13 Development of the special GPR including a chirp radar in the survey of a cavity and a settlement of the back-fill material

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R&D Objectives and Subjects

Objectives

As a new technology, "Vehicle traction type GPR for deep cavities", where we develop a searching depth, and "Multichannel GPR for cavities under reinforced concrete", where we apply cavity detection under reinforced concrete that is hard to detect, are introduced. We provide better discovery precision of cavities and loosening areas around quay walls than conventional techniques and improve survey costs reduction and monitoring systems.

Subjects

<Vehicle traction type GPR for deep cavities>

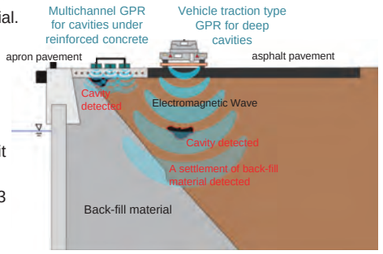
We apply asphalt pavement to quay walls

- Ability to detect deeper than using conventional technology .
- Ability to detect cavities and settlements of back-fill material.
- Improvement of operational efficiency by vehicle traction.

<Multichannel GPR for cavities under reinforced concrete>

We apply apron pavement to the quay wall

- Ability to detect cavities under reinforced concrete that it is hard to detect with conventional technology.
- Improvement of operational efficiency by investigating 3 survey lines at the same time.

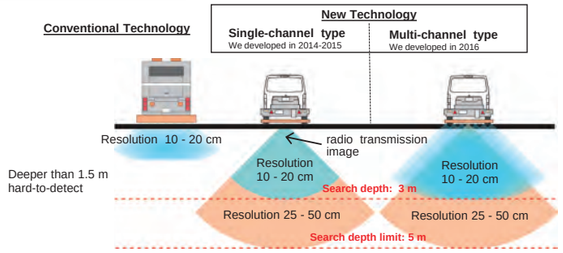


Current Accomplishments (1/2)

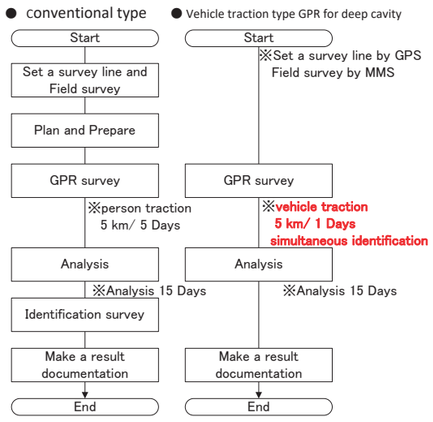
<Vehicle traction type GPR for deep cavities>

<Results>
- Resolution of cavity detection is less than 10 cm when monitoring
- Ability to detect back-fill material through the improvement of search depth.
- Improved operational efficiency by setting survey lines with GPS

◆ System improvements

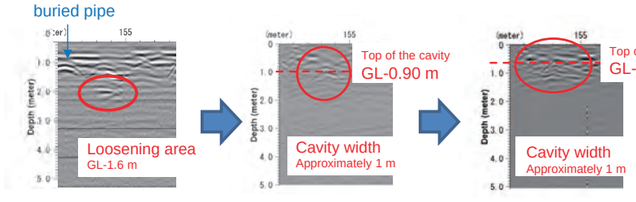


◆ Operation flow



◆ Monitoring of the cavity

- 2013/9/25 No cavity
- 2015/9/29 Detect a cavity
- 2016/3/2 Change of cavity depth and width

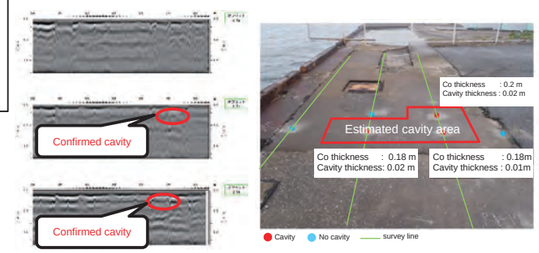


Vertical extension velocity of the cavity
- Before earthquake：15 cm/155 days 0.1 cm/day
- After earthquake: 35 cm/190 days 0.18 cm/day

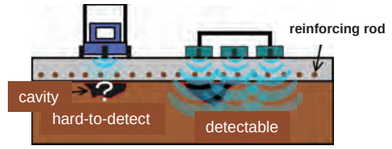
Current Accomplishments (2/2)

<Result>
- Ability to detect cavity less than a thickness of 5 cm
- Ability to detect cavity under reinforced concrete with a thickness of 38 cm
- Improved judgement of cavity area efficiency by measuring three survey lines simultaneously

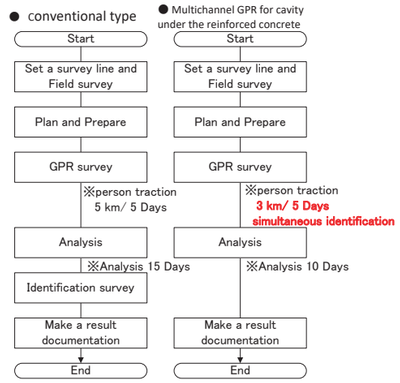
◆ Very small cavity detection



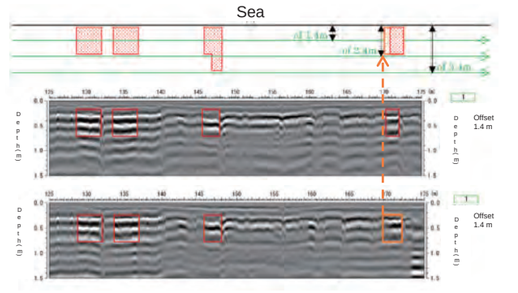
Conventional Technology New Technology



◆Operation flow



◆Monitoring of cavities



Orange broken line :
The cavity spread approximately 1 m over three months

Goals

◆Final targets

thi	Targets	Degree of achievement	Further consideration
Vehicle traction type GPR for deep cavity	• Ability to detect cavities and back-fill material • Resolution:10 cm • Improvements of operational efficiency • Ability to detect deeper than conventional technology （from 1.5 m to 3 m）	• Resolution: less than 10 cm • Improved operation efficiency by the setting of a survey line by GPS • Ability to detect back-filling material under 3 m • Cost reduction by system improvement	• Examination of technology with objectivity • Examination of determination method by a third person
Multichannel GPR for cavities under reinforced concrete	• Ability to detect cavities • Resolution 10 cm • Ability to detect under reinforced concrete • Improve operational efficiency	• Ability to detect cavities of less than 5 cm in thickness • Ability to detect cavity under reinforced concrete with a thickness of 38 cm • Improved operation efficiency by multiple surveys	Monitoring (cavity range expansion) • Examination of determination method by a third person

◆Advantage of new technology

実施項目	Rate of cost reduction	Labor-saving efforts
Vehicle traction type GPR for deep cavities	・15% decrease	・Field - work Days: 1/5
Multichannel GPR for cavities under reinforced concrete	・19% decrease	・Field - work Days: 3/5 ・Analysis Days: 2/3