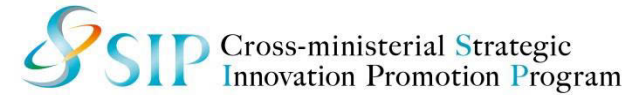


- R&D Topics : Inspection, Monitoring and Diagnostics Technologies
- R&D Theme : Interdisciplinary R&D of NDE techniques for innovative maintenance
- Principal Investigator : Masahiro Ishida
(Chief Researcher, Public Works Research Institute)
- Collaborative Research Groups : The University of Tokyo, Riken



R&D Objectives and Subjects



Targets



Steel corrosion in concrete structures



Ducts unfilled with grout



Degradation of concrete slabs

Objectives

Develop a **diagnostic method** for concrete structures by **visualization techniques** using **X-ray** and **Neutron sources**

Subjects

- Develop a **portable visualization system using high-power X-rays** and use it on actual bridges
- Downsize the **water visualization system using small scale Neutron sources** and examine its feasibility for water detection in concrete slabs
- Develop a **diagnostic method based on visualization** to evaluate deteriorated structures

Current Accomplishments (1/2)

Suspected PC girder (wire fracture, etc.)



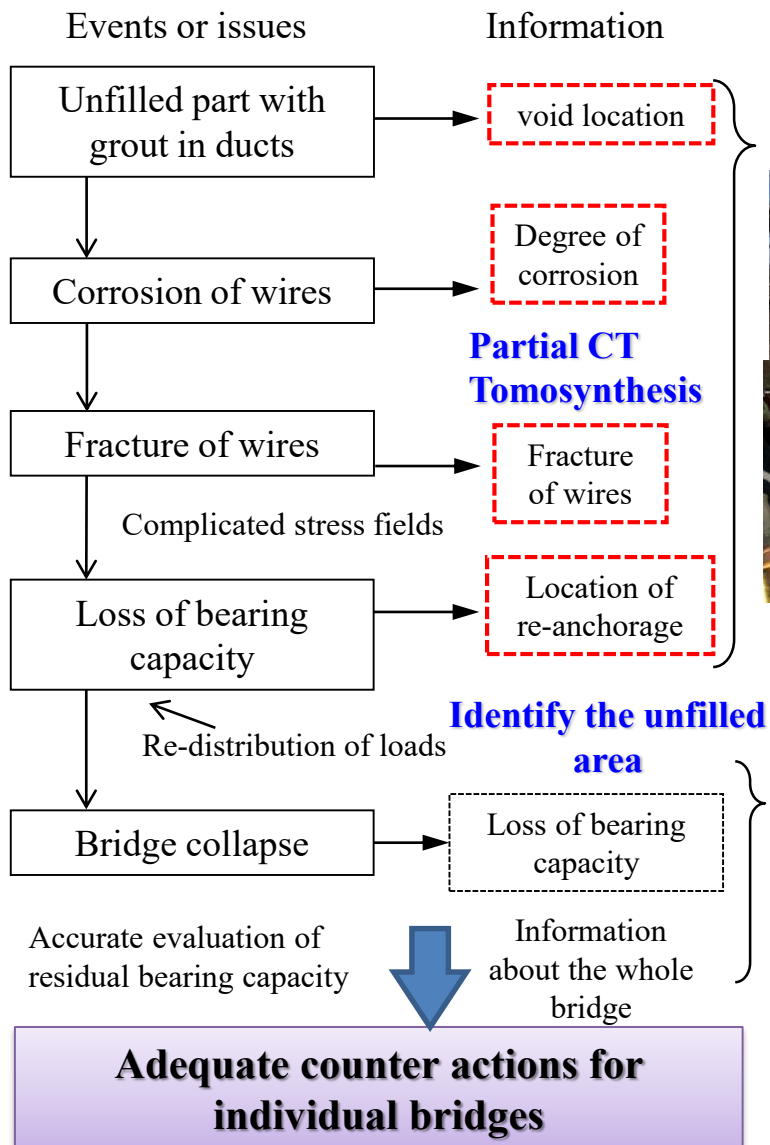
Suspected case of unfilled grout



Inner corrosion difficult to find by visual inspection



Sudden collapse



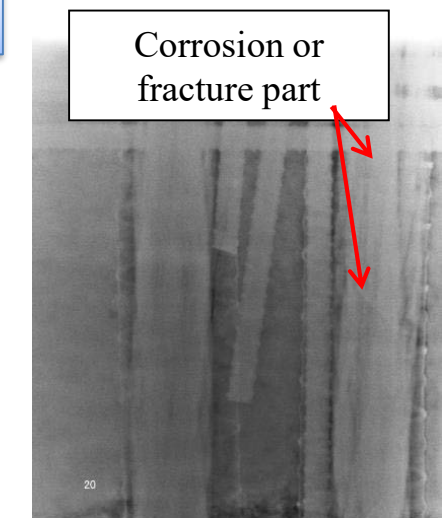
Visualization by High-power X-ray



Visualization of inner steel with corrosion and fracture in an serviced bridge was successfully attained (using 950keV X-ray)

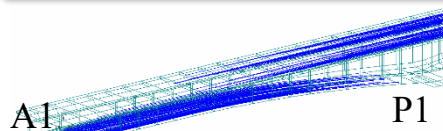


Corrosion or fracture part

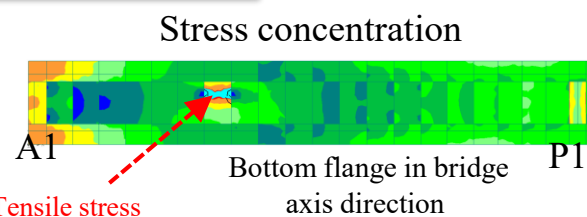


Visualization of inner steel by X-ray

Diagnostic technique based on visualization



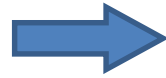
Wire location between A1 and P1
Develop a analytical method based on visualization



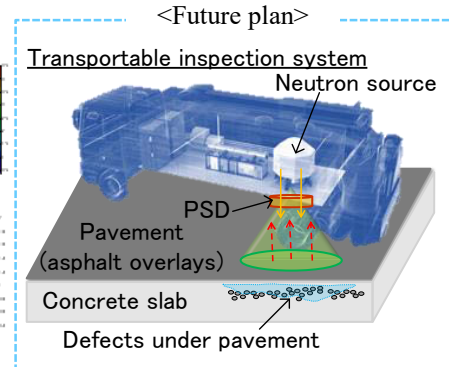
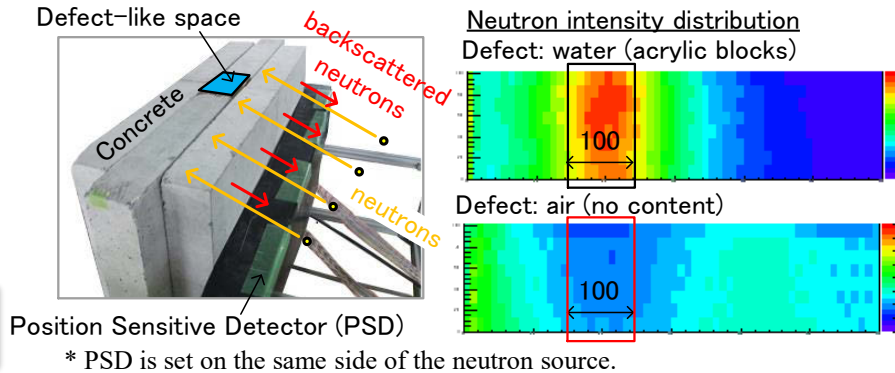
Tensile stress

Bottom flange in bridge axis direction

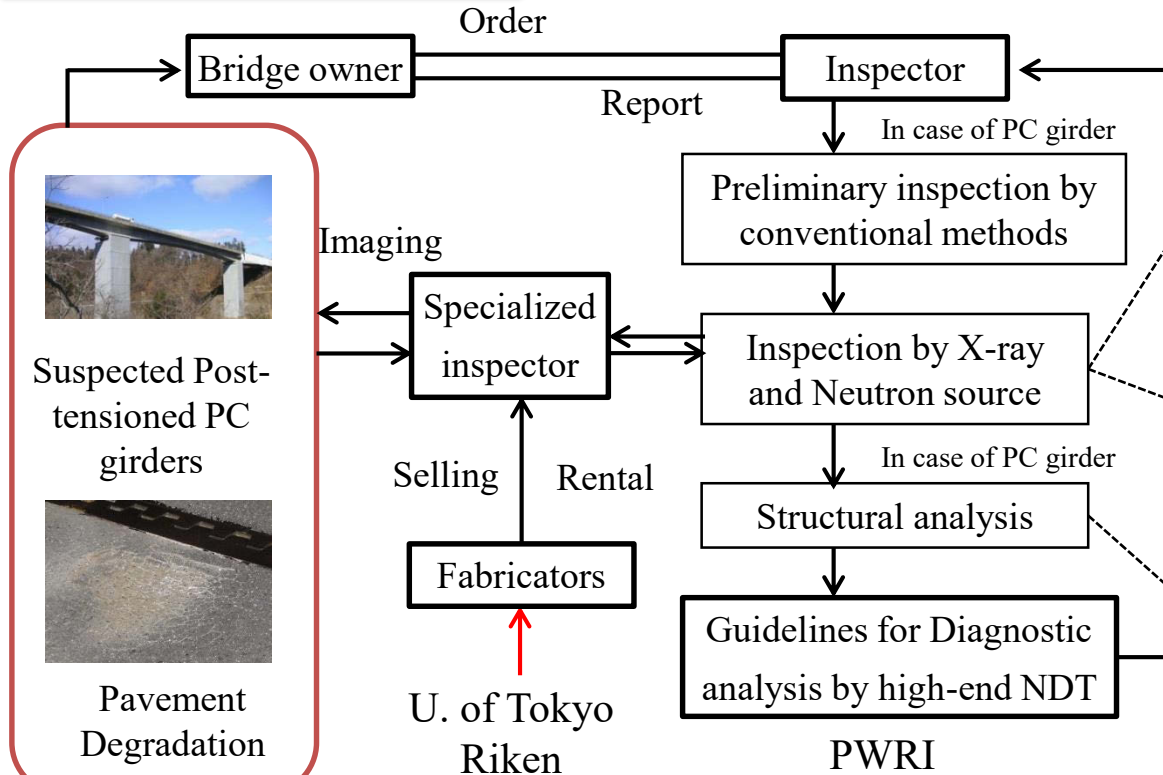
Defects visualization in concrete slabs



Optimum planning of slabs and pavement rehabilitation



Operational sequence



Neutron source (Riken)

- Defects under pavement were successfully captured by a new method using backscattered (reflected) neutrons.
- Development of more compact accelerator neutron source

X-ray source (U. of Tokyo)

- On-site imaging of actual bridges was successfully done. Safety and feasibility were also confirmed
- Verification of partial CT technique and Tomosynthesis

Evaluation (PWRI)

- Experimental verification of the proposed method was successfully carried out using a large-scale PC box girder with an artificial fracture
- Numerical model with re-anchorage wire was developed.

Implementation of developed techniques for domestic bridges

Final goals

- Establishing the fundamental technologies of X-ray transmission imaging and limited angle CT reconstruction through inspections of actual infrastructures using the portable high power X-ray sources.
 - Detection of fractures or corrosion of steel in millimeter resolution.
 - Securing radiation safety by controlling air dose under 250 mSv/3month at the boundaries of controlled areas.
 - Clarifying applicable conditions of the X-ray back scattering imaging.
- Investigate the on-site applicability of compact neutron sources through in-lab experiments on deteriorated existing structures
 - inspect the defects in concrete slabs with the imaging technique using backscattered (reflected) neutrons
 - develop a prototype of the transportable accelerator neutron source
- Develop an analytical method to simulate deteriorated PC girders with corrosion and fractures in PC wires
 - Re-anchorage of PC wires is properly considered
- Develop a diagnostic evaluation of deteriorated concrete bridges using visualized inner structures
 - propose guidelines for diagnostic analysis using visualization techniques

Exit strategy for practical application

- Downsize the system for more prompt activity to extend its application
- Endorse the proposed guidelines by organizing a public committee
- Promote the proposed techniques through the consulting activities with CAESAR, PWRI.
- Demonstrate its safety by conducting actual inspections lead by CAESAR as often as possible

Dissemination to the world

Find and collaborate with counterparts in countries where the system would be officially applicable in bridge inspection