

Toward Efficient Pavement Management based on Inspection Technical Standards in Japan

2022.10.29 The PDRG Meeting JRPUG 2022



Public Works Research Institute

Pavement Research Team
Team Leader

YABU Masayuki

History

Year	Public Works Research Institute(PWRI)	Civil Engineering Research Institute for Cold Region(CERI)
1922	Established as the Civil Engineering Laboratory in the Ministry of Internal Affairs.	
1923		Founded as the Testing Laboratory of the Civil Engineering Department, Hokkaido Agency.
1948	Renamed as the Public Works Research Institute, Ministry of Construction.	
1951		Attached to the newly established Hokkaido Development Bureau and renamed as the Civil Engineering Research Institute.
2001	Established the Independent Administrative Agency Public Works Research Institute.	Renamed as the Independent Administrative Institution the Civil Engineering Research Institute of Hokkaido.
2006	Integrated as the Incorporated Administrative Agency Public Works Research Institute.	
2015	Transformed into the National Research and Development Agency Public Works Research Institute.	

Tsukuba



Sapporo



R&D Program

PWRI will work on the following issues revealed at the medium to long-term objectives to focus on socially demanding issues while looking at the future.

1. Contribution to realization of a safe and secure society
2. Contribution to strategic maintenance and renewal of public infrastructure
3. Contribution to realization of a sustainable and vibrant society

1. Present Status of Road Pavement in Japan

2. Inspection Guideline for Pavement

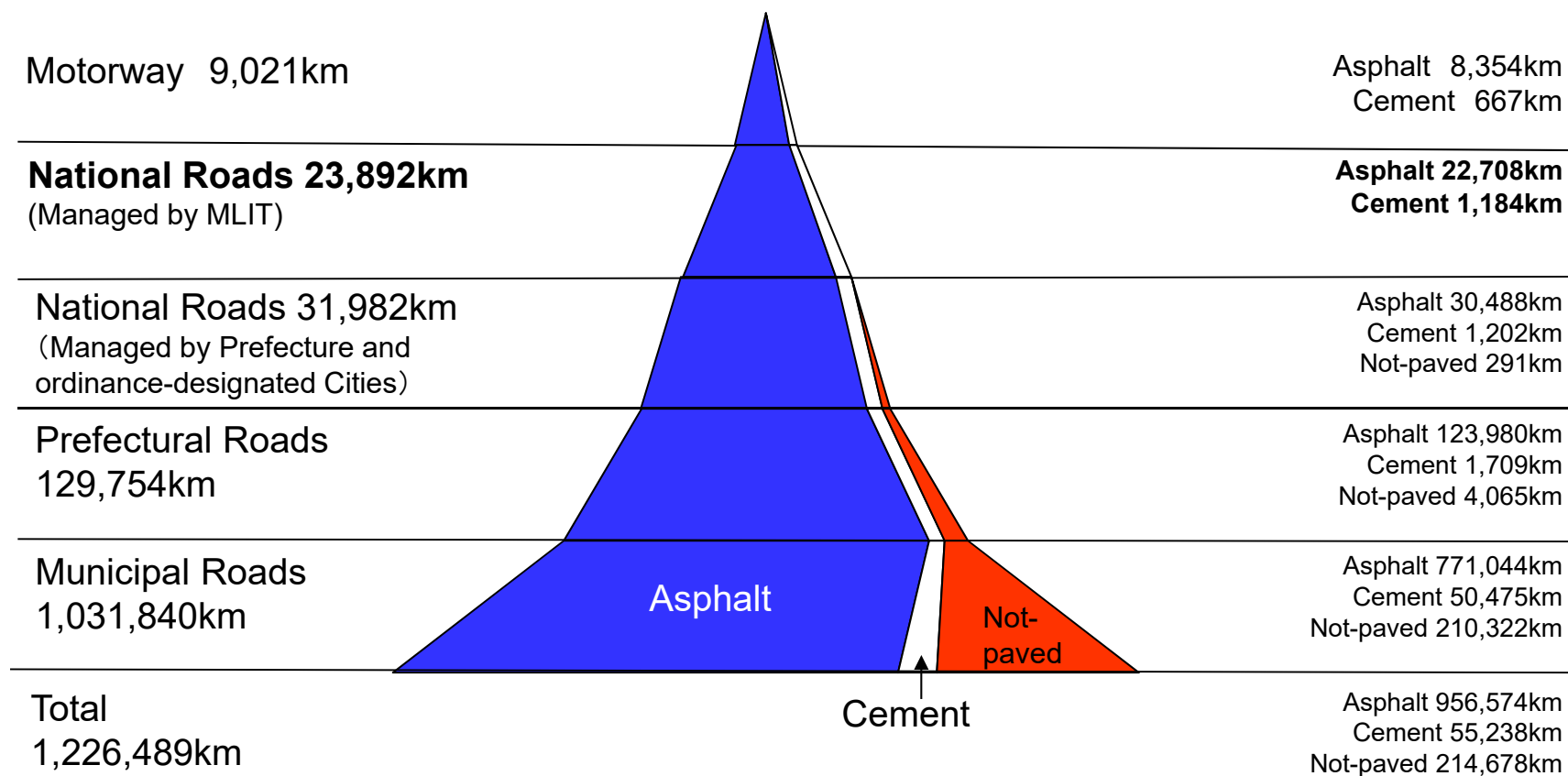
(Road Bureau, Ministry of Land, Infrastructure, Transport and Tourism, 2016)

3. Toward Efficient Pavement Management

Present Status – Road Pavement –

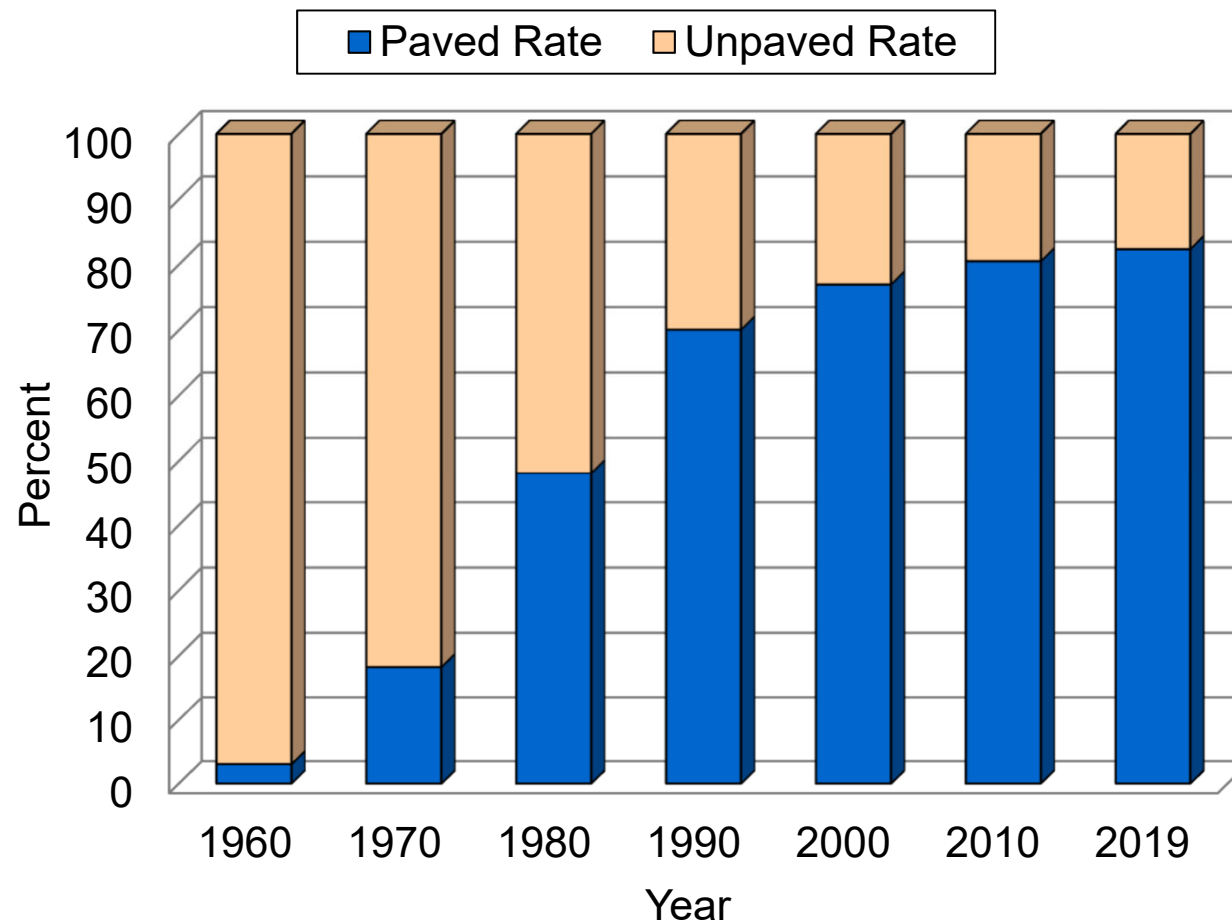


(2019.3.31)



※ Road statistics annual report ,MLIT

Present Status – Paved Rate –



※ Road statistics annual report ,MLIT

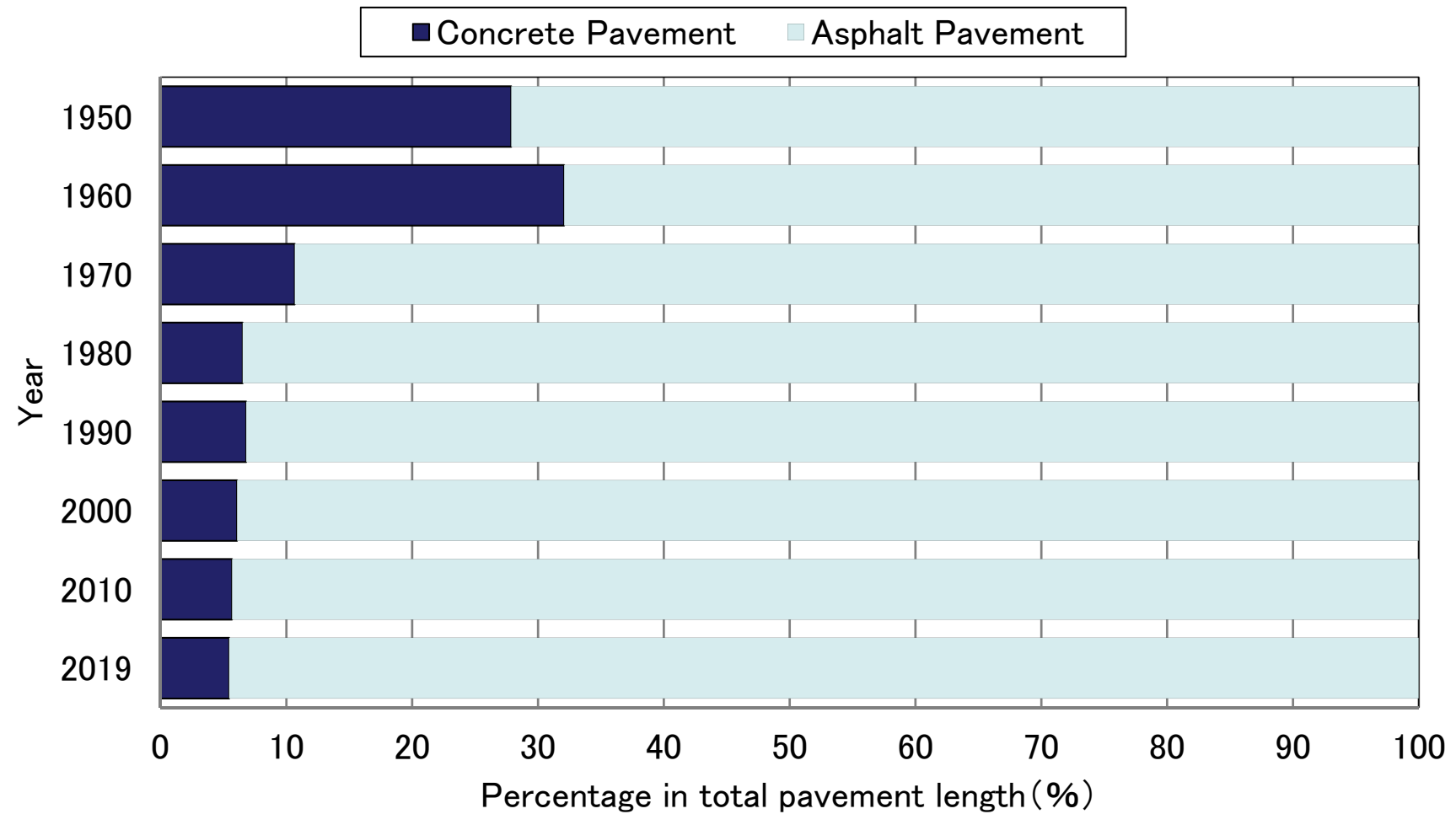
■ Unpaved



■ Paved



Present Status – Pavement Type –

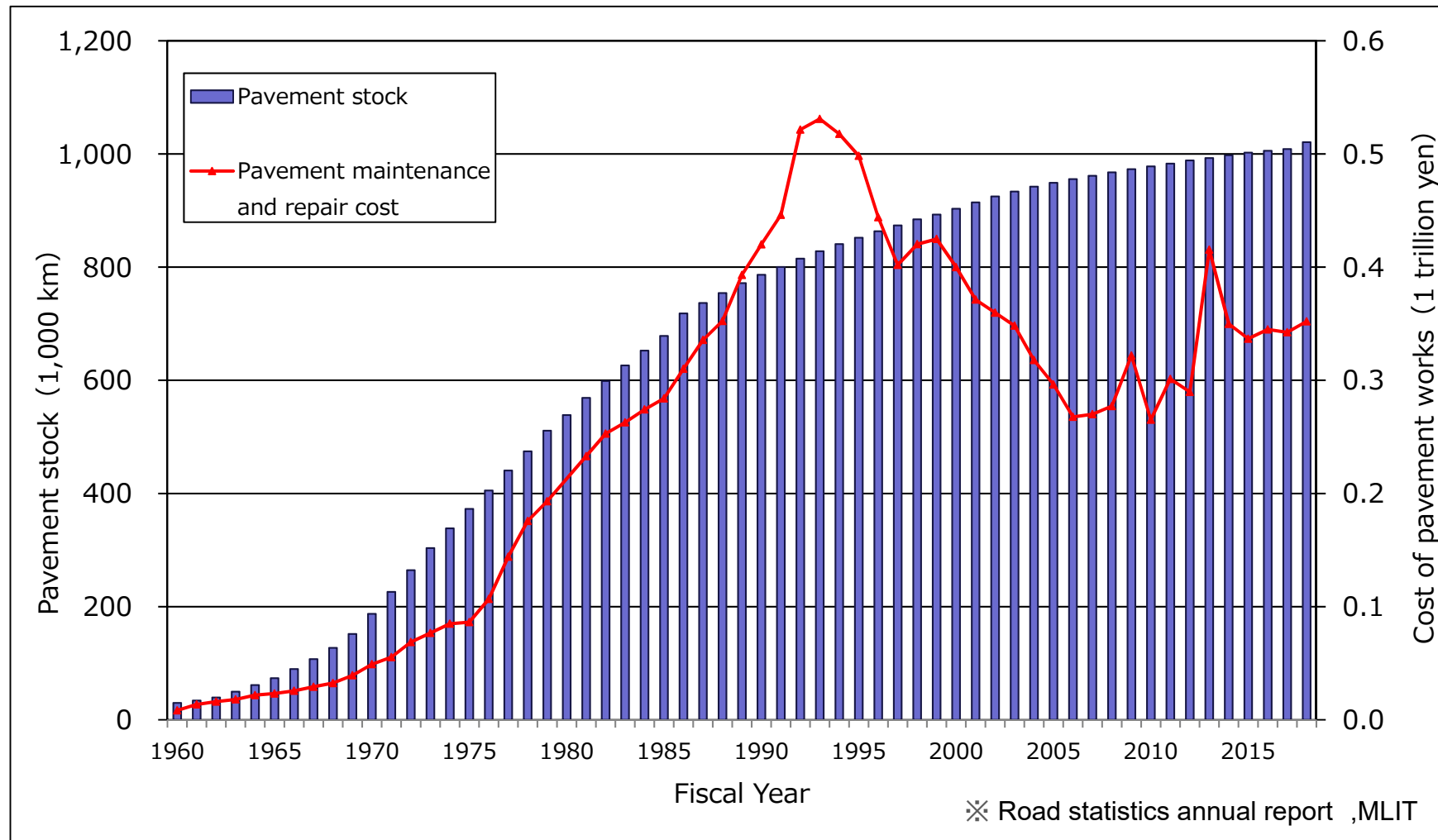


※ Road statistics annual report ,MLIT

Present Status – Pavement Stock & Maintenance Cost –



- The budget is decreasing and the appropriate preventive maintenance and repairs are insufficient.



The Maintenance Cycle shall be established to extend the life of pavement and reduce LCC

Maintenance Cycle



Inspection



Diagnosis

**Maintenance
Cycle**

区分	
I	健全
II	表層機能保持段階
III	修繕段階

**Implementation
of Measures**



Recording

Inspection Guideline for Pavement

Road Bureau,
Ministry of Land, Infrastructure,
Transport and Tourism,

2016.10

舗装点検要領

平成28年10月
国土交通省 道路局

1. Present Status of Road Pavement in Japan

2. Inspection Guideline for Pavement

(Road Bureau, Ministry of Land, Infrastructure, Transport and Tourism, 2016)

3. Toward Efficient Pavement Management

Inspection Guideline for Pavement

[Table of Contents]

- | | |
|--|---|
| 1. Scope of Application | |
| 2. Purpose of Inspection | |
| 3. Definition of Terms | |
| 4. Classification of Roads | |
| 5. Basic Concept of Inspection | |
| 6. Inspection of Asphalt Pavement | 6-2 Roads with Slow Damage Progression (Classes C and D) |
| 6-1 Roads with Fast Damage Progress (Classes A and B) | (1) Inspection Method |
| (1) Inspection Method | (2) Soundness Diagnosis |
| (2) Soundness Diagnosis | (3) Implementation of Measures |
| (3) Implementation of Measures | (4) Recording |
| (4) Recording | |
| | 7. Inspection of Concrete Pavement |
| | (1) Inspection Method |
| | (2) Soundness Diagnosis |
| | (3) Implementation of Measures |
| | (4) Recording |

Provision for effective implementation of pavement repair

- The pavement inspection guideline is provided for the improvement of travel performance and comfort according to the road characteristics by **effectively implementing repairs**.

Position of the Guideline

The guideline specifies basic items relevant to the inspection to be implemented the provision for effective implementation of repairs including the extension of the service life and the reduction in the life cycle cost (LCC) of pavement.

Maintenance Cycle

- (1) Inspection Method**
- (2) Soundness Diagnosis**
- (3) Implementation of Measures**
- (4) Recording**

Concepts of inspection depending on the structural characteristics of pavement types.

Basic Concepts of Inspection

(1) Asphalt pavement

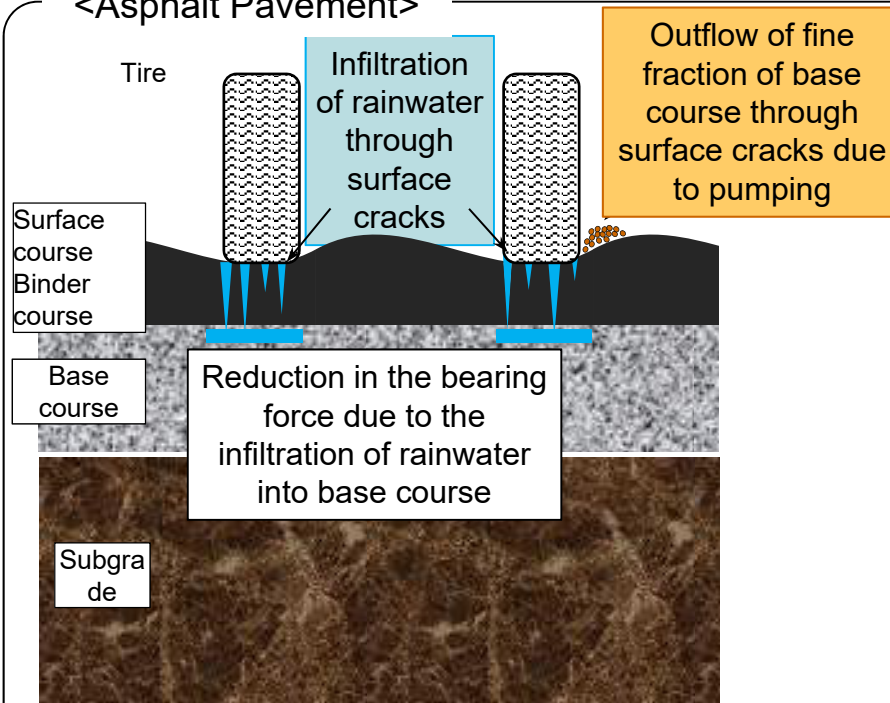
- Inspection for the extension of service life in a manner that protects base course and below by repairing surface and binder courses at appropriate times.

(2) Concrete pavement

- Inspection focusing on joint sections and cracks on slabs in order to prolong the high durability of concrete pavement for an even longer period.

Outline of Inspection Guideline ③-2

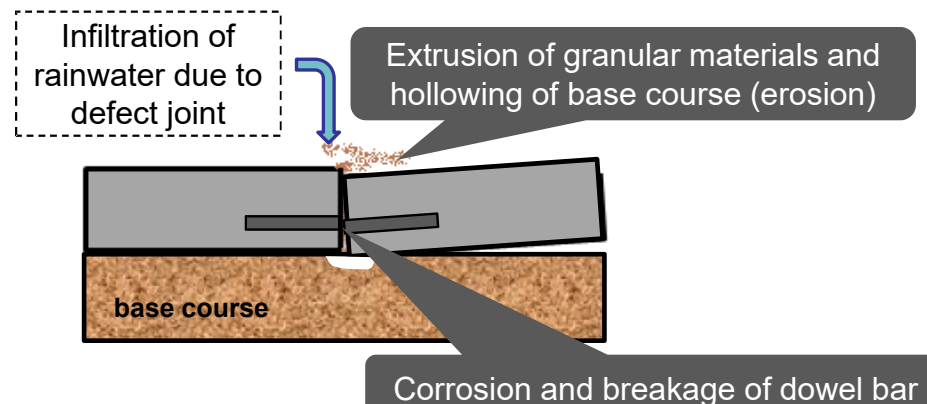
<Asphalt Pavement>



Concentration of crushed stone after the outflow of fine fraction from base course due to pumping



<Concrete Pavement>



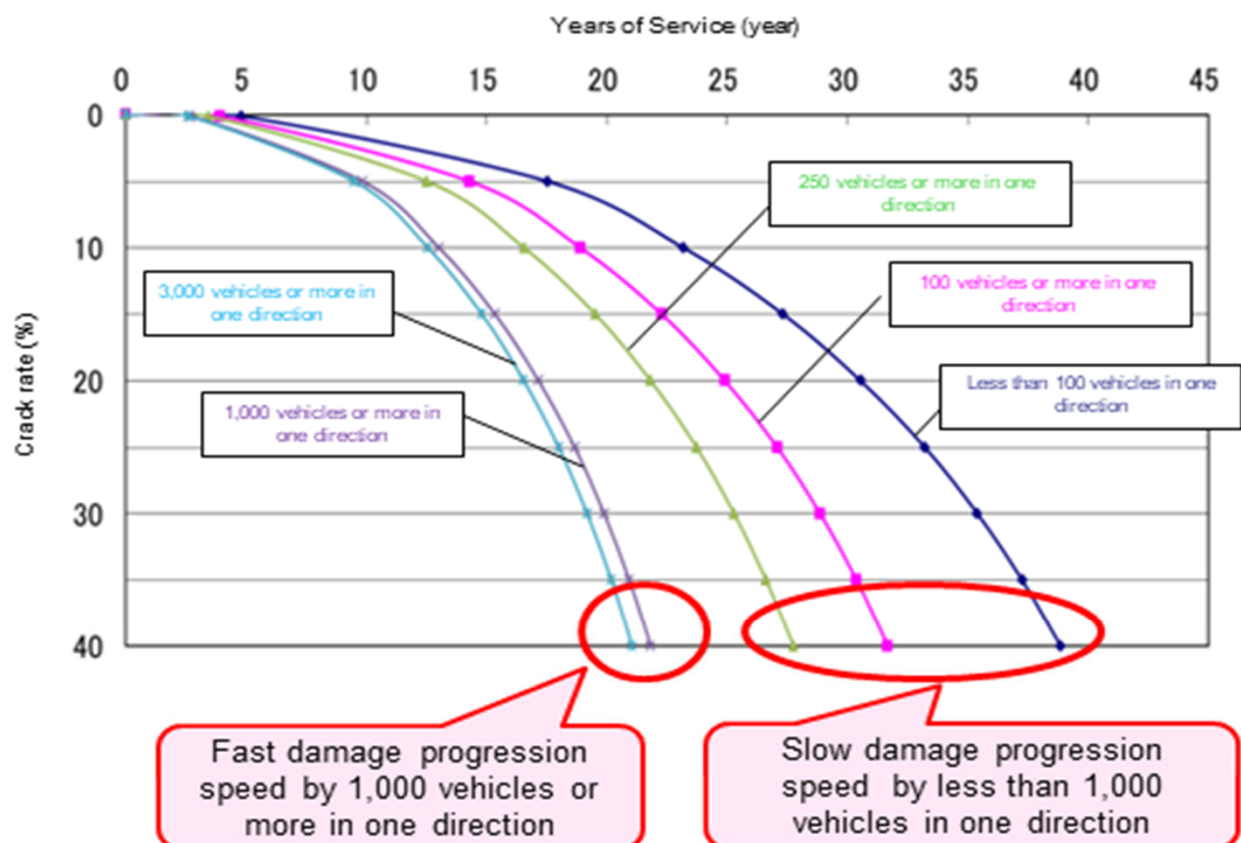
Classification of roads according to the damage progression speed and road characteristics

Classification of Roads

Large classification	Small classification	Class	Road type (Image)
Roads with fast pavement damage progression (For example, roads with a lot of heavy vehicle traffic)	Arterial high-standard highways (Roads such as express highways for which a high level of services are required)	A	Express highways
		B	National highways managed by the national government
Roads with slow pavement damage progression (For example, roads with not much heavy vehicle traffic)		C	Municipal roads of government-decreed cities
	Residential roads (Roads with extremely slow pavement damage progression and long service life if not affected by the excavation associated with public utility works)	D	Municipal roads

Outline of Inspection Guideline ④-2

Relation between heavy vehicle traffic and damage to pavement on asphalt pavement



Source: Data of the Ministry of Land, Infrastructure, Transport and Tourism

Outline of Inspection Guideline ⑤-1

Inspection methods according to classification of roads

Asphalt Pavement

■ Roads with Fast Damage Progression (Classes A and B)

- Implementing effective repairs on surface course at appropriate times to prevent damage to base course
- Setting target service periods to promote pavement management with a focus on extension of service life
- Implementing inspection at least once every 5 years
- Classification of damage determination criteria into 4 categories

■ Road with Slow Damage Progression (Classes C and D)

- The guideline specifies the establishment of an inspection plan and the implementation of inspection according to the plan.
- Classification of damage determination criteria into 3 categories

Concrete Pavement

- Roads with fast damage progression and roads with slow damage progression

- Priority confirmation of the status of weak structural sections such as joints
- Inspection frequency of at least once every 5 years (for roads with fast damage progression);
- Establishment of inspection plans and implementation of inspection according to plans (for roads with slow damage progression)
- Grouping the classifications into 3 categories.

Soundness Diagnosis

(Asphalt Pavement)

Classification	
I	Sound
II	Stage with function of surface course preserved
III	Stage requiring repair
	(III-1: repair of surface course)
	(III-2: replacement of base course)

Classes A&B (I, II, III-1, III-2)

Classes C&D (I, II, III)

(Concrete pavement)

Classification	
I	Sound
II	Stage requiring minor repair
III	Stage requiring major repair

Case of National Roads Managed by MLIT (Asphalt Pavement)

I : Cracking Ratio < 20%

Rutting depth < 20mm

IRI < 3mm/m

II : 40 > Cracking Ratio ≥ 20%

40 > Rutting depth ≥ 20mm

8 > IRI ≥ 3mm/m

III : Cracking Ratio ≥ 40%

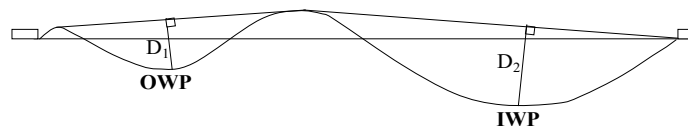
Rutting depth ≥ 40mm

IRI ≥ 8mm/m

Rutting \Rightarrow Rutting Depth (D)



$$D = \max(D_1, D_2)$$



Cracking \Rightarrow Cracking Ratio (C)



$$C = \frac{\text{Cracking area (m}^2\text{)}}{\text{Section area (m}^2\text{)}} \times 100$$





Calculation method of cracking area is defined by Manual for Pavement Testing Method (Japan Road Association)

Setting Target Service Life



Soundness Diagnosis (Asphalt Pavement Classes A and B)

Classification		Condition
I	Sound	Minor damage: deterioration is at a minor level with reference to the management standards with pavement surface kept in sound condition.
II	Stage with function of surface course preserved	Intermediate damage: deterioration is at an intermediate level with reference to the management standards.
III	Stage requiring repair	Major damage: deterioration exceeds or is expected to be at an early stage in exceeding the management standards.
	(III-1: repair of surface course)	The in-service period of a surface course exceeds the target service life (on the assumption that base course is still in sound condition)
	(III-2: replacement of base course)	The in-service period of a surface course is less than the target service life (on the assumption that a course below base course is damaged)



Damage evaluation of asphalt pavement [Crack]

Classification	Damage Images
○ I: Sound (Cracking ratio of 0% to 20%)	
○ II: Stage with function of surface course preserved (Cracking ratio of 20% to 40%)	 
○ III: Stage requiring repair (Cracking rate of 40% or more)	 





Damage evaluation of asphalt pavement [Rutting]

Classification	Damage Images
○ I: Sound (Rutting depth from 0 to 20 mm)	
○ II: Stage with function of surface course preserved (Rutting depth from 20 to 40 mm)	
○ III: Stage requiring repair (Rutting depth of 40 mm or more)	

Damage evaluation of asphalt pavement [IRI]

Classification	Damage Images
○ I: Sound (IRI of 0 to 3 mm/m)	
○ II: Stage with function of surface course preserved (IRI of 3 to 8 mm/m)	
○ III: Stage requiring repair (IRI of 8 mm/m or more)	

Damage evaluation of concrete pavement

Classification	Damage Images
○ I: Sound	
○ II: Stage with function of surface course preserved	 
○ III: Stage requiring repair	 

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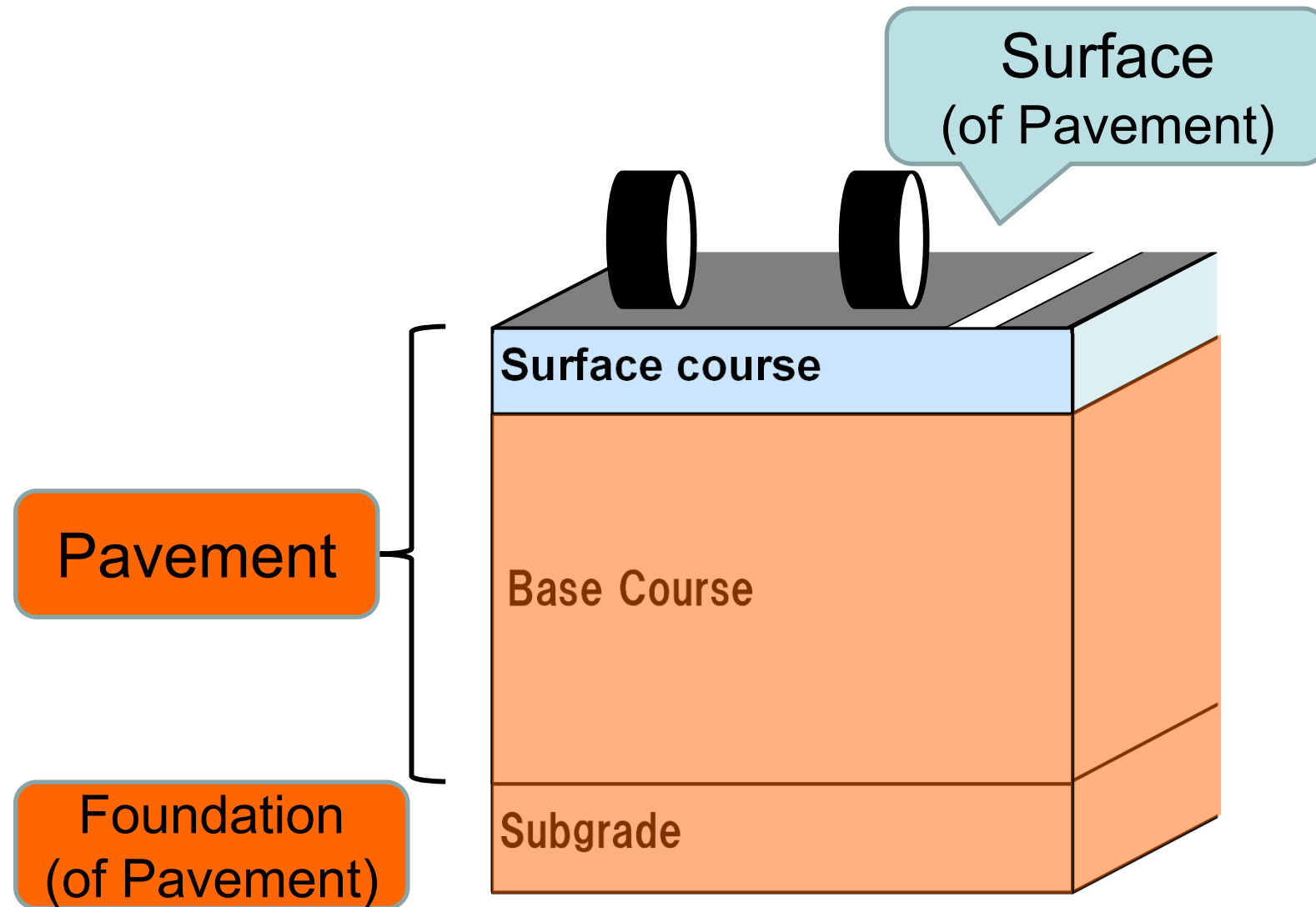
(Road Bureau, Ministry of Land, Infrastructure, Transport
and Tourism, 2016)

3. Toward Efficient Pavement Management

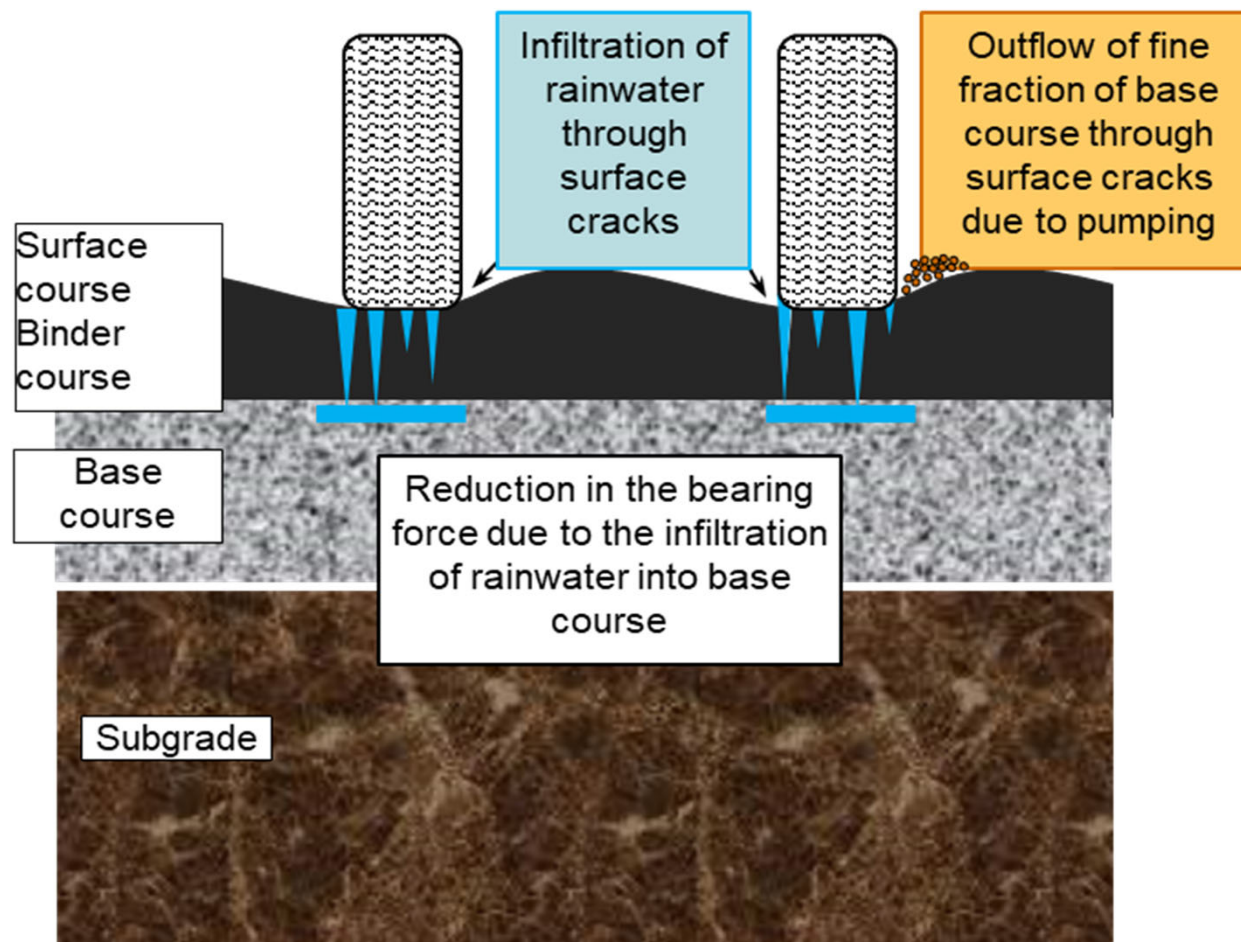
- **Indicates inspection, diagnosis, Implementation of measures, and records**
- **Inspection according to road characteristics**
(← Not uniform for all roads)
- **Inspection focusing on pavement structure**
(← not only road surface)

Considered pavement as a structure.





<Mechanism of structural damage on pavement (example)>



Considered pavement as a structure.

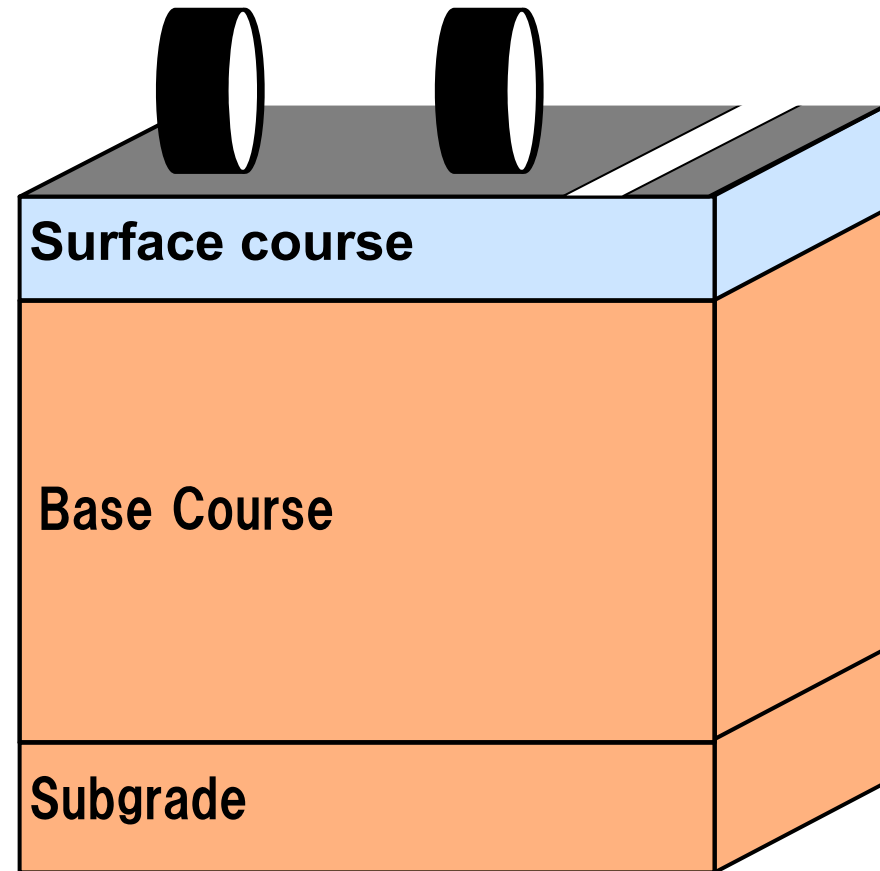
(Without considering its function as a road surface.)

Bridge

Pavement

Inspection Guideline for Pavement(excerpt)

•••Inspection for the extension of service life in a manner that **protects base course and below** by repairing surface and binder courses at appropriate times.



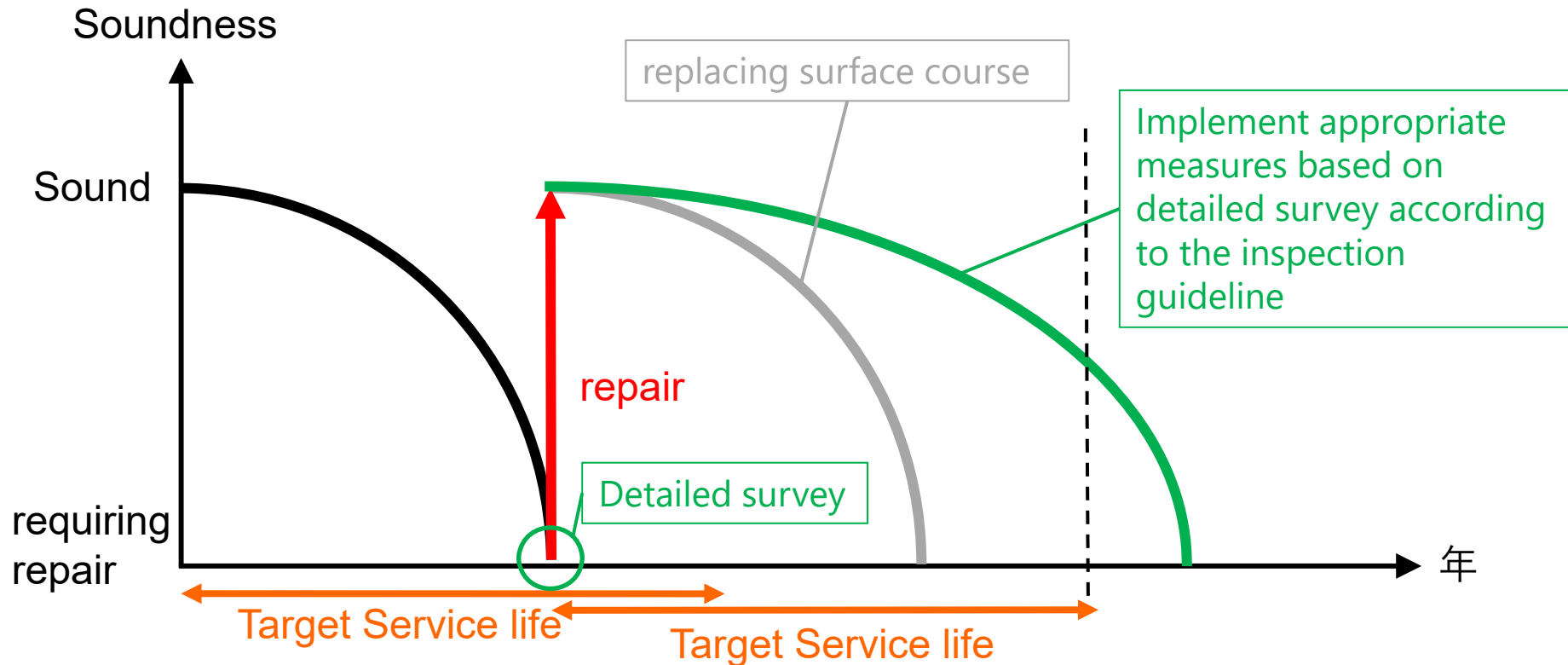
Setting Target Service life

Soundness Diagnosis(Asphalt Pavement Classes A and B)

Classification		Condition
I	Sound	Minor damage
II	Stage with function of surface course preserved	Intermediate damage
III	Stage requiring repair	Major damage: deterioration exceeds or is expected to be at an early stage in exceeding the management standards.
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	(III-2: replacement of base course)	The in-service period of a surface course is less than the target service life (on the assumption that a course below base course is damaged)

III-2: Detailed survey should be conducted and appropriate measures should be implemented based on the results of the survey.

Pavement Management using Target Service Life



In order to extend the life of the pavement as a whole, it is necessary to **eliminate the "early deterioration section"**



Open-cut survey



FWD

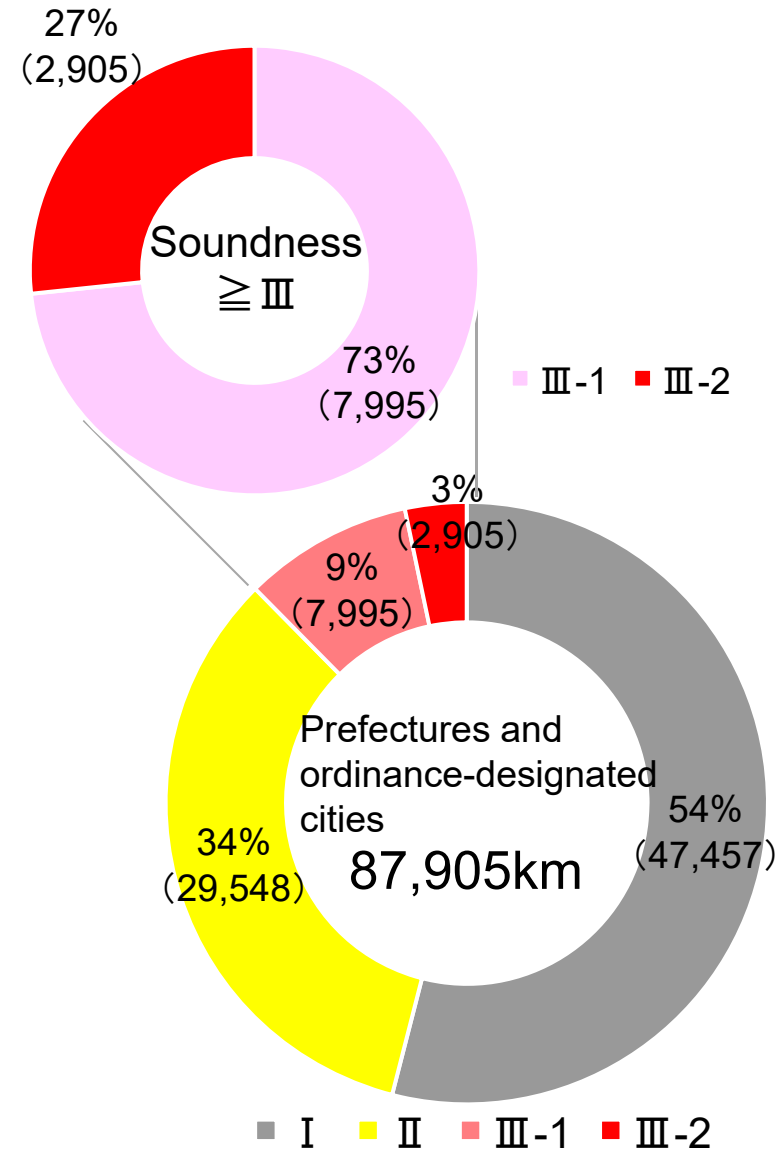
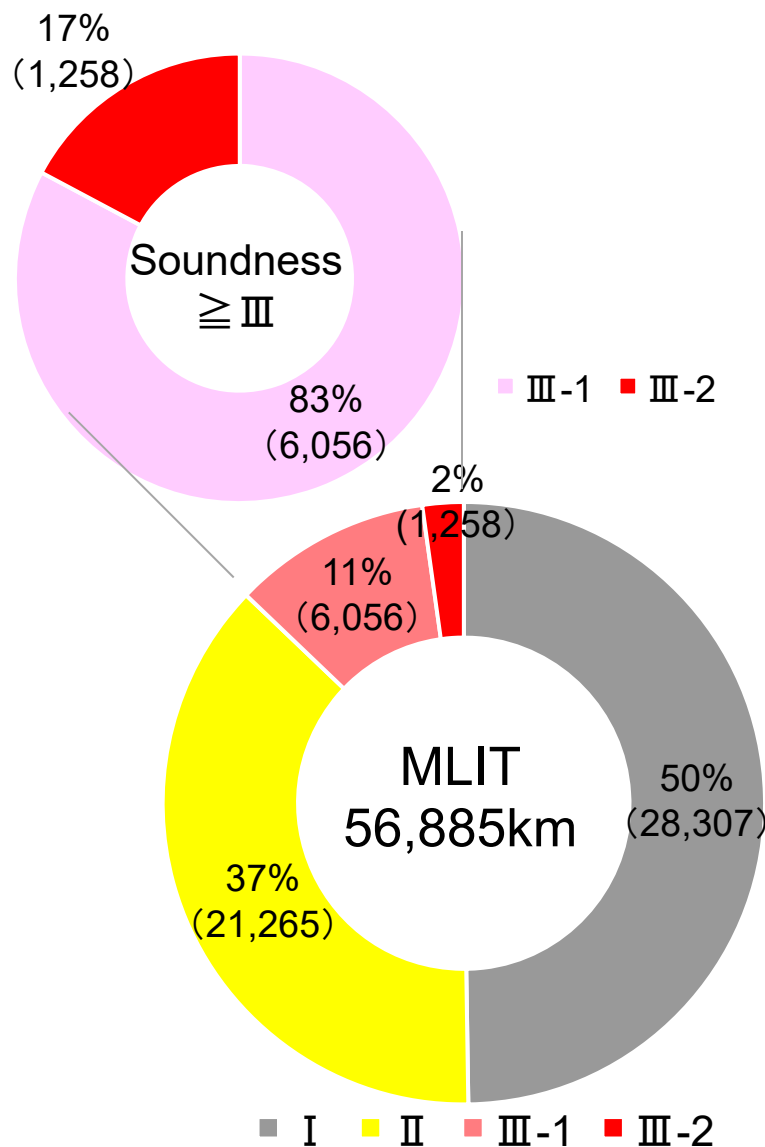


Core

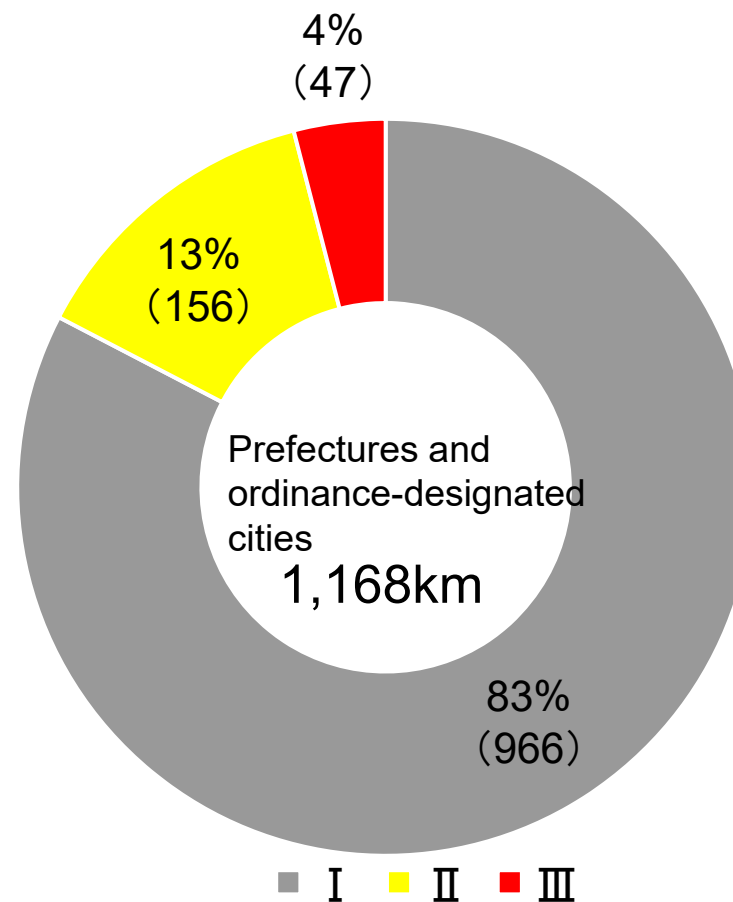
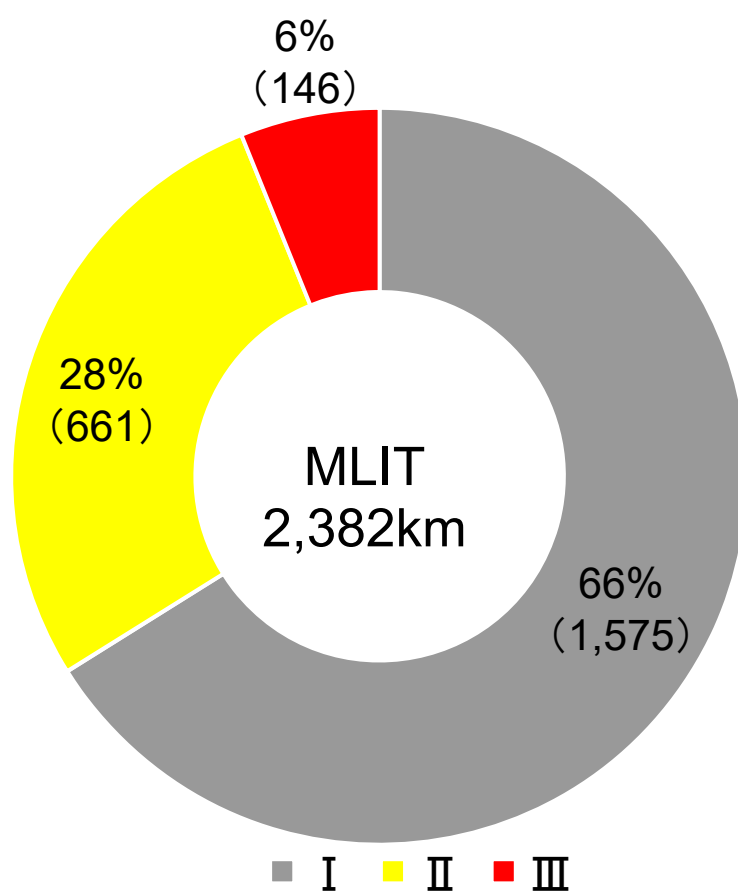


Present Status – Soundness of Road Pavement –

[Asphalt Pavement]



[Concrete Pavement]



Handbooks and Manuals (Related to the Guideline)



Inspection Guideline for Pavement

MLIT

舗装点検要領

平成28年10月
国土交通省 道路局

2016.10

Handbooks & Manuals

Japan Road Association
(Pavement Committee)

MLIT

Research Institute
University

Pavement Contractor

舗装点検必携

平成29年版

平成29年4月

公益社団法人 日本道路協会

2017.4

For inspection on site

舗装点検要領に基づく
舗装マネジメント指針

平成30年9月

公益社団法人 日本道路協会

2018.9

For pavement management

For detailed survey & repair

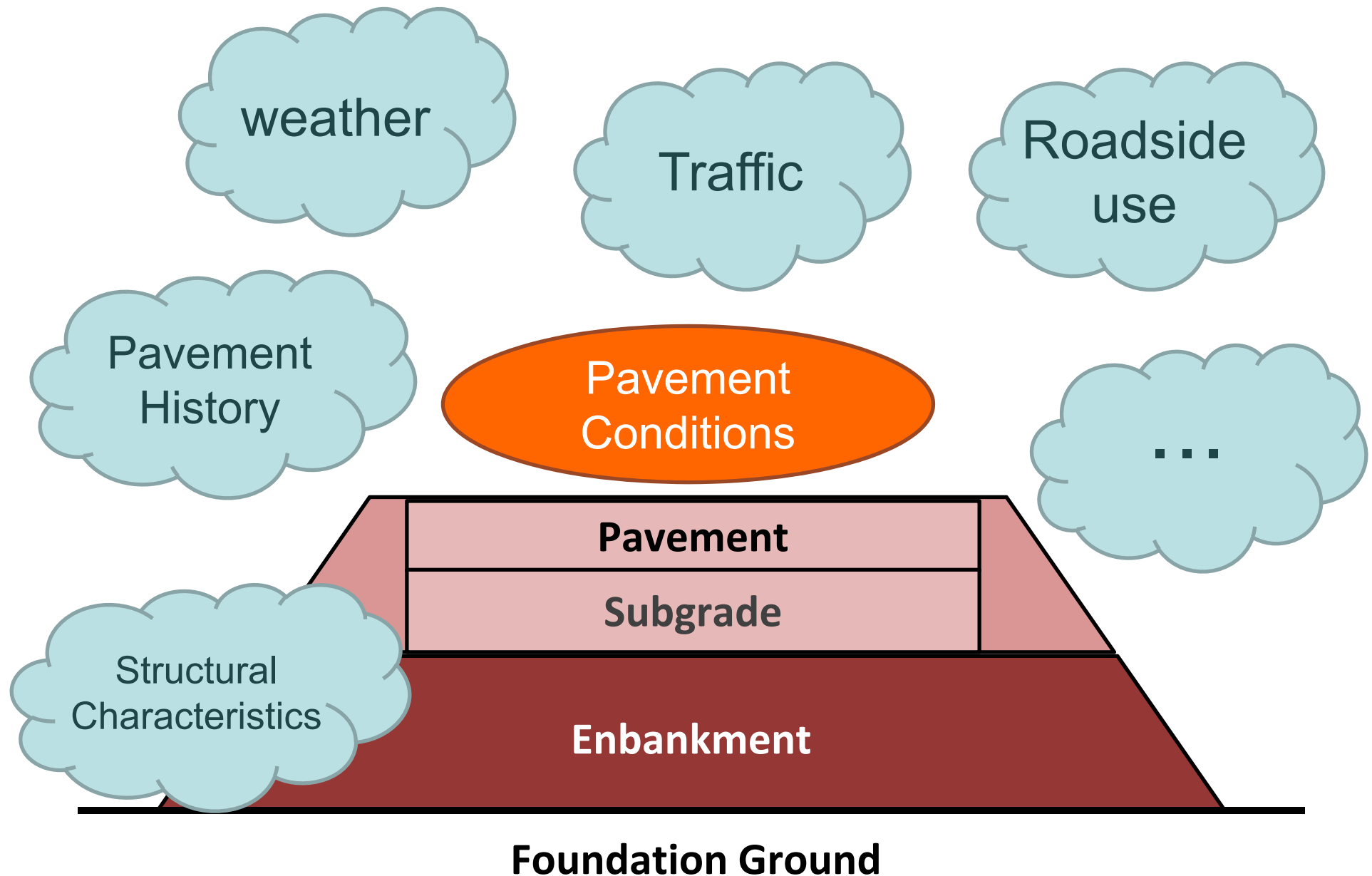
アスファルト舗装の詳細調査・修繕設計便覧

令和〇〇年〇〇月

公益社団法人 日本道路協会

in preparation

Various conditions affecting the pavement



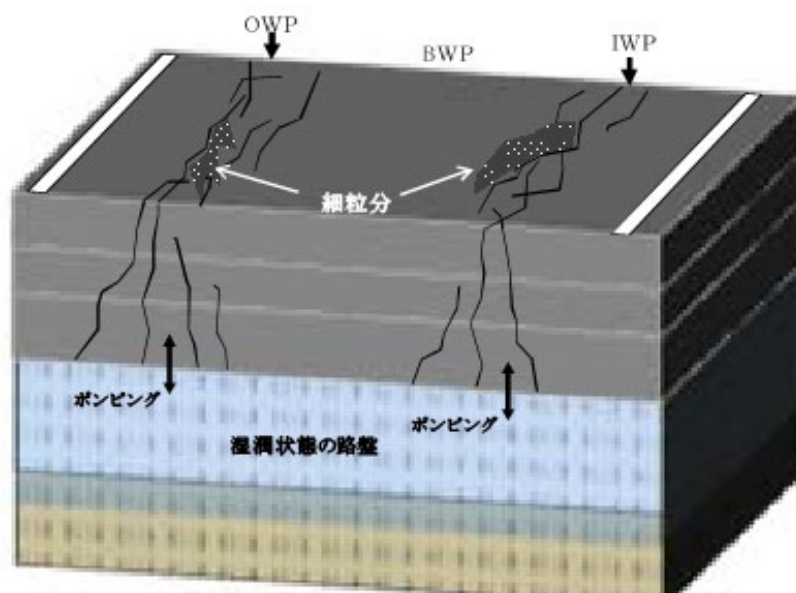
Studying and Gathering of Knowledge



Research Project

Research on long-life design and renewal technology
according to the cause of pavement damages
(2022-2027)

Develop appropriate pavement design methods based on the mechanism of rapid deterioration.



- How to prevent factors that cause rapid deterioration
- How to avoid rapid deterioration even in the presence of factors that cause rapid deterioration

PWRI Activities (related to the guideline)



PWRI
Pavement Test
Field
(Accelerated
pavement
testing facility)

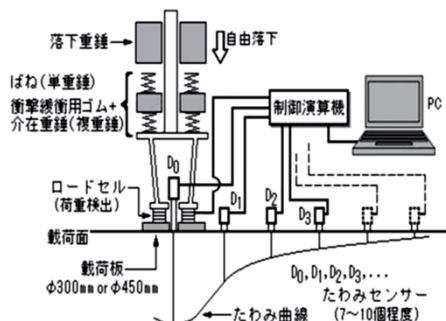
Heavy vehicle



PWRI Activities (related to the guideline)

FWD Verification

FWD Verification Facility



Verification Certificate

認定書

FWD証第H29〇〇〇号

舗装たわみ測定装置(FWD)検定認定書

株式会社 〇〇〇〇 殿

貴社から申請のあった下記装置は、舗装たわみ測定装置(FWD)として
舗装たわみを適切に評価できる装置であることを認証する。

2017/〇〇/〇〇

認定機関 国立研究開発法人土木研究所
理事長 西川 和廣

- 舗装たわみ測定装置(FWD)

所有者	株式会社 〇〇〇〇
種類	つくば 〇〇〇 す 〇〇〇〇
- 検定試験

検定日	2017/XX/XX
検定方法	検定要領に準拠
- 試験結果

仕様評価	提出書類	装置	荷重計	:合格
		装置	ひずみ計	:合格
		装置	温度計	:合格
性能検定	荷重計	書類	自動車検査証	:合格
	ひずみ計			:合格
- 本装置の有効期間

2019/△△/△△

国立研究開発法人土木研究所

Efforts to develop MWD

FWD

Measurement takes time because the vehicle is stationary.

Traffic control is needed.



MWD

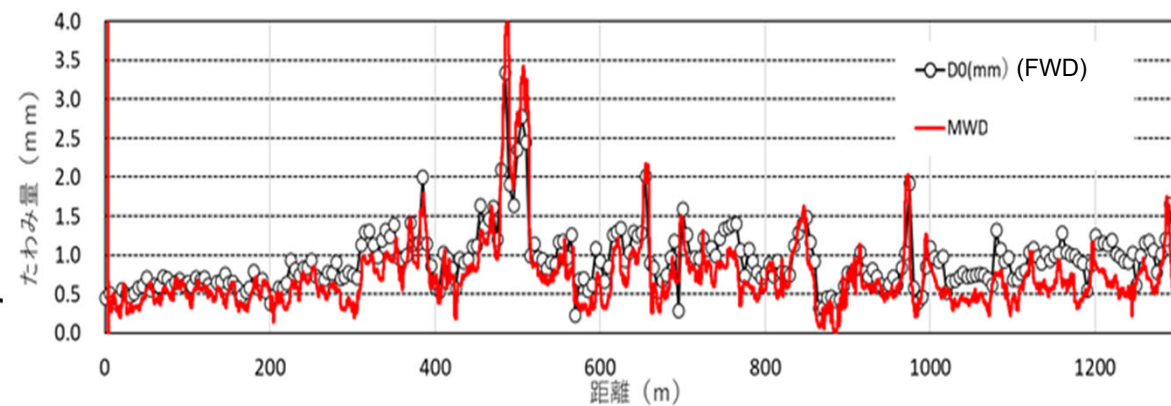
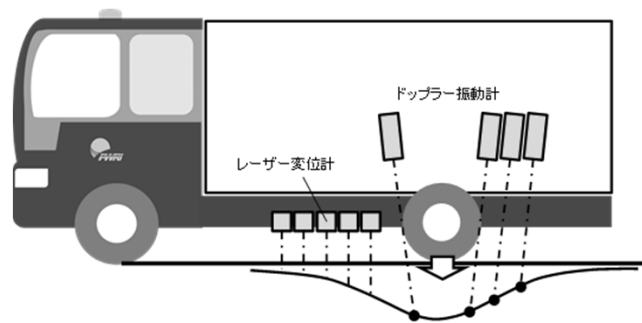
MWD = Moving Wheel Deflectometer

While driving, measure the deflection under the wheels caused by the vehicle's own weight.

→ Efficiently survey the structural soundness of the pavement



Efforts to develop MWD



Thank you for your attention.

