35 Clarification of Deterioration Mechanism of Infrastructures and Development of Technology for Efficient Maintenance and Management through COE for Infrastructure Materials Research

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Collaborative Research Groups: Kyoto University, Tokyo Institute of Technology

R&D Objectives and Subjects

Objectives

【Social Backgrounds】

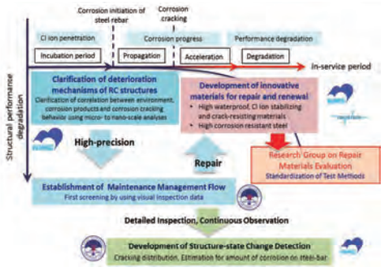
- It is necessary to develop an efficient maintenance and management flow to deal with a large stock of social infrastructures with a limited budgets and human resources in Japan .
- It is necessary to establish a feasible and highly accurate degradation diagnosis method as well as innovative repair technology.

【Purpose of Research &Development】

- Development of diagnostic technology with reduced labor, reduced cost and well-planned maintenance suitable for maintenance in local authorities.
- Fostering multi-disciplinary researchers/engineers who have a birds-eye view over materials and structures for the future.

Subjects

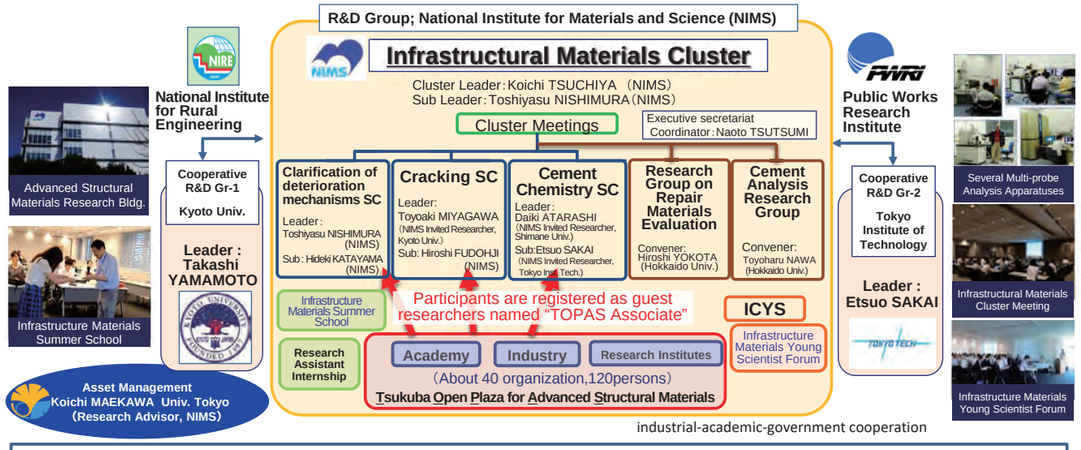
- Establishment of COE for infrastructural materials R&D to promote interdisciplinary collaboration, industrial - academic - government cooperation and human resource development.
- Clarification of deteriorating mechanisms in RC infrastructures.
- Improvement of remaining life assessment for infrastructures by clarification of the correlation between 1) environment in service, corrosion products and cracking or 2) concrete cracking and load capacity, using advanced inspection technologies, such as non-destructive evaluation and corrosion environment sensors, which have been cultivated in NIMS.
- Development of efficient repair materials and long-life materials as well as evaluation methods.



Current Accomplishments (1/4)

Consolidation to COE for infrastructural Materials R&D with industrial - academic - government cooperation

- About 30 researchers and engineers who belong to the "SIP-Social Infrastructure Materials Lab" and various analytical apparatus for infrastructural materials R&D are located in the Advanced Structural Materials Research Bldg.



- New industrial - academic - government cooperative group named "TOPAS" has been established to promote Infrastructural Materials R&D.
- "Infrastructural Material Cluster" (31 industries, 8 academic institutes or public labs, and 120 persons) plays an important role in the project, such as 1) information exchange, 2) several educational programs [young scientist forum, summer school, cluster seminars] and 3) discussion and investigation of cooperative R&D for social infrastructural implementation.

Current Accomplishments (2/4)

Clarification mechanisms & Application of NIMS seeds for Infrastructure Maintenance

Clarification of deterioration mechanisms in RC structures

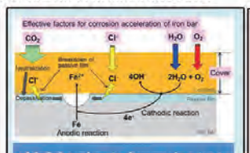
Research seeds for fundamental research to clarify degradation mechanism and advanced technology for establishment of maintenance flow .

Development of efficient maintenance and renovation

Research seeds in validation or implementation phase by intense cooperation with universities, institutes and private companies through SIP.

A1-1 Advanced nano-scale analysis for corrosion product

Orthogonal FIB/SEM: Suitable for 3D observation of corrosion morphology.
Environmental SEM: Suitable for repairing materials for cement.

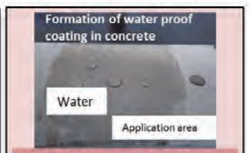


A1-2 Accelerated corrosion test (Device development for accelerated supply of corrosion enhancing factors)

Rebar corrosion in concrete will be accelerated by more than 5 times by enhanced supply of a rate determining factor.

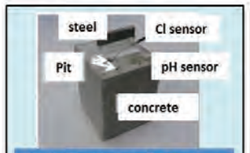
A1-5 High corrosion resistant steel

Production of steel rebars which have mechanical property satisfying JIS standard. Evaluation in concrete structures. (Collaboration with Tokyo Univ.)



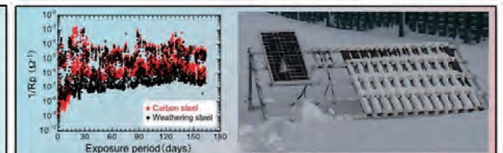
A1-8 Water curing repair agent for concrete

- Start practical tests and mass production study with companies
- Evaluation on concrete structures (In collaboration with Kyoto Univ.)



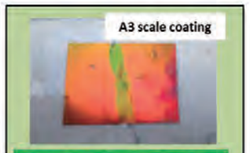
A1-3 Monitoring of inner environment in concrete (pH and Cl)

- Development of new reference electrodes and data collection system.
- The corrosion starts after the environmental factors exceed threshold.



A1-4 Corrosion environment monitoring・corrosion environment map

- Development of the corrosion environment monitoring system by cooperation with company (patent pending).Difference in corrosion environment is currently under investigation by corrosion monitoring of concrete model specimen in laboratory.
- Exposure tests have been conducted at more than 30 sites ranging from snowy cold region to tropical region. The databases for corrosion environment is currently enhanced by referring to literatures and various survey reports.

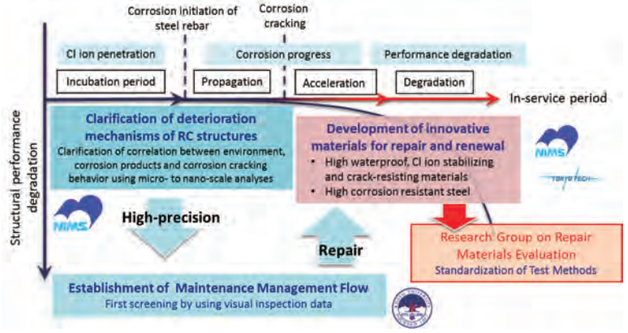


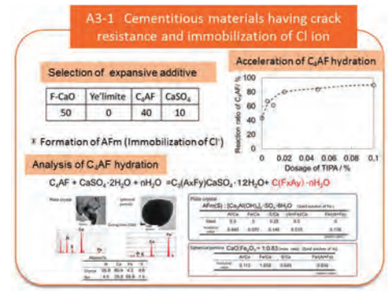
A1-6 Strain imaging sheet to detect cracks in concrete

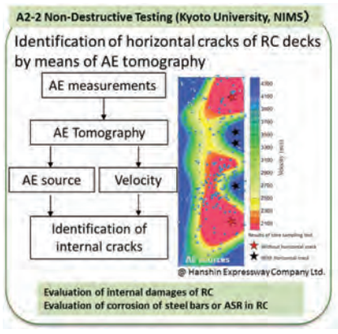
- Resistance test in enviroment (Collaboration with Public works research institute)
- Demonstration and performance evaluation (Collaboration with Nagasaki Univ.)
- Adhision test for concrete (Collaboration with TOPAS member company)

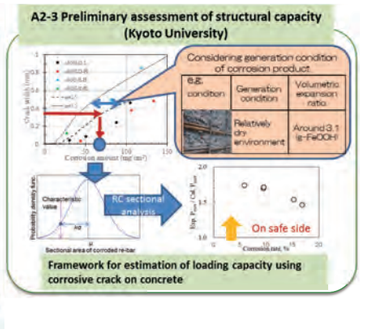
Current Accomplishments (3/4)

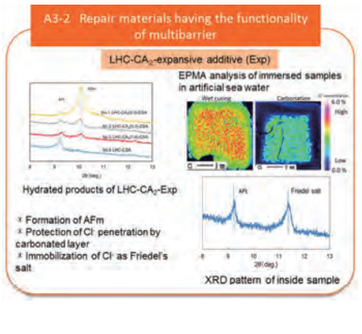
Establishment of new maintenance management flow (Kyoto University) & Development of repair materials and highly durable cement (Tokyo Institute of Technology)





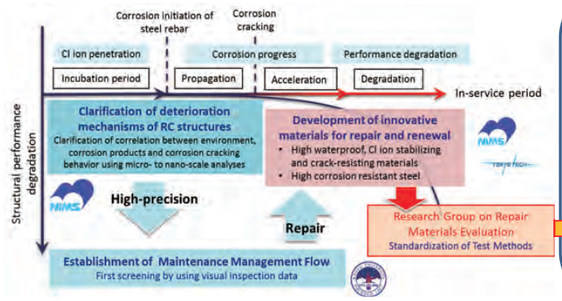


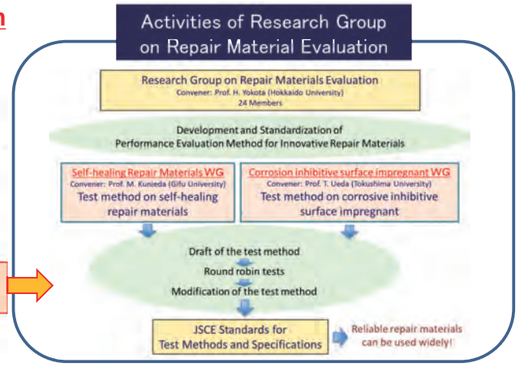


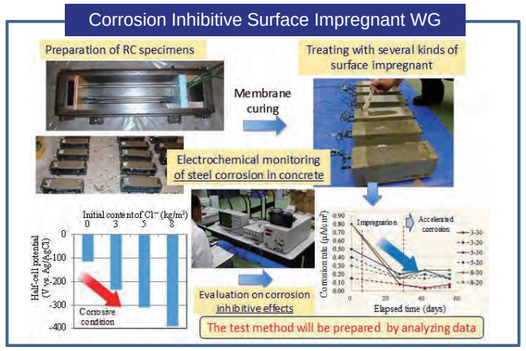


Current Accomplishments (4/4)

Research Group on Repair Materials Evaluation



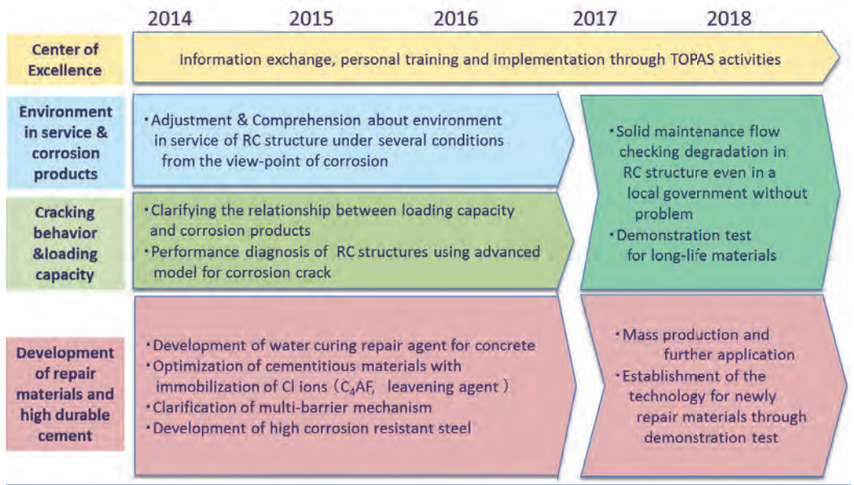




Goals

Actual Reflection of R&D Results to the Society

Strong promotion at “Infrastructural Materials Cluster” to establish the high-efficient Maintenance Flow



- Establishment of a Core of Excellence for infrastructure materials in the SIP Project
  - Introduction of research facilities for R&D of infrastructural materials
- Sustainable network formation with industrial - academic - government cooperation
  - Co-production with infrastructural companies registered in TOPAS
- “Intellectual accumulation” concerning infrastructural materials
  - Cooperative R&D with Kyoto University, Tokyo Institute of Technology, University of Tokyo and other institutions
- Fostering great young talents to be future multi-disciplinary researcher/engineer