SIP Cross-ministerial Strategic Innovation Promotion Program

5 Development of Automatic Technology on Pavement & Embankment Survey and Evaluation

Principal Investigator Atsushi Yashima (Professor, Gifu University)

Collaborative Research Groups Celery Co. Ltd., Const. Res. Ctr. Gifu Pref.

R&D Objectives and Subjects

Objectives

The maintenance work of pavement is often planned based on rutting, cracking, IRI and FWD data. However, repeated damage to pavement are observed at many places. This surface damage to pavement partly originates from the weakness of the subgrade, damage to the embankment and infiltration of ground water. In order to avoid repeated maintenance work on pavement, the condition of embankment structures should be evaluated by an easy logging technique from the pavement surface. In this research, an automatic technology for surveys and evaluations of pavement, as well as embankment structures, is proposed by using surface wave logging and electric resistivity logging.

Collapses of road embankments due to large earthquakes and heavy rainfalls have also been reported. These collapses were also caused by inappropriate groundwater treatment and slaking/weathering of embankment materials. The proposed automatic technology for surveys and evaluations of embankments by using surface wave logging and electric resistivity will evaluate the stability of embankments during large earthquakes and heavy rainfalls.

Subjects

① Development of a fully-automatic survey & evaluation system for surface wave logging
② Development of a fully-automatic survey & evaluation system of electric resistivity logging and an increase in investigation depth
③ Speed-up and generalization of preliminary analysis of field investigation data
④ Standardization of pavement & embankment stability by using S-wave velocity and electric resistivity
⑤ Development of a data base of survey & evaluation results
⑥ Development of a road management system with survey planning and maintenance planning (Web-GIS)

Current Accomplishments (1/2)

① The automation surface wave & electric resistivity logging system was designed and manufactured.
② The desired target inspection speed, 500 m per hour (mean speed) was achieved.
③ The stiffness (Vs) & electric resistivity (Ω) of the embankment was continuously obtained for many sections.
④ Hybrid survey by the automatic survey technique developed in this study and FWD was successfully carried out. Detailed information about the pavement, subgrade and embankment was simultaneously obtained.

① Automatic survey by EV and newly-designed cart

② Inspection speed ≧500m/hour

FWD

Automatic survey system
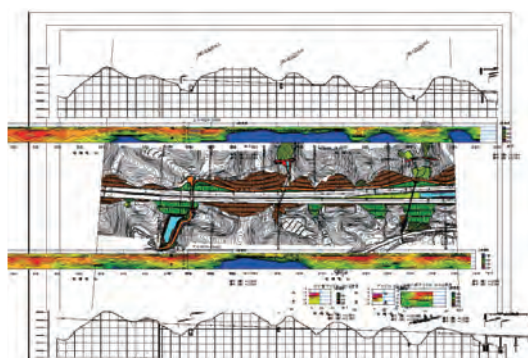
③ Shear wave velocity of expressway embankment
④ Hybrid survey system with FWD

Current Accomplishments (2/2)

① There have been many reports on collapses of road embankments due to heavy rainfalls and large earthquakes. These collapses were caused by inappropriate groundwater treatment and slaking/ weathering of embankment materials. In order to evaluate the stability of an embankment, we have to know the stiffness, soil profile and groundwater conditions in the embankment.

② The stiffness, soil profile with fine content information and groundwater conditions were continuously obtained along the road embankment by Shear-wave velocity (Vs) & electric resistivity (Ω).

③ The stability of the embankment was evaluated by Vs and Ω. We were able to understand the stability levels continuously along the road embankment. This continuous information along the road will be utilized to narrow down further detailed investigation sections.

④ The liquefaction potential value (FL) of embankments were calculated based on the stiffness, soil profile with fine content and groundwater tables in the embankment/natural ground. That information was obtained by Vs and Ω.

① Failure by heavy rainfall　　Failure by earthquake

②,③ Stability evaluation of embankment by Vs&Ω
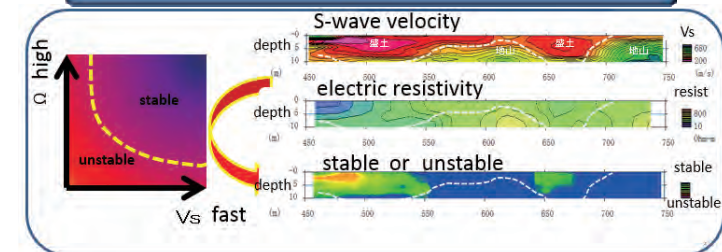
④ Liquefaction potential of embankment by Vs&Ω
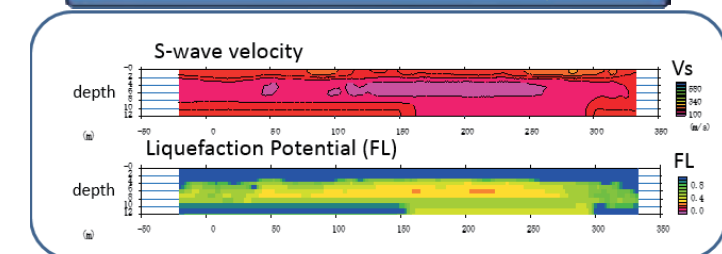
Goals

① Development of a fully-automatic survey & evaluation system of surface wave logging & electric resistivity logging

survey speed ≧ 500 m/hour
survey depth ≧20 m for Vs logging
survey depth ≧10 m for Ω logging
resolution for Vs logging;
0.2 m for pavement, 1.0 m for embankment

② Evaluation of pavement performance and the stability of the embankment
・ Evaluation of the stiffness of the pavement & the embankment
・ Evaluation of the stability of the embankment
・ Evaluation of the liquefaction potential of the embankment resolution along the road; 2.0 m

Development of a road management system with survey planning and maintenance planning (Web-GIS)

Web-GIS management system

The road to practical use