Paper Presentation and Peer-Review
Group 1

ROYAL INSTITUTE OF TECHNOLOGY

Freeze – Thaw Performance Assessment of Stabilized Pavement Foundations

Peter J. Becker, David J. White, Pavana K. R. Vennapusa, Mark J. Dunn.

Emanuele Grimolizzi
Octavian Babiuc

Freeze and thaw phenomenon

- ❑ Temperature decreases: water freezes
- ❑ Volume increases
- ❑ Temperature increases: ice melts
- ❑ Saturated soil: weaking of the support capacity

- AASHTO 1993 design guide: effective roadbed soil resilient modulus base on the month of the year
- The Mechanistic-Empirical Pavement Design Guide (MEPDG): equivalent subgrade resilient modulus based on:
  - ➢ Regional climatic data
  - ➢ Time after thawing
  - ➢ Soil properties

Site conditions

- Project constructed in Boone, Iowa in May-July 2012
- 16 different cross sections
- Length from 674 ft to 1348 ft (205 m to 410 m)
- Test done in October 2012 and April 2013 (during one seazon of spring-thaw)

Test Section Description	Foundation Layer Profile[a] (above natural subgrade)	
Control	6 in. CLS[b]	12 in. compacted subgrade[c]
Mechanical Stabilization	6 in. CLS[b]	12 in. mechanically stabilized subgrade
4 in. Geocell + NW Geotextile	2 in. CLS[b]	4 in. geocell reinforced CLS, NW geotextile
6 in. Geocell + NW Geotextile	1 in. CLS[b]	6 in. geocell reinforced CLS, NW geotextile
NW Geotextile	6 in. CLS[b]	NW geotextile
Woven Geotextile	6 in. CLS[b]	woven geotextile
BX Polymer Grid	6 in. CLS[b]	biaxial geogrid
TX Polymer Grid	6 in. CLS[b]	triaxial geogrid
MP Fibers + PC Subbase	6 in. CLS[b]	6 in. recycled subbase + 5% PC + 0.4% MP fibers
FP Fibers + PC Subbase	6 in. CLS[b]	6 in. recycled subbase + 5% PC + 0.4% FP fibers
PC Subbase	6 in. CLS[b]	6 in. recycled subbase + 5% PC
Recycled Subbase	6 in. CLS[b]	6 in. recycled subbase
PC Subgrade	6 in. CLS[b]	12 in. 10% PC stabilized subgrade
10% FA Subgrade	6 in. CLS[b]	12 in. 20% fly ash (Port Neal) stabilized subgrade
15% FA Subgrade	6 in. CLS[b]	12 in. 15% fly ash (Ames) stabilized subgrade
20% FA Subgrade	6 in. CLS[b]	12 in. 10% fly ash (Muscatine and Port Neal) stabilized subgrade

[a] All thicknesses provided are nominal.
[b] CLS = crushed limestone subbase GP-GM or A-1-a (7% fines content).
[c] Existing subgrade scarified, moisture conditioned, and compacted.

In situ testing methods

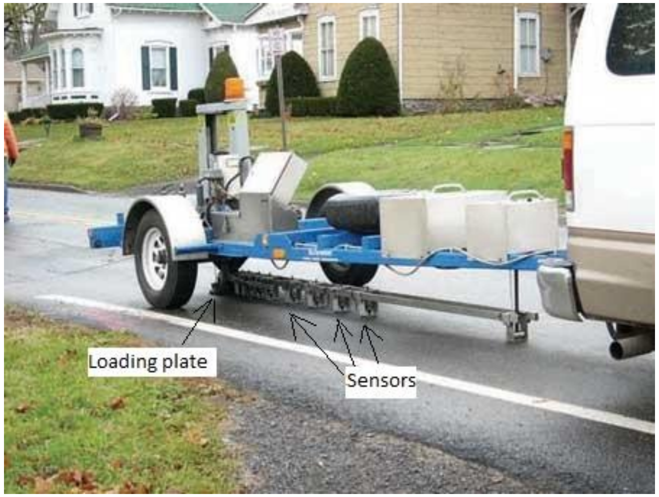
➢ Falling Weight Deflectometer

- 11.81 in. (3.6m) loading plate
- Load varies from 5000 lb to 15000 lb (2200 kg to 6800 kg)
- Deflections recorded by seismometers

Above: Kuab FWD, used for this test

$$E_{FWD} = \frac{(1-\eta^2)\cdot\sigma_0\cdot r}{D_0}F$$

$$E_{FWD} = elastic\ modulus\ [\text{psi}]$$
$$D_0 = vertical\ deflection\ [in.$$
$$\eta = 0.4 = Poisson's\ ratio$$
$$\sigma_0 = applied\ stress\ [psi]$$
$$r = radius\ of\ the\ plate\ [\text{in.}]$$
$$F = 2 = shape\ factor$$



In situ testing methods

- **Dynamic Cone Penetrometer**
  - Dropping of a 17.6 lb (~8 kg) from a height of 22.6 in.
  - Measurements of the penetration
  - Determination of CBR

$$CBR = \frac{292}{PI^{1.12}} \; for\ all\ soils\ with\ CBR > 10$$

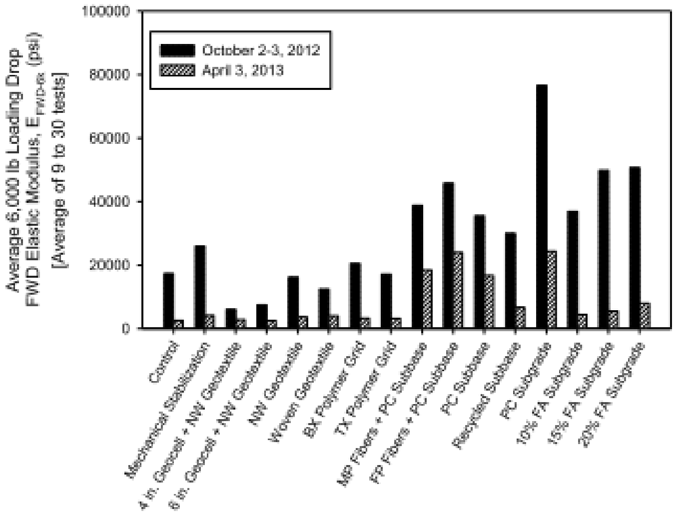
$$CBR = \frac{1}{(0.017019PI)^2} \; for\ subgrade\ CBR < 10$$

$$CBR = California\ Bearing\ Ratio$$

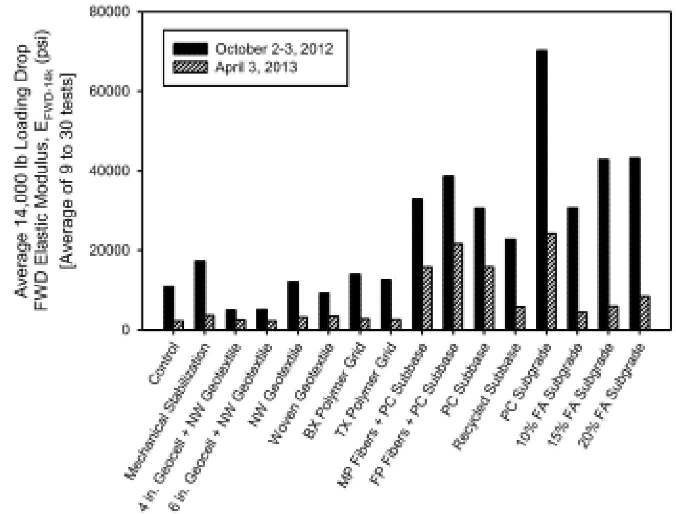
$$PI = Penetration\ Index\ \left[\frac{mm}{blow}\right]$$

Results

- ❑ FWD results showed that all sections experienced a significant decrease in E_{FWD}. Cement stabilized shows the best behaviour, the same for DCP test.
- ❑ Statistical analysis showed correlation between the two tests.
- ❑ A cost analysis is carried out.

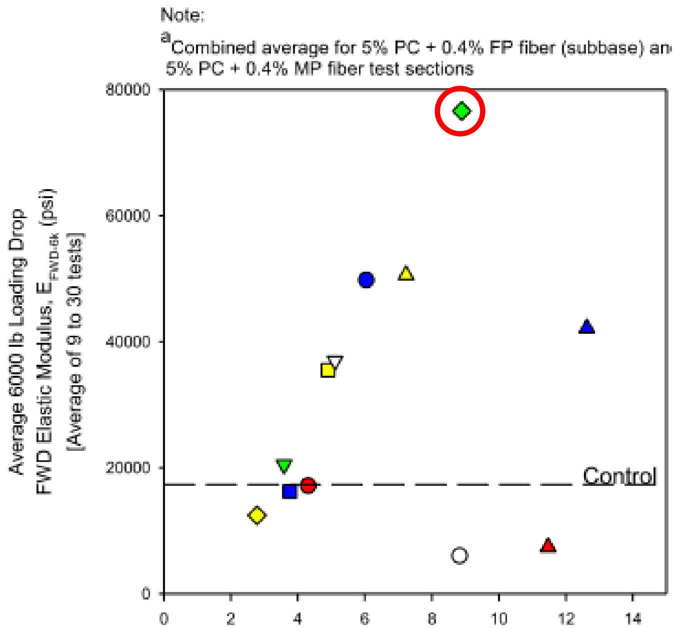


(a)

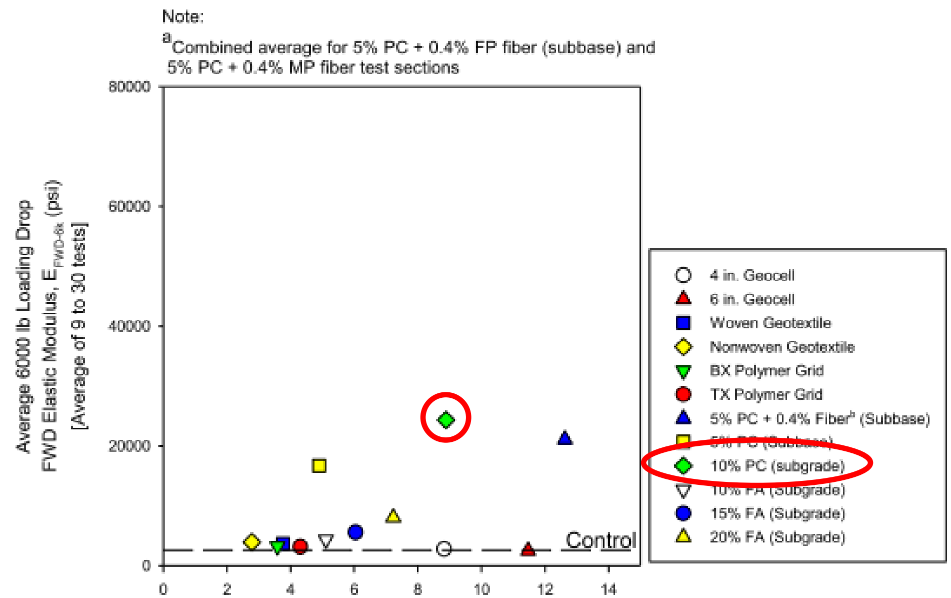


Cost Analysis

- Pavement foundation stabilization must be cost effective.
- 6 different contractors have submitted a cost analysis.
- Higher investiments with the use of cement stabilization contribute to better pavement performance.



October 2012 test



April 2013 test

Review

- Positive aspects:
  - Good paper organization, the language is fluid and not hard to understand
  - The paper content reflects what the reader expects
  - Cost analysis, very useful and reliable.

- Negative aspects:
  - More pictures!
  - Problems with units
  - Statistics,not easy to understand!
  - Test made in USA, what about other countries?

Questions?