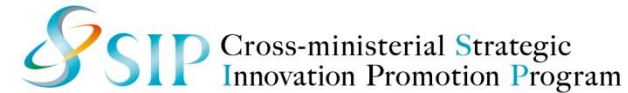


- R&D Topics : Inspection, Monitoring and Diagnostics Technologies
- R&D Theme : Inspection and diagnosis system of port structure using radio controlled boat
- Principal Investigator : Tetsuya Ogasawara (Penta-Ocean Construction Co., Ltd.)
- Collaborative Research Group : Penta-Ocean Construction Co., Ltd.



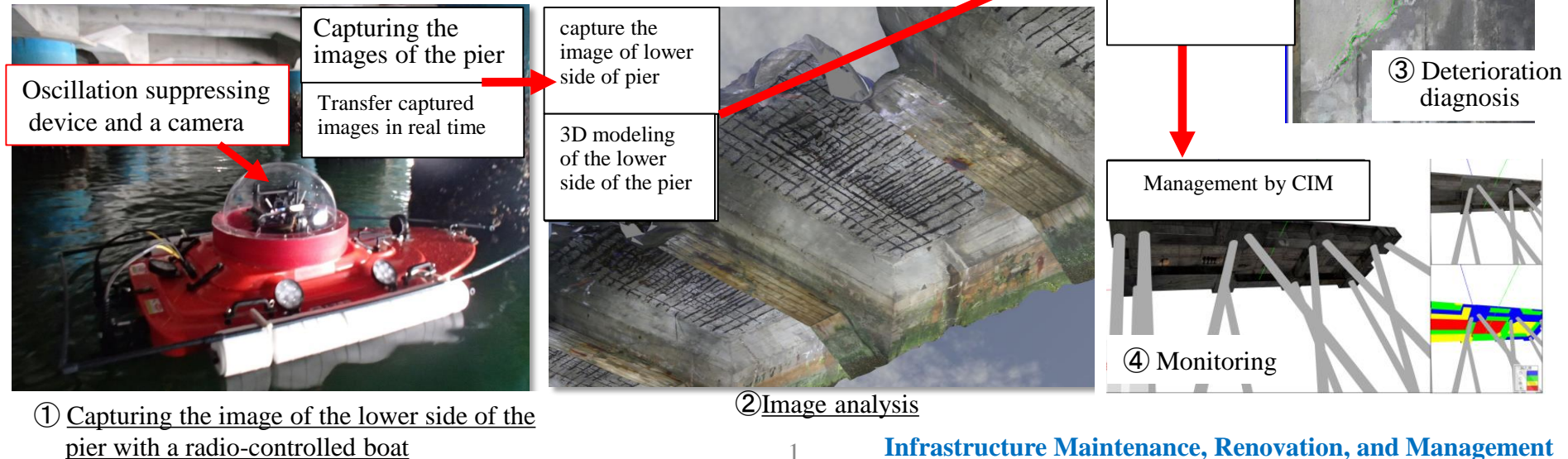
R&D Objectives and Subjects



Objectives

- (1) To install a camera on a radio-controlled boat via a high-performance oscillation suppressing device in order to develop a system that should capture the images of the lower sides of piers efficiently while suppressing the effects of wave shaking.
- (2) To diagnose and monitor deterioration by image analysis and to conduct experiments for the efficient maintenance and objective management of port facilities.

Subjects



Current Accomplishments (1/2)

Establishment of a comprehensive inspection and diagnosis system using a radio-controlled boat and designated software

- Using a radio-controlled boat and designated software developed in 2014 and 2015, we investigated the bottom of the pier and verified the importance of this system in 2016.
- After the creation of 3D models by SFM / MVS from the captured images, we extracted the orthochromatic images. Upon the comparison of the diagnosis results of the software with the results from humans, both were found to be in agreement. Thus we have confirmed the benefits of this technology.



Investigation conditions of the actual pier using a radio-controlled boat

Advantages of this technology

- ① A person without specialized knowledge can inspect and diagnose without going directly to the lower pier.
- ② Investigation speed is doubled → Increases efficiency of inspection.
- ③ Accumulation of objective data by images → Understanding the state of deterioration quantitatively, even upon the change of the person in charge.
- ④ From the 3D models, the state of deterioration can be understood with ease.
- ⑤ Reduces the burden on inspectors while surveying in narrow places and prolonged surveys.
- ⑥ Post-processing can be done efficiently using this software. It is possible to understand the state of deterioration quantitatively and compare the temporal changes in deterioration.

Capturing **images** by the **radio-controlled boat**



Create 3D models



Extraction of orthochromatic images



Register orthochromatic images in the software



Extract damaged parts



Determination of the **degree of deterioration**

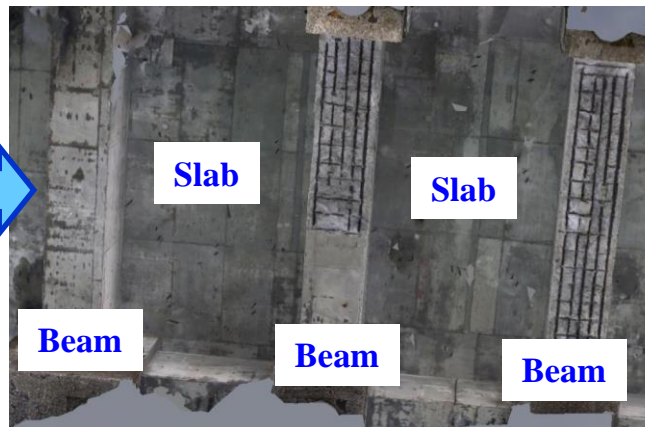
Deterioration diagnosis flow of this technology

Current Accomplishments (2/2)

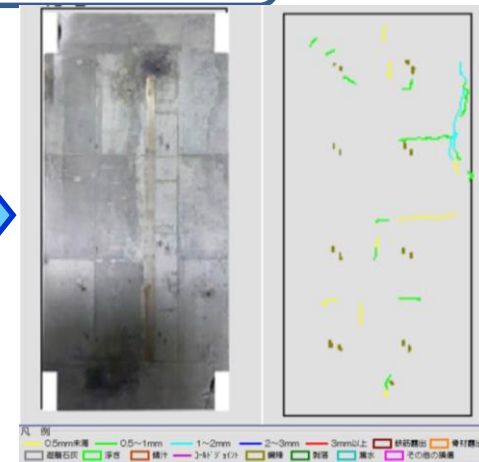
Establishment of a comprehensive inspection and diagnosis system using a radio-controlled boat and designated software



Captured images from the radio-controlled boat



3D models

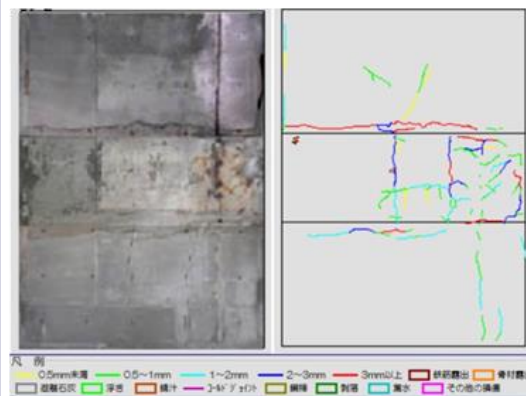


Extraction of orthochromatic images (Slab)

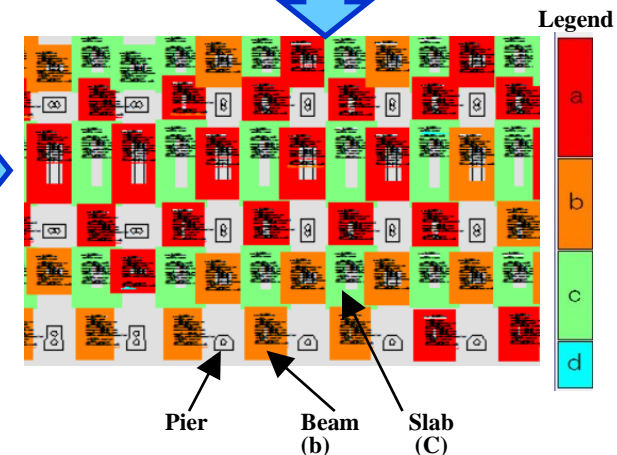
Results of verification of deterioration diagnosis on the pier
(Comparison of results of degradation diagnosis by this technology and a person)

- ① **Slab** → 98% match
(Except at one place)
- ② **Beam** → 65% match
(Approximate match)

During the investigation of the beam with this technology, the images were unclear due to rain and low illuminance, so we were not able to capture the cracks. However, this can be improved (by using LED lighting and others).



Extraction of orthochromatic images (Beam)



Example of the results of degradation diagnosis by designated software

Goals

Contribute to the development and improve the efficiency of maintenance management of port facilities

- Include post-processing time and cost, and compare with conventional visual inspection
- Though the diagnostic results of this technology are in agreement with the results of humans, we set out to improve accuracy by investigating the cause of differences in results when done by person.
- To shorten the preparation and clean up time and to increase the area inspected in one day
- Promotion of this technology by posting articles and publishing them in magazines



Final goal in FY2016 (last year)

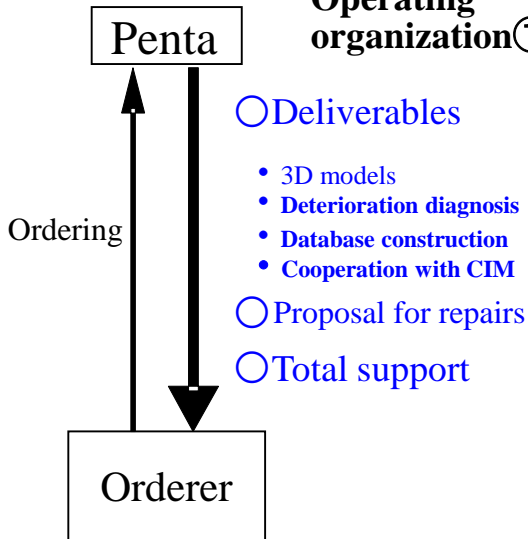
Improvement and completion of inspection and diagnosis system using a radio controlled boat and automatic deterioration determination



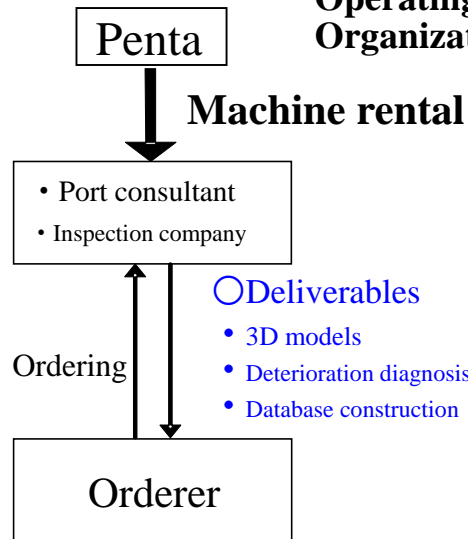
Social Implementation Image of this technology

By advancing social implementation of this technology, we hope to accumulate inspection and diagnostic data, and improve the accuracy of inspection and diagnosis in the future

Operating organization①



Operating Organization②



Possibility of using the system more extensively

- If the accuracy of such as the extraction of crack widths are improved, it may be available for initial inspection in new construction projects in Japan and overseas
- This technology may be used in other fields because of its easy and wide-area monitoring