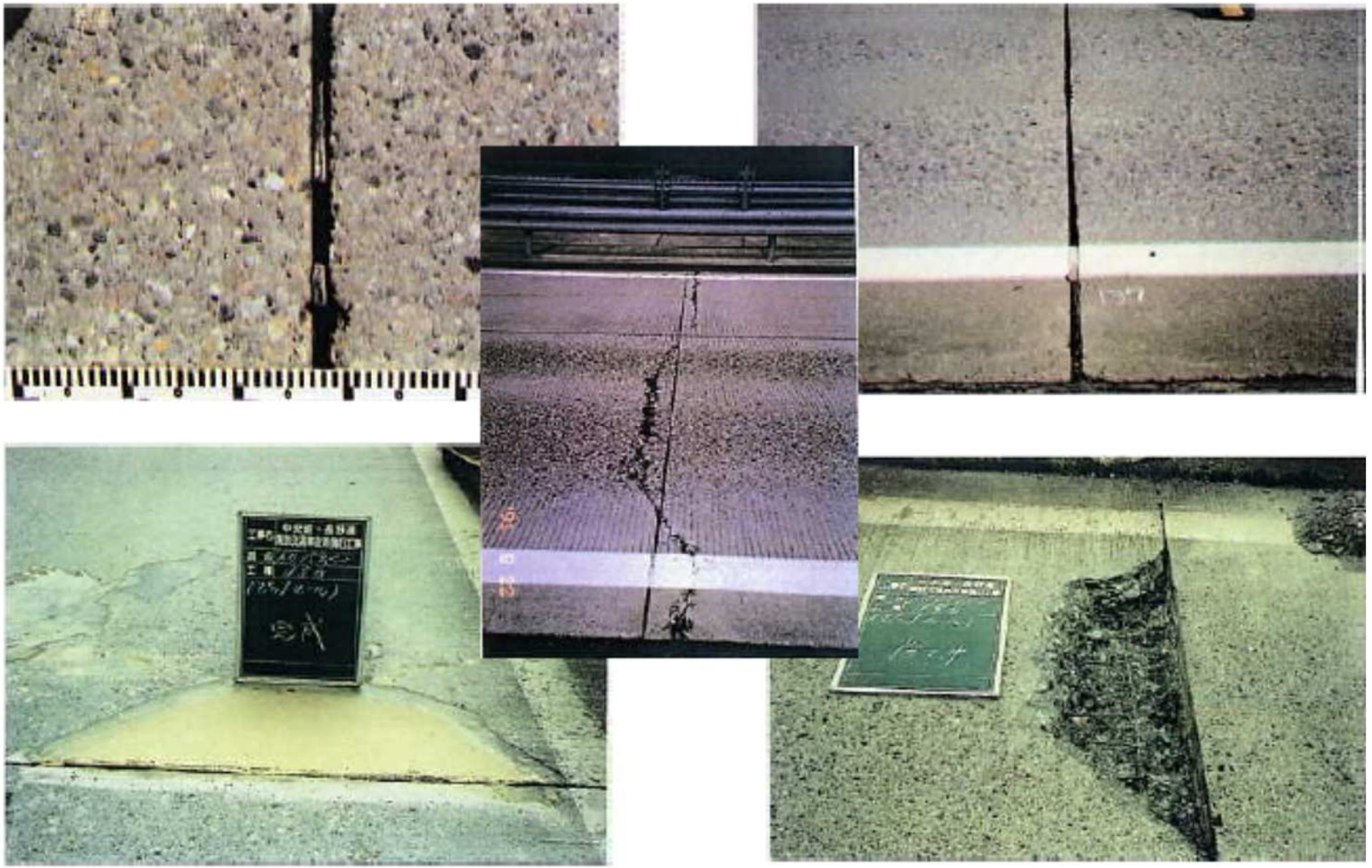
Raveling

Blistering

1.7 Asphalt pavement damage

破損の種類			主な原因等	原因と考えられる層	
				路面	コンクリート版以下
ひび割れ		初期ひび割れ	施工時における異常乾燥，打設後コンクリートの急激な温度低下	○	○
		隅角部ひび割れ	路床・路盤の支持力不足，目地構造・機能の不完全，コンクリート版厚の不足，地盤の不等沈下，コンクリートの品質不良等		◎
		横断方向ひび割れ			◎
		縦断方向ひび割れ			◎
		亀甲状ひび割れ			◎
		構造物付近のひび割れ	構造物と路盤との不等沈下，構造物による応力集中		◎
平たん性の低下	摩耗わだち	ラベリング	タイヤチェーンの走行等	◎	
	平たん性	縦断方向の凹凸	地盤の不等沈下，路床・路盤の支持力不足	○	○
	段差	版と版の段差	ダウエルバー・タイバーの機能の不完全，ポンピング現象，路床・路盤の転圧不足，地盤の不等沈下		◎
		版とアスファルト舗装との段差		○	○
		構造物付近の段差			◎
浸透水量の低下		滞水，水はね	空隙づまり（ポーラスコンクリート）	◎	
すべり抵抗値の低下		ポリッシング	摩耗，粗面仕上げ面の摩損，軟質骨材の使用	◎	
騒音値の増加		騒音の増加	路面の荒れ	◎	
目地部の破損		目地材の破損	目地板の老化，注入目地材のはみ出し，老化・硬化・軟化・脱落，ガスケットの老化・変形・はく脱飛散等	◎	
		目地縁部の破損	目地構造・機能の不全	○	○
その他		はがれ（スケーリング）	凍結融解作用，コンクリートの施工不良，締固め不足	◎	
		穴あき	コンクリート中に混入した木材等不良材料の混入，コンクリートの品質不良	◎	
		座屈（ブローアップ，クラッシング）	目地構造・機能の不全		◎
		版の持ち上がり	凍上抑制層厚さの不足		◎
		路盤のエロージョン	ポンピング作用による路盤の浸食		◎

Damage at joints in concrete pavement



Crack damage and sealant injection in concrete pavement

Peeling repair of concrete pavement

Patching with resin-filled concrete

Improvement of slip resistance of concrete pavement