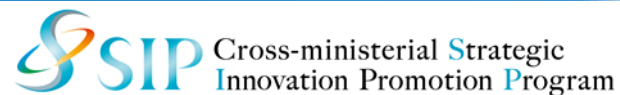


■ R&D Topics : Asset Management Technologies

■ R&D Theme : Resolution of Early-aged Deterioration Mechanism & Development of Total Management System Based on Evaluation for Material and Structure Quality Performance

■ Principal Investigator : Kazuyuki Torii (Kanazawa University)

■ Collaborative Research Groups : Kanazawa Institute of Technology, Ishikawa National College of Technology, Nagaoka University of Technology, University of Fukui



R&D Objectives and Subjects

Objectives

Bridges in Hokuriku region are exposed to the following severe environments:

- In the coastal areas, salt damage deterioration due to airborne salt brought by monsoon
- In snowy regions, salt damage deterioration due to the spraying of anti-freezing agents
- ASR degradation in bridges using reactive aggregates, e.g., andesitic stone
- In mountainous areas, frost damage spreads easily at high altitudes

Main purposes: unlike aging deterioration, this degradation occurs early and complexly. This R&D proposes a sequential flow, i.e., inspection–diagnosis–monitoring, evaluation–judgment, countermeasures (reinforce, repair, renovation) as the basis maintenance management system

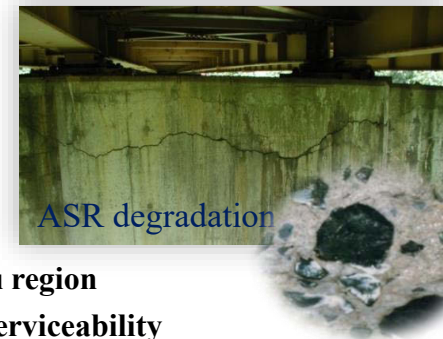
Implementation: the Hokuriku region and other areas with the same kind of early deterioration



Salt damage deterioration

Subjects

- Elucidating the early-aged degradation mechanisms of salt damage and ASR damage, and developing methods for using roads safely for long periods of time
 - Investigating actual conditions of salt damage & ASR deterioration in road bridges of the Hokuriku region
 - Making the girders and slabs simulated degradations with actual sizes, then evaluating safety and serviceability
 - Standardizing fly-ash concrete, slowing down the process of salt damage and ASR degradation
 - Developing sensible inspection techniques, including simple monitoring technology
- Developing a maintenance management system which can be operated by local governments
 - Establishing evaluation methods for structural health, a method of ranking for repair work, budget methods, and proposing an evaluation-judgment method corresponding to early deterioration
 - Holding open seminars regularly, developing human resources



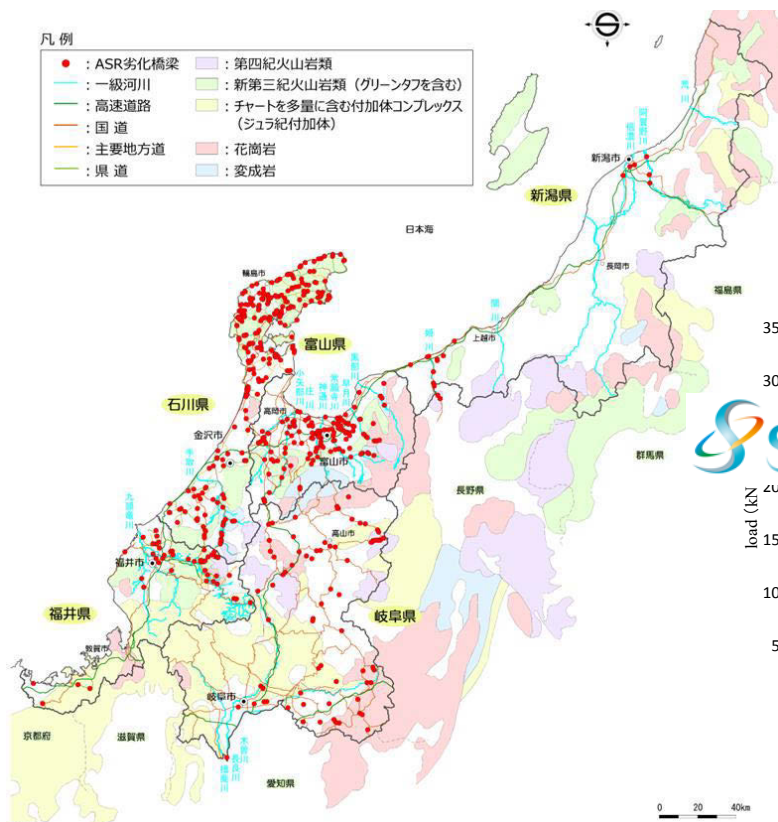
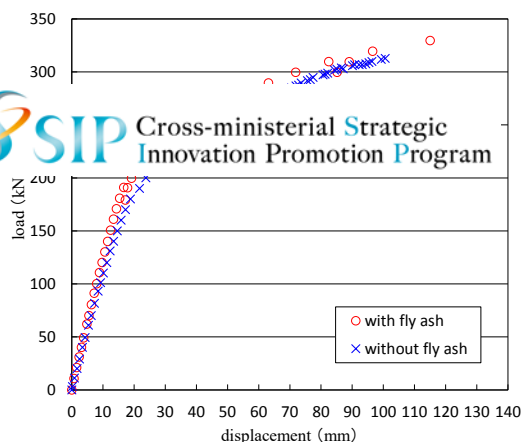
ASR degradation

Elucidate the relationship between rock types/mineralogical features and ASR degradation

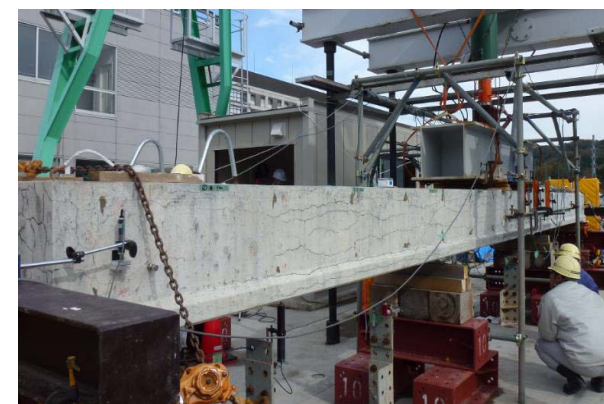
Distribution of ASR-affected bridges in the Hokuriku region

凡例

- : ASR劣化橋梁
- : 第四紀火山岩類
- : 一級河川
- : 新第三紀火山岩類 (グリーンタフを含む)
- : 高速道路
- : チャートを多量に含む付加体コンプレックス (ジュラ紀付加体)
- : 国道
- : 花崗岩
- : 主要地方道
- : 変成岩
- : 県道

Elucidate the degradation mechanisms by investigating PC girders undergoing ASR degradations



Developing a database for the characteristics of ASR degradations is important in the inspection and diagnosis of ASR deterioration

As a result of the load tests, ultimate strength and toughness were improved due to the use of fly ash concrete



Diagnose the health of early-aged deteriorated slabs by using a large, mobile impact vibration exciter

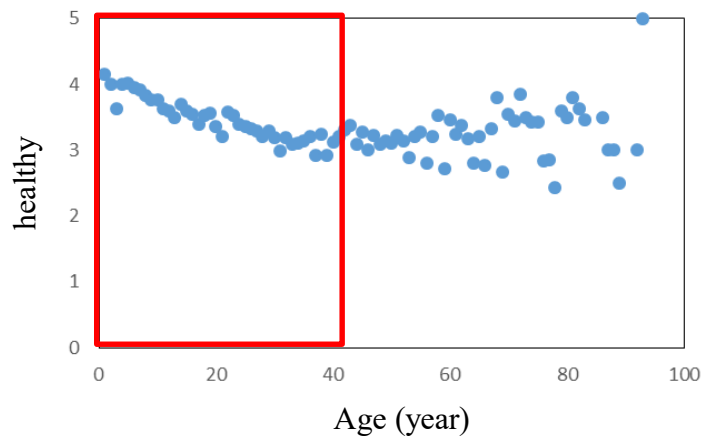
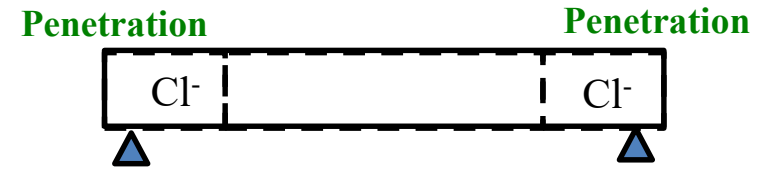
Monitoring for early-aged degradation bridges



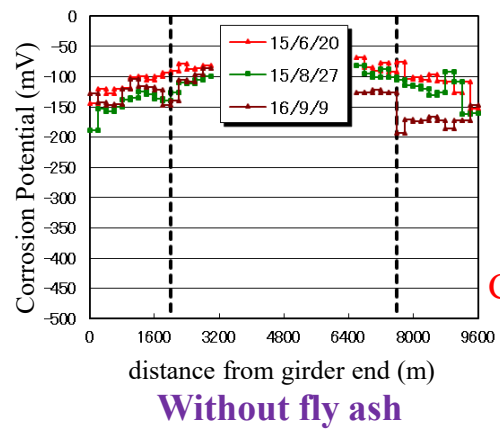
FWD Light



Self-propelled Impact Vibration Equipment

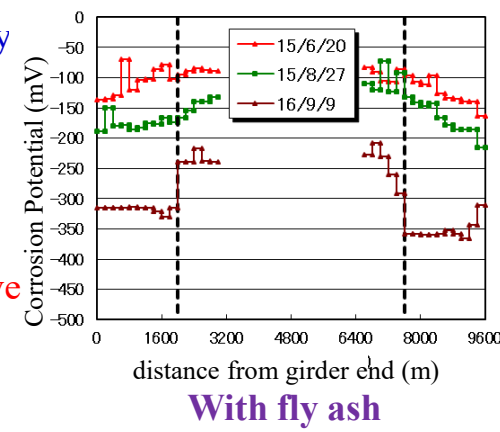


From an age-healthy relationship, a tendency of monotonous deterioration until the 40th year can be observed and some recovery work is done after 40 years.



Without fly ash

Healthy
↑
↓
Corrosive



With fly ash

Confirm the effects of fly ash on salt damage

Goals

Grasping the actual conditions of structures accurately, improving the accuracy of diagnostic technology, repeating effective maintenance and establishing maintenance management which can be turned into preventive maintenance carried out by local governments in the next 50 years

Features: This project does not propose a nation-wide standard maintenance system; it develops a standard one for the Hokuriku region based on regional characteristics, to improve the safety of infrastructure and to reduce wasteful spending

Publishing technology information on the home page



<http://sip-hokuriku.com>

Education for engineers



Demonstration for municipal bridge-management engineers



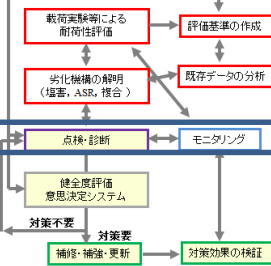
Open seminars

Industry-academia-government collaboration



Conference of Hokuriku Road maintenance

Create evaluation criteria



Propose maintenance management

Publish maintenance manual + technology report



Elucidate the early-aged degradation mechanism

Establish accurate diagnostic technologies

Countermeasures for salt damage Expanding the application of cathodic protection technology

Effective use of fly ash Regionally produced and consumed



Countermeasure for salt damage -ASR

Expanding the application of pre-cast PC slabs using fly ash concrete



External power supply system in cathodic protection



New galvanic anode system Infrastructure Maintenance, Renovation, and Management

Dispatch the information to other regions having the same problems as the Hokuriku region