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DIAGNOSIS OF ALKALI-SILICA REACTION IN AIRPORT PAVEMENT IN JAPAN

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Contents

1. Introduction

2. Diagnosis of ASR in an airport

3. Ongoing research project

- Current structural performance
- Future expansion



Introduction

- ASR in airport pavement has rarely been reported in Japan (Recently, several)
- **No established flow** for evaluating ASR-affected pavement
 - e.g. - Diagnosis (to identify ASR and the cause)
 - Performance evaluation (current, future)
- This study is a **case one to suggest the flow**
- In particular, put emphasis on
 1. **Diagnosis**
 2. **Current structural performance**
 3. **Future expansion**



Contents

1. Introduction

2. **Diagnosis** of ASR in an airport

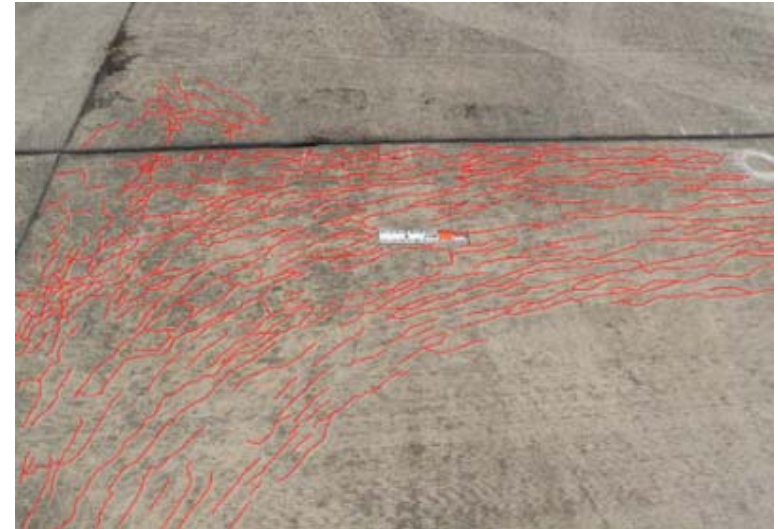
- Outline of the pavement site
- Alkali contents in concrete
- Petrographic examination

3. Ongoing research project

- **Current structural performance**
- **Future expansion**

Outline of the pavement site

- ASR was identified in an pavement area (Deicers are not used)
- Surface cracks were observed in 40% of the pavement slabs
 - No freezing and thawing
 - Few repeated loadings
- Cores were sampled from both sound and cracked pavement slabs



D-cracking due to ASR



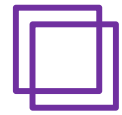
Cross-section of cracked pavement



Estimation of alkali contents

Estimated by following *Katayama*

	Sound pavement	Cracked pavement
I: Total amount of cement alkali (Estimated by EDS analysis of unhydrated cement clinker)	2.3kg/m ³ (Regulation in Japan is <3.0)	2.5kg/m ³
II: Water-soluble alkali from coarse aggregate	0.4kg/m ³	0.5kg/m ³
III: Total alkali in concrete (III = I + II + (fine aggregate, chemical admixture))	2.7kg/m ³	3.2kg/m ³

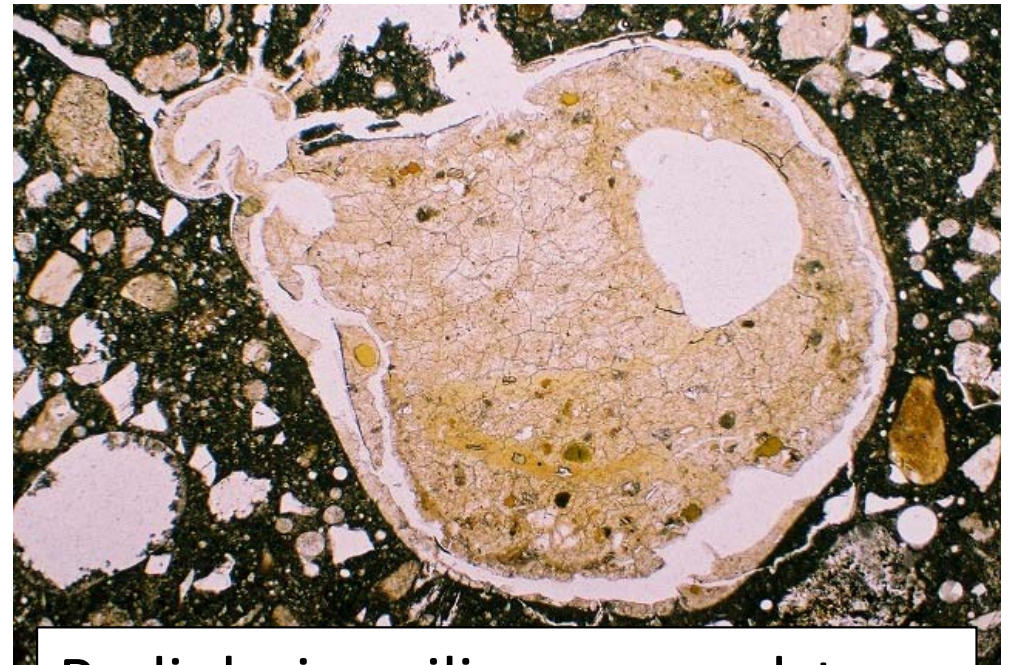


Petrographic examination

Polished thin sections were prepared from cores of sound and cracked pavements



Glassy rhyolite



Radiolarian siliceous mudstone

- ASR was identified in fine aggregates containing rhyolite with **volcanic glass** and mudstone with **opal**

Summary of diagnosis

- ASR occurred even when total amount of cement alkali was less than 3.0 kg/m^3 (Japanese regulation)
- Because fine aggregates contained highly reactive minerals that exhibit a *pessimum proportion effect*
- Petrographic diagnosis points to the necessity of re-considering the Japanese regulation



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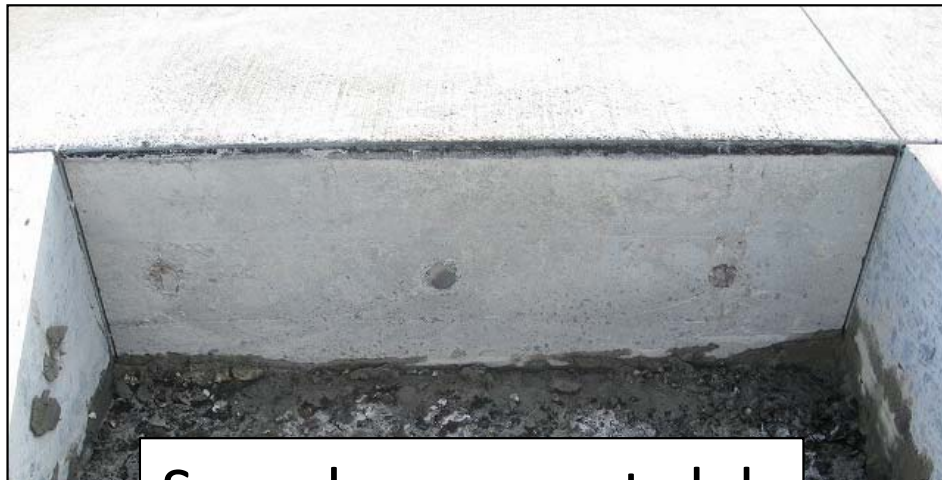
- Outline of the pavement site
- Petrography
- Alkali contents in concrete

3. Ongoing research project

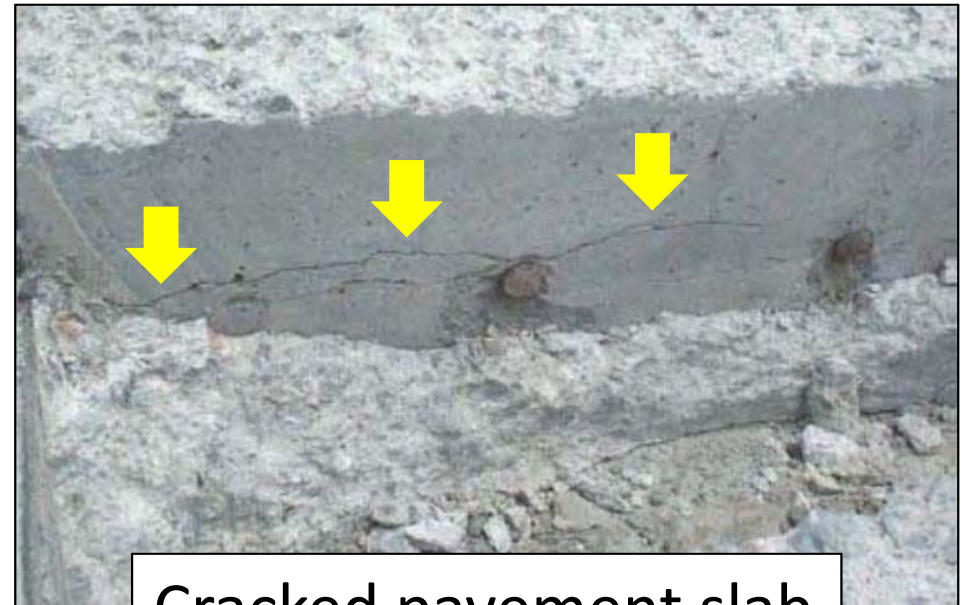
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Current **structural** performance

- The performance of ASR-affected pavement is one concern when judging the necessity of repairment
- We do not know whether ASR affects the performance



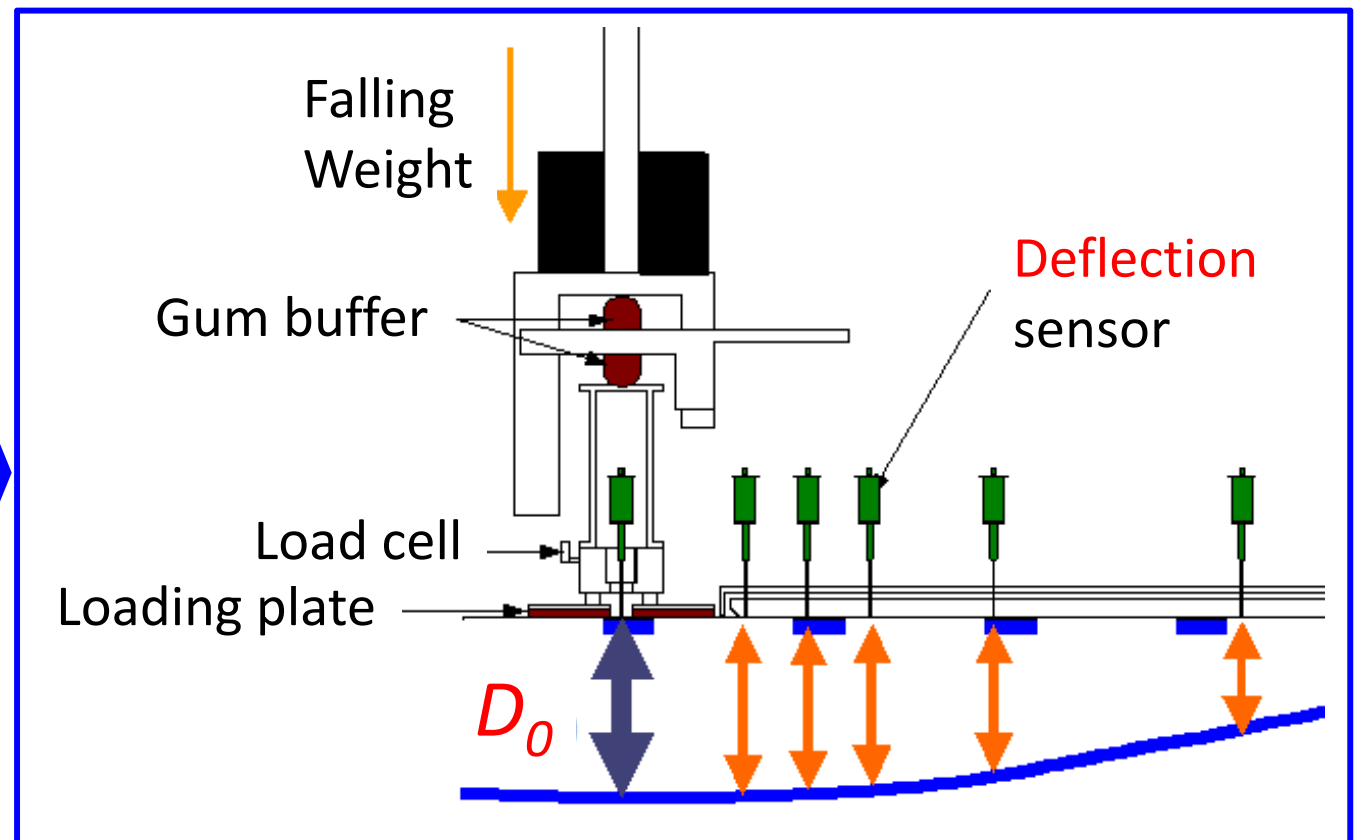
Sound pavement slab



Cracked pavement slab

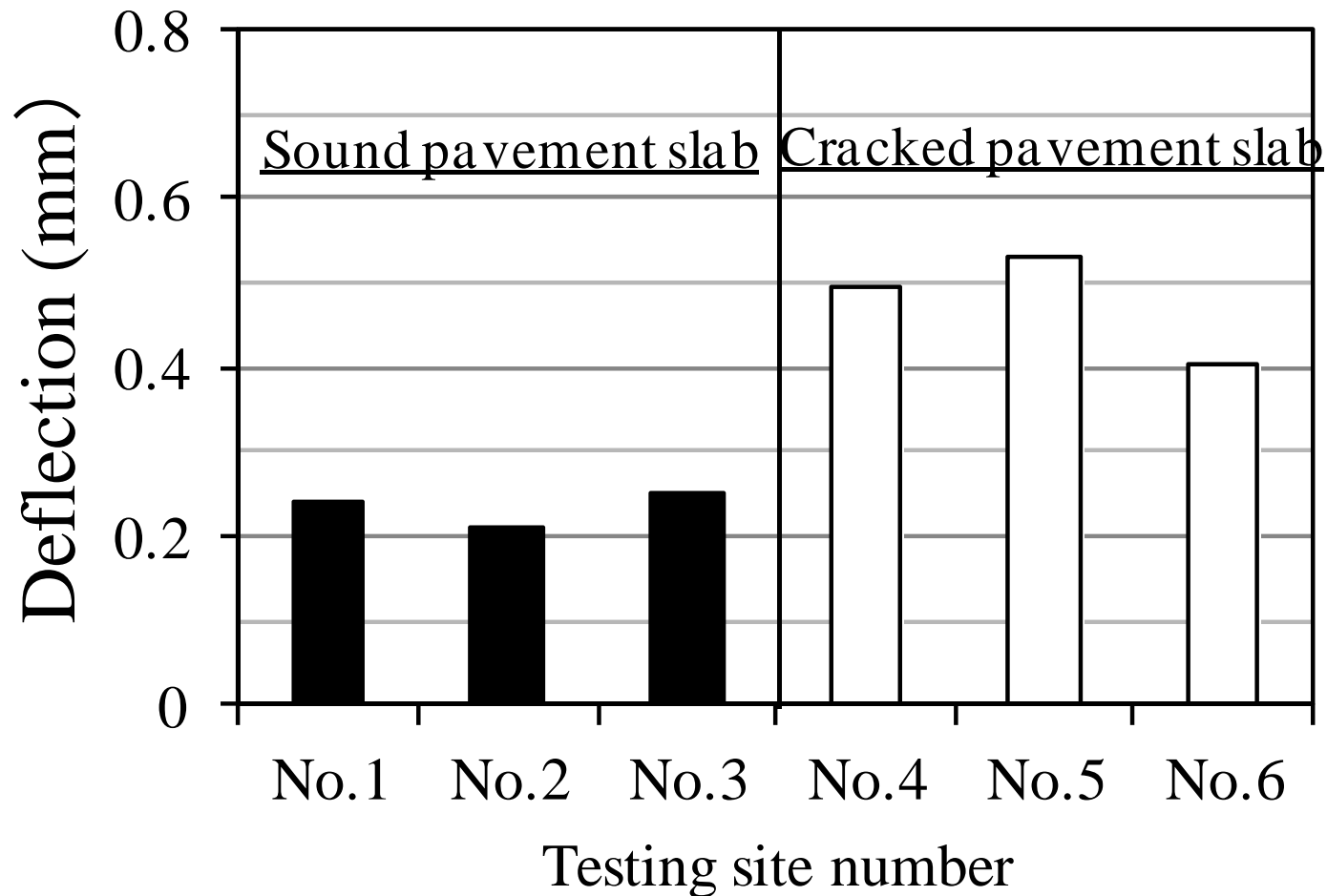
FWD test in the airport

- We evaluated the performance of cracked and sound pavements by **Falling Weight Deflectometer (FWD)**
- FWD is commonly used to evaluate structural performance in airport





Test results



- Deflection of cracked pavement was twice larger.
- FWD could evaluate the performance of the affected pavement



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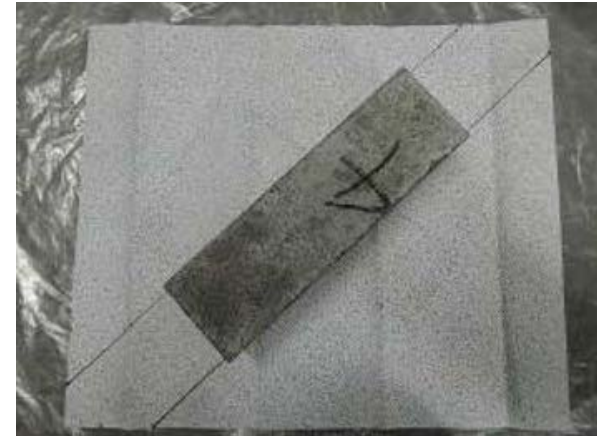
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Expansion test with alkali wrapping

- To predict expansion is necessary to predict performance degradation
- Predictive model was proposed by the second author. It can predict field expansion using the result of expansion test.
- Alkali leaching and drying in the test are critical issues
- “Alkali wrapping (AW)” was proposed to avoid them

Alkali wrapping (AW)



Wet cloth containing alkali solution

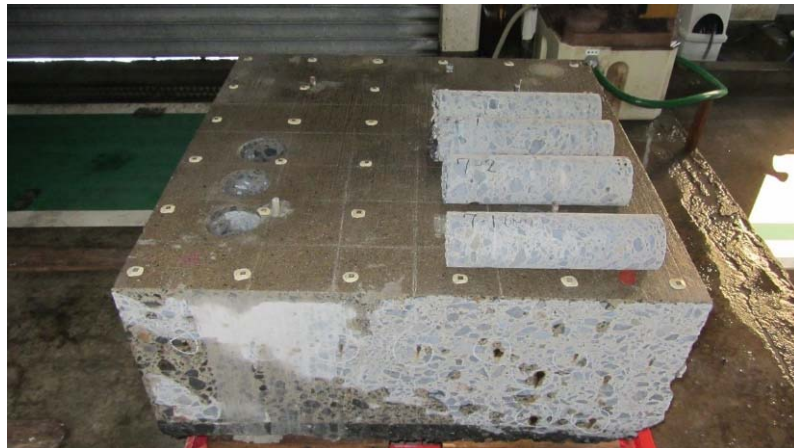
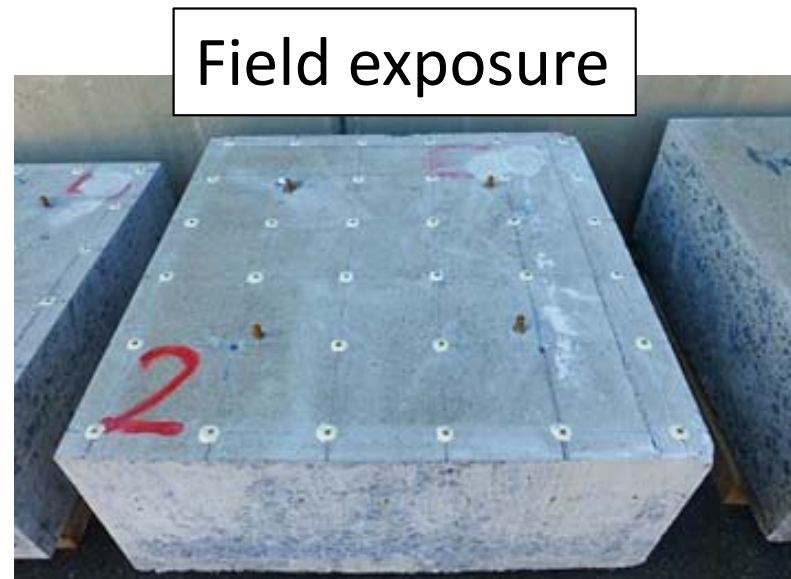
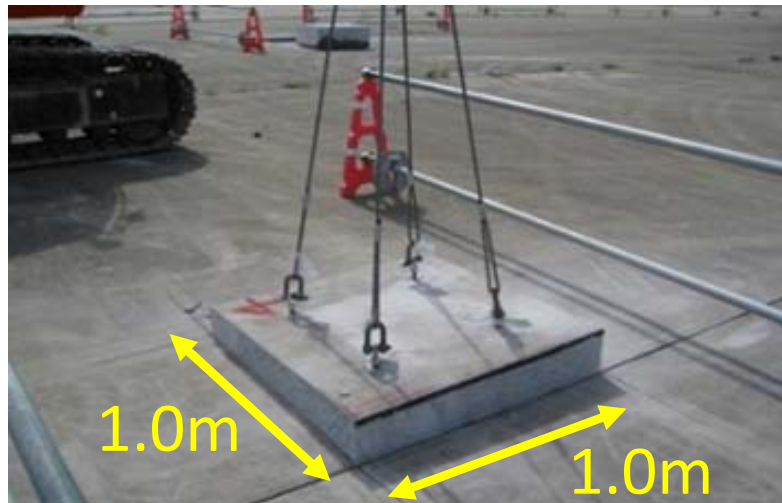


Covered by thin plastic film to avoid drying

Yamada, this conference

Trial experiment

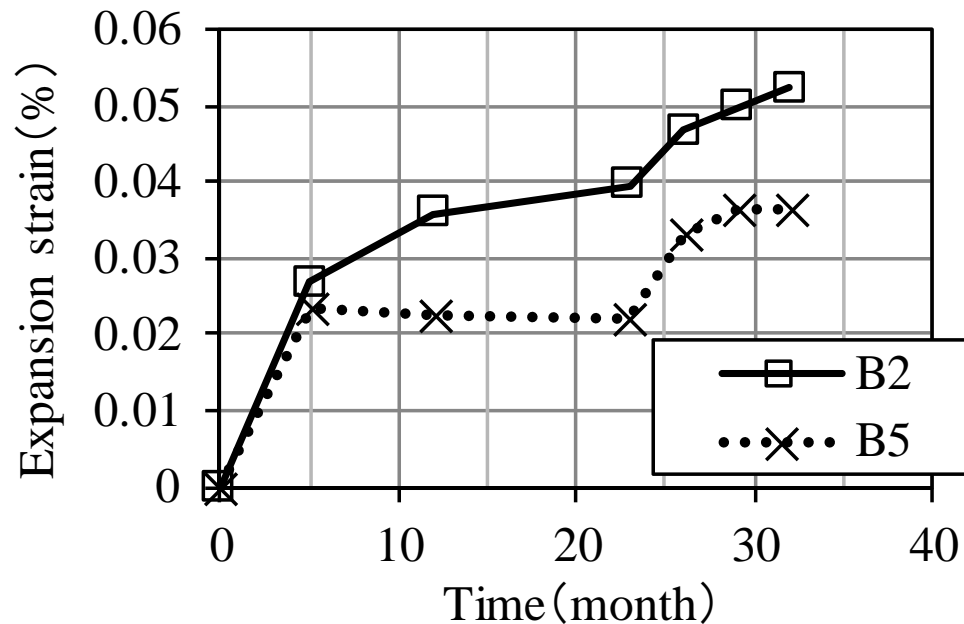
Investigate effectiveness of AW using the affected pavement specimens



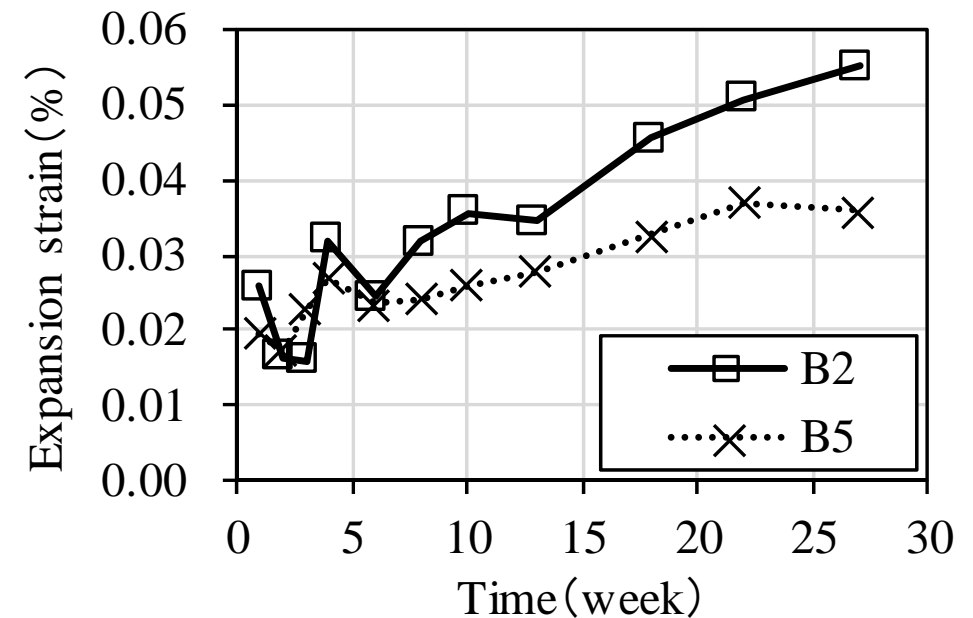


Results

Field expansion



Expansion test

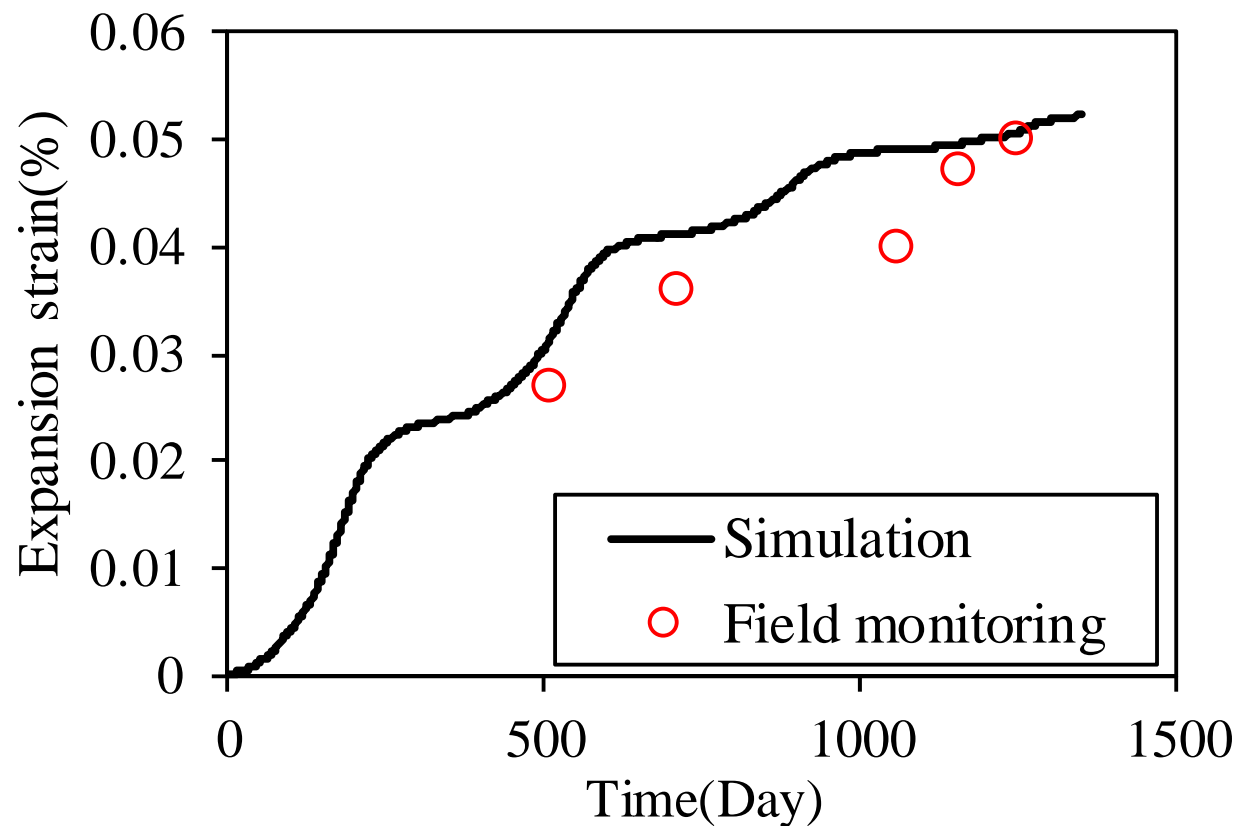


- Expansion test with AW **can simulate sustained expansion behaviour** shown in the field.



Simulation of field expansion

Simulation using the result of expansion test
(The model is following Kawabata)



- Simulation was well consistent with the result of expansion of field block



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Conclusion

ASR diagnosis

- The cause of ASR can be identified by petrographic diagnosis. The petrography pointed to the necessity of re-considering Japanese regulation

Current structural performance

- FWD could be a promising tool for evaluating the performance of ASR-affected pavement

Future expansion

- Expansion test with AW can simulate the sustained expansion behaviour shown in the field

Thank you for your kind attention

