Effects of Implements of Husbandry on Pavement Performance

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Office of Materials
Minnesota Department of Transportation
CTS Conference
April 27, 2010
Acknowledgement

- Professional Nutrient Applicators Association of Wisconsin and Minnesota.
- Iowa DOT
- IL DOT
- MN Local Road Research Board
- Wis. DOT
A pooled fund study

- **participants:**
  - IL DOT
  - Industries Represented by Professional Nutrient Applicators Association of Wisconsin (PNAAW)
  - Iowa DOT
  - Minnesota Local Road Research Board (LRRB)
  - MnDOT
  - Wis. DOT

- **Private Industry:**
  - PNAAW
  - John Deere, CaseIH, AgCo,
  - Houle Farm Equipment
  - Husky Farm Equipment
  - Minnesota, Iowa, Ohio, Michigan, Manure Applicators Associations
  - Michelin, Firestone/Bridgestone

- PIs: Univ. of MN; Iowa state Univ.
Major Objectives

- Determine pavement responses to selected agricultural equipment using instrumented pavements.
- Compare pavement response to typical 5-axle semi.
Research Approach

Cell 84 at MnROAD
- 5.5” HMA with PG58-34
- 9” gravel aggregate base
- A-4 subgrade soil

Cell 83 at MnROAD
- 3.5” HMA with PG58-34
- 8” gravel aggregate base
- A-4 subgrade soil
Existing PCC section 54
- 7.5” PCC
- 12” aggregate base

Existing PCC section 32
- 5.5” PCC
- 12” aggregate base
Instrumentation of Test Sections

- Strain gauges: bottom of HMA (18 per section)
- Pressure in base (6 per section)
- LVDTs (3 per section)
- Base moisture measurement: TDR & ECH20 (8 per section)
- Thermocouples (32 in cell 83; 16 in cell 84)
Project Status

- A 3 year project
  - 2 weeks testing in each spring
  - 2 weeks testing in each fall
  - The 1\textsuperscript{st} Spring test – Mar., 08
  - The 1\textsuperscript{st} Fall test – Aug., 08
  - The 2\textsuperscript{nd} Spring test – Mar.16, 09
  - The 2\textsuperscript{nd} Fall test – Aug. 09
  - The 3\textsuperscript{rd} Spring test – Mar. 10
S1: 4400 gal  
S2: 4400 gal  
S3: 1800 gal
T1: 6000 gal

T2: 4000 gal

T3: 6000 gal
T4: 7300 gal  
T5: 9500 gal  
R4: 2400 gal
MN: 80,000 LB  

MN: 102,000 LB
Axle Weight and Contact Pressure Measured
Test Configuration

- 4 different weights: 0%; 25%; 50%; 80%; 100%
- 3 different speeds: Creep; 5 mph; 10 mph, 20mph
- Offset: 0 and 12 inches
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Failure

- Cell 83 (Spring 09)
- Cell 32 (Spring 09)
- Cell 83 (Fall 09)
Wheel Offset
Preliminary Example Analysis

S5 Subgrade Stress (83PG4) Spring 09

[Graph showing test results with labels for 25%, 50%, and 80%]

[Diagram showing locations TE004, TE005, and TE006 with a 12 in offset]

[Image of a blue tanker truck]
Fall vs. Spring Maximum AC Strains
Fall vs. Spring Maximum Subgrade Stresses

Subgrade Stress (83PG4) 80%

- Mn80
- R4
- T6
- T7

[Bar chart showing comparison between Fall and Spring subgrade stresses for different vehicles]
Comparison of Subgrade Stresses

Subgrade Stresses (83PG4) 80%

Mn80 max subgrade stress at Cell 84 (80%)
Comparison of AC Strains

AC Strain (83AE4) 80%

Vehicles

- Mn80
- R4
- R5
- S4
- S5
- T6
- T7
- T8

[Graph showing comparison of AC Strains]
The analysis is very preliminary and does not represent any conclusion.
Thank you