DIAGNOSIS OF ALKALI-SILICA REACTION IN AIRPORT PAVEMENT IN JAPAN

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2. Diagnosis of ASR in an airport

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   - 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
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2. **Diagnosis** of ASR in an airport
   - Outline of the pavement site
   - Alkali contents in concrete
   - Petrographic examination

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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
### Estimation of alkali contents

Estimated by following *Katayama*

<table>
<thead>
<tr>
<th>I: Total amount of cement alkali</th>
<th>Sound pavement</th>
<th>Cracked pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Estimated by EDS analysis of unhydrated cement clinker)</td>
<td>2.3kg/m³</td>
<td>2.5kg/m³</td>
</tr>
<tr>
<td>II: Water-soluble alkali from coarse aggregate</td>
<td>0.4kg/m³</td>
<td>0.5kg/m³</td>
</tr>
<tr>
<td>III: Total alkali in concrete (III = I + II + (fine aggregate, chemical admixture))</td>
<td>2.7kg/m³</td>
<td>3.2kg/m³</td>
</tr>
</tbody>
</table>

(Regulation in Japan is <3.0)
Petrographic examination

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

- 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/m³ (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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- The performance of ASR-affected pavement is one concern when judging the necessity of repairment.

- We do not know whether ASR affects the performance.
- We evaluated the performance of cracked and sound pavements by **Falling Weight Deflectometer (FWD)**

- FWD is commonly used to evaluate structural performance in airport
- Deflection of cracked pavement was twice larger.
- FWD could evaluate the performance of the affected pavement
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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
Investigate effectiveness of AW using the affected pavement specimens

Field exposure

Expansion test
(Stored at 38°C after AW)
Results

- 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
Introduction

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  e.g.  - Diagnosis (to identify ASR and the cause)
  - Evaluation of current and future performance

- The study is a case one to suggest the flow

- In particular, put emphasis on
  1. Diagnosis
  2. Current structural performance
  3. Future expansion
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