The Effects of Implements of Husbandry “Farm Equipment” on Pavement Performance

**Participating Agencies**
Minnesota (Lead State), Iowa, Illinois, Wisconsin, PNAAW, Local Road Research Board (LRRB)

**Contract Duration**
Start – June 2009
End – Dec 2012

**Funding**
Total Funds $438,000

**Contracted Principal Investigator**
Lev Khazanovich
University of Minnesota
Khaza001@umn.edu

**Agency Lead Contact**
Shongtao Dai
Minnesota DOT
shongtao.dai@state.mn.us

**Project Description**
Over the past few decades, there have been significant changes in both farm size and farm equipment. These factors combined with a regulatory emphasis that has encouraged farmers to store manure as a liquid and apply it in a short time frame, have encouraged the farm equipment industry to produce larger manure hauling and application equipment. The shift to larger and heavier equipment has occurred at a faster rate than pavement design, materials technology, or state regulatory structures could match. Today, equipment innovations such as steerable axles, flotation tires, and new tire designs are not reflected in state DOT regulations. This situation has led to the adoption of equipment and practices that, while complying with the letter of the law, may actually create more pavement damage. The objectives of this study are to determine pavement response under various types of agricultural equipment (including the impacts of different tires and additional axles) and to compare this response to that produced by a typical 5-axle tractor-trailer.

For this study, an entirely new road was built at MnROAD, the “farm loop.” The test roadway, constructed in 2007, is typical of many rural, low-volume county roads. One section represented a typical 7-ton road in Minnesota and the other represented a typical 10-ton road.

Two major objectives are tied to this pooled fund:
1. Determine the pavement response under various types of agricultural equipment (including the impacts of different tires and additional axles) through instrumented pavements at MnROAD.
2. Compare this response to that under a typical 5-axle semi tractor-trailer and develop recommendations for determination of relative damage caused by farm equipment if any.

**Project Accomplishments**

Every March and August from 2008 to 2010 as well as in November of 2010 testing with several different farm equipment vehicles and a 5-axle semi has been conducted on two sections of the “farm loop” test track at MnROAD. In spring 2009, researchers observed extensive structural failure and
severe rutting on the 7-ton section, which is paved with a thinner layer of asphalt and unpaved shoulder. During fall 2009 testing, more damage was detected on another part of the 7-ton pavement section. These pavement failures illustrate the importance of spring load restrictions for this type of roadway. This suggests that 7-ton roads do not hold up under this kind of heavy equipment. Another observation from this study is that the 10-ton section, which is paved with a thicker layer of asphalt and an asphalt shoulder and does not require spring load restriction on commercial traffic, did not show significant distress.

An analysis of measured top surface subgrade stresses has shown that all farm equipment vehicles in all resulted in high stresses (higher than stresses from a standard 80-ton semi). Therefore, if a pavement has weight restrictions on commercial traffic, the restriction should be applied to farm equipment as well.

The researchers also developed several recommendations aimed to minimize pavement damage:

- If possible, divert traffic from the pavement edge. In some cases it can be achieved by designate certain roads as one way except for emergency traffic for limited time period (2-3 days). Townships in Wisconsin began implementing this recommendation.
- Avoid hauling during critical time periods: spring thaw, after heavy rain, in the hot afternoon
- For tankers with multiple axles ensure that the load is evenly distributed among the axles.

**Remaining Effort**

The research team has completed data collection and data analysis efforts. The team is preparing the final report.

**Implementation Plan**

Work with counties and cities to implement some findings from the project, such as designate certain roads as one way except for emergency traffic for limited time period (2-3 days) as townships in Wisconsin has implemented.