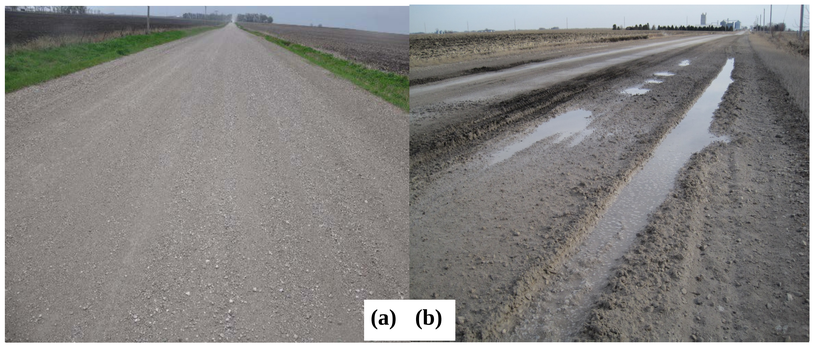
Evaluation of MASW and FWD Test for Measuring Multi-Layered Elastic Modulus of Chemically Stabilized Unpaved Roads

Measuring the elastic modulus for each of the material layers of unpaved roads are important

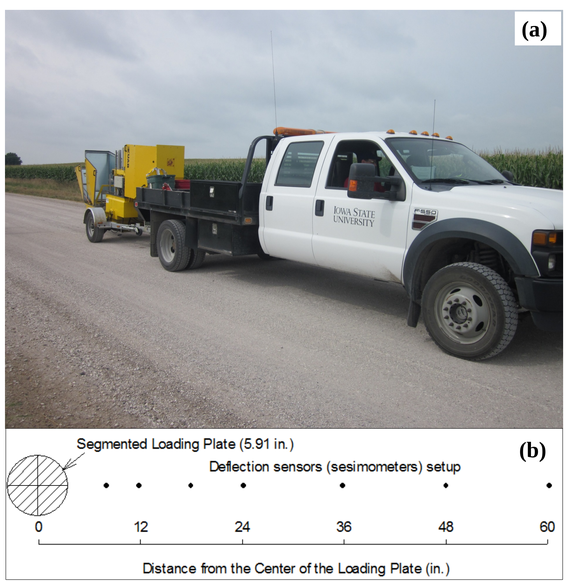
- Evaluate performance and predict damage susceptibility.
- Conduct mechanistic design for overlay or surface upgrade.



Surface conditions of an unpaved road test section: (a) prior to freezing and (b) post thawing

Falling weight deflectometer (FWD) test

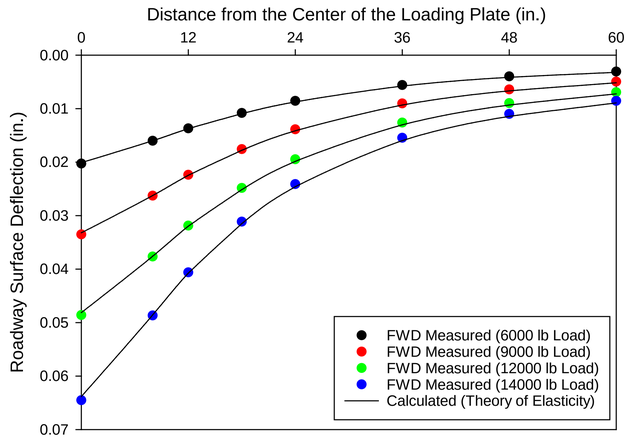
- Kuab Model 150 2m FWD
- Four impact loads: 6000, 9000, 12000, and 14000 lb.
- Backcalculation method: combines the Boussinesq theory and Odemark's equivalent layer thickness assumption (AASHTO 1993).



A (a) photo of the FWD test device and (b) schematic of sensors setup

In situ FWD measured deflection data were compared with theoretical calculated results

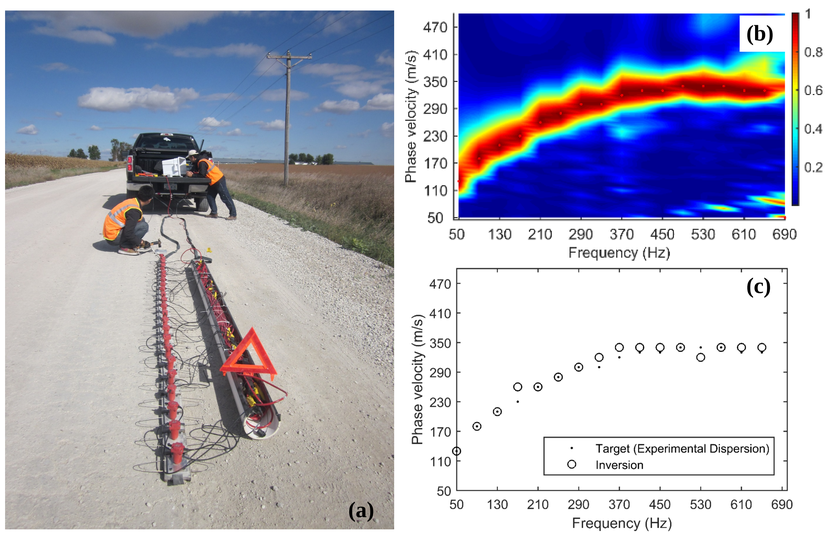
- KENLAYER software using theory of elastic layer systems (Huang 2004).



A comparison of FWD measured and theoretical calculated surface deflections

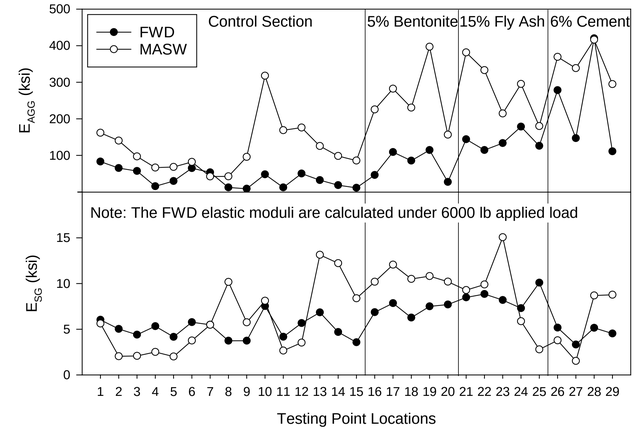
Multichannel analysis of surface waves (MASW) test

- A geophysical test method using wave propagation theory.
- A phase-velocity and intercept-time scanning method for dispersion analysis (Lin 2014).
- A hybrid genetic-simulated annealing optimization algorithm for improving inversion (Lin 2014).

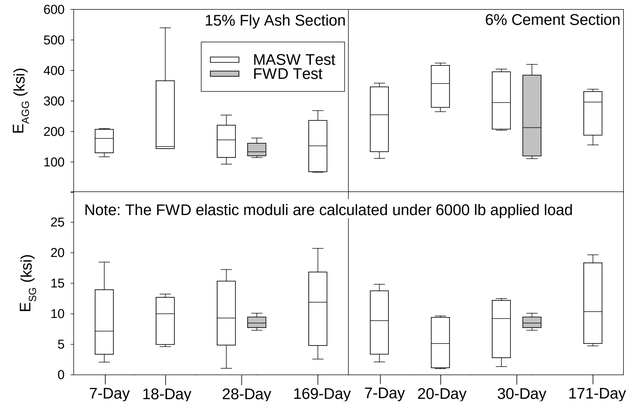


The MASW test procedure: (a) data collection, (b) dispersion analysis, and (c) inversion

Comparisons of the MASW and FWD test results



As-constructed FWD and MASW backcalculated moduli for the test sections



The FWD and MASW test results conducted during curing and post-thawing period

Conclusions

- The FWD backcalculation method is reliable for determining elastic modulus of two-layer unpaved road systems.
- The MASW is capable of measuring the near-surface material elastic modulus of unpaved roads.
- The MASW measured elastic modulus values are higher than the FWD measured results due to low testing strain levels.

References

- AASHTO (1993). *AASHTO guide for design of pavement structures 1993*, American Association of State Highway and Transportation Officials, Washington, D.C.
- Huang, Y. H. (2004). *Pavement analysis and design*, Pearson Education, Inc., Upper Saddle River, New Jersey.
- Lin, S. (2014). "Advancements in active surface wave methods: modeling, testing, and inversion." Doctor of Philosophy, Iowa State University, Ames, IA.

Cheng Li

Major Professors: Drs. Jeramy Ashlock and David White

IOWA STATE UNIVERSITY

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