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“Technical Research and Development for Road Policy Quality Improvement”
Study Summary

No.	Title	Principal Researcher
No.30-8	Development of Long-life Repair Method for Road based on Soundness Evaluation of Embankment and Pavement	GifuUniv. Prof. Atsushi Yashima

Repeated damage to pavement has been 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 structure should be evaluated and the appropriate repair work should be done. In this research, the development of long-life repair method for road based on soundness evaluation of embankment and pavement has been discussed.

1. Backgrounds and Objects

Although the maintenance work of pavement is often planned based on MCI and FWD data, the repeated damages of pavement are observed at many places. This surface damage of pavement is partly originated by the weakness of subgrade, damage of the filled up ground and ground water. In order to avoid repeated maintenance works of pavement, the condition of embankment structure should be evaluated by an easy logging technique from pavement surface. The automatic technology for surveys and evaluations of pavement and embankment by using surface wave logging and electric resistivity logging has been proposed. In this study, we tried to develop the long-life repair method for road based on soundness evaluation of embankment and pavement.

2. Activities in Research Period

The following activities were carried out during this research.

- ✓ Development of automatic technology for surveys and evaluations of pavement and embankment by using surface wave logging and electric resistivity logging
- ✓ Development of long-life repair method for road based on soundness evaluation of embankment and pavement
- ✓ Development of monitoring system for evaluating long-life repair method

3. Study Results

- ✓ Hybrid measurements have been conducted on many roads where repeated repair works were done. The investigation and soundness evaluation records were collected and stored in the road check result database. An example of soundness evaluation of embankment and pavement is shown in **Fig.1**.

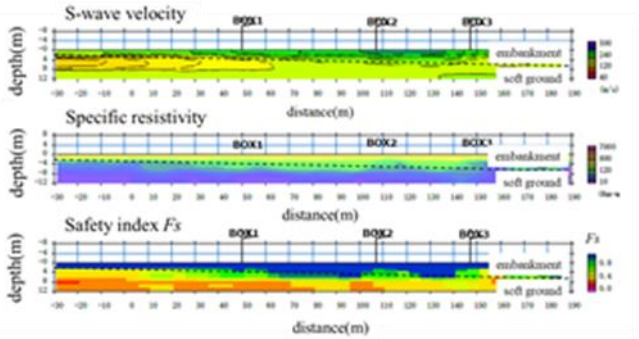

Fig.1 Example of soundness evaluation

- ✓ “Manual of investigation and design for long-life repair method for road based on the hybrid investigation” with an application example was proposed.
- ✓ Trial repair works were carried out on two prefectural road sections in Gifu prefecture using the proposed geosynthetics improvement.
- ✓ The real scale experiment using the proposed geosynthetics improvement were carried out in National Institute for Land and Infrastructure Management. The great improvement effects to the pavement damage was confirmed.
- ✓ Performance tests of improvement materials has been conducted. It was found that geosynthetics improved the toughness and bending stiffness of roadbed.

- ✓ “Manual of repair work for long-life pavement using geosynthetics” with an application example was proposed.
- ✓ In order to confirm the repair effect of the pavement in two trial sites, optical fiber sensor and moisture sensor were developed. It was found that the tensile strain was reduced in the upper subbase in a case with geogrid reinforcement.

4. Papers for Presentation

- ✓ Tsuji,S., Ito,S., Yokota,Y., Yashima,A.,Murata,Y. Kariya,K. and Okamura,T. : Development of long-life roadbed improvement procedure for road pavement using geosynthetics – Characteristics of roadbed material and geosynthetics composite structure -, Journal of Geosynthetics, Vol.34, pp.61-68, 2019.
- ✓ Murata,Y., Kariya,K., Yashima,A., Okamura,T., Ito,S., Tsuji,S. and Yokota,Y. : Development of long-life roadbed improvement procedure for road pavement using geosynthetics – test construction and effect of roadbed improvement -, Journal of Geosynthetics, Vol.34, pp.69-74, 2019.
- ✓ Murata,Y., Kariya,K., Yashima,A., Okamura,T., Nguyen,H-Q., Yokota,Y., Ito,S. and Tsuji,S.: Long-life repair method for road based on soundness evaluation of embankment and pavement, Japanese Geotech. Society Special Publication, Vol.8(11), pp.424-429, 2020.
- ✓ Murata,Y., Kariya,K., Yashima,A., Yamamoto,K., Nakajima,Y. and Ishiguro,T. : Soundness evaluation of road embankment and pavement by geophysical exploration and FWD test, Proc. 62nd Geotechnical Engineering Symposium, No.2-1, 2020.

5. Study Development and Future Issues

(1) Social implementation of hybrid measurement

A simple road surface investigation has been often performed to evaluate pavement condition. The repair work design is also carried out based on those simple investigations. In order to apply the proposed hybrid exploration technique for evaluating the essential cause of pavement damage and designing the long-life repair method for road, it is important for road management organization to understand that the overall check of pavement and embankment is needed. It is expected that “Manual of investigation and design for long-life repair method for road based on the hybrid investigation” becomes some help.

(2) Material and construction procedure for proposed repair work

In this research, the general geocell and geogrid have been used for pavement reinforcement. Problems such as poor compaction of upper subbase and poor adhesion with bitumen improvement layer were left during repair works. Some solutions are described in “Manual of repair work for long-life pavement using geosynthetics”.

Although the general multi-axial geogrid was used for the real scale experiment in National Institute for Land and Infrastructure Management, the great improvement effects to the pavement damage have been confirmed. The development of highly functional geosynthetics for road pavement will be waited for from now on.

6. Contribution to Road Policy Quality Improvement

“Manual of investigation and design for long-life repair method for road based on the hybrid investigation” and “Manual of repair work for long-life pavement using geosynthetics” have been proposed in this research. The contents described in both manuals are purely practical and very useful for road management organization.

7. References, Websites, etc.

The results of this research have already been published. A video of the real-scale model test using the road infrastructure experimental facility in National Institute for Land and Infrastructure Management and summaries of overseas efforts regarding the use of geocells and geogrids for pavement repair can be seen on the following website：
https://www1.gifu-.ac.jp/~geotech/material.html