Study of the Impacts of Implements of Husbandry on Bridges

Justin Dahlberg¹, Travis Hosteng², Doug Wood³, Scott Neubauer⁴ and Ahmad Abu-Hawash⁵

Abstract

Traditional bridge design and bridge rating are based upon codified procedures that examine a bridge’s capability to resist traditional highway-type vehicles. It is known, however, that other vehicles (e.g., farm/agricultural vehicles or implements of husbandry) have characteristics that are quite different from traditional vehicles; specifically, they tend to have different wheel spacing, different gage widths, different wheel footprints, dynamic coupling characteristics, and others. Currently, the Bridge Rating Engineer must make assumptions about how highway bridges resist these non-traditional vehicles. It is desired to understand how these agriculture loads are distributed through the structural elements comprising the bridge and to assess the magnitude of the dynamic loads these vehicles impose. Further, it is desired to know what methods of analyzing bridges for these loads are acceptable, so that accurate bridge ratings may be produced.

A research study is in progress that includes sponsors and cooperators from Iowa and several other states, as well as a federal agency. The overall objective of this study is to determine how the implements of husbandry distribute their load within a bridge structural system and to provide recommendations for accurately analyzing bridges for their loading effects. To achieve this objective the distribution of live load and dynamic impact effects for different types of agricultural vehicles will be determined by load testing and evaluating two general types of bridges. The types of equipment studied will include but is not limited to; grain wagons/grain carts, manure tank wagons, agriculture fertilizer applicators, and tractors. Once the effect of
these vehicles has been determined, recommendations for the analysis of bridges for these non-traditional vehicles will be developed.

This presentation will focus on the first of the three following overall project tasks: 1) load testing and evaluation of approximately 10 bridges in Iowa, 2) development of engineering/code based comparisons, and 3) the development of analysis recommendations. Ten test bridges located in Iowa were load tested and evaluated. The presentation will describe load tests performed on two bridges types with single spans: 1) timber stringer with timber decks and 2) steel stringer with timber decks. The following vehicle variables included vehicle type, speed, lateral positioning, and vehicle weight. The load test results will include experimental data evaluated against typical bridge design parameters and against measured highway vehicle behaviors.

Key words: implements of husbandry—bridge load testing—heavy agricultural vehicles—lateral live load distribution—bridge field testing

1Bridge Research Specialist, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-9360, Fax: 515-294-0467, Email: dahlberg@iastate.edu
2Bridge Research Specialist, Bridge Engineering Center, Iowa State University, Ames, IA 50011, Tel: 515-294-7197, Fax: 515-294-0467, Email: kickhos@iastate.edu
3Structural Laboratory Manager, Civil, Construction and Environmental Engineering Department, Iowa State University, Ames, IA 50010, Tel: 515-294-3768, Fax: 515-294-8216, Email: dwoody@iastate.edu
4Bridge Rating Engineer, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA 50010, Tel: 515-239-1290, Fax: 515-239-1978, Email: Scott.Neubauer@dot.iowa.gov
5Chief Structural Engineer, Office of Bridges and Structures, Iowa Department of Transportation, Ames, IA 50010, Tel: 515-239-1393, Fax: 515-239-1978, Email: Ahmad.Abu-Hawash@dot.iowa.gov