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PROJECT TITLE

Effects of Diagnostic Load Testing on Bridge Embargoes

SPONSOR

Iowa Department of Transportation

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The Bridge Engineering Center (BEC) is part of the Institute for Transportation (InTrans) at Iowa State University. The mission of the BEC is to conduct research on bridge technologies to help bridge designers/owners design, build, and maintain long-lasting bridges.

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IOWA STATE UNIVERSITY
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Diagnostic Load Testing May Reduce Embargoes

tech transfer summary

Conventionally calculated bridge load ratings may be unnecessarily conservative as the bases for establishing load limits.

Summary

Establishing bridge load ratings based on data from diagnostic bridge load tests may result in fewer embargoed (posted) bridges or, where posting remains necessary, may allow an increase in allowable loads. This conclusion is based on data-based load ratings for 17 Iowa bridges, which in general proved to be less conservative (that is, the ratings were higher) than conventionally calculated load ratings.

Problem Statement

Bridge embargoes (i.e., weight limit postings) can negatively affect traffic flow by forcing weight-restricted vehicles to take alternate routes. To avoid traffic disruptions based on unnecessarily conservative postings, it is important that agencies post only those bridges that present an actual safety hazard and, when posting is warranted, not understate actual limits.

Currently, Iowa jurisdictions rely on the conventional system of calculating bridge load ratings using codified parameters, both for inventory/reporting purposes and for identifying bridges to embargo. Recent modifications to some of Iowa's legal load limits have resulted in the embargoing of additional bridges under this conventional rating system.

Compared to conventionally calculated bridge load ratings, ratings based on data collected from diagnostic bridge load tests more accurately reflect a bridge's strength and serviceability. The Iowa DOT's Office of Bridges and Structures (OBS) wanted to determine if deriving load ratings through diagnostic bridge tests would affect the number of embargoed bridges and/or the posted limits.



US-18 bridge east of Hartley, Iowa, being instrumented

Research Description

Researchers at Iowa State University's Bridge Engineering Center field-tested 17 bridges, 12 of which were embargoed and had been identified by the Iowa DOT's OBS as having a negative impact on traffic flow.

The bridges were instrumented with strain gauges at predetermined critical locations. The gauge measurements were supplemented with visual inspections to identify bridge deterioration or damage.



Positioning of load truck for static load test

Load-related strain data were gathered for the following:

- Critical span(s), sections, and members
- Lateral load distribution
- Composite action and end restraints

Key Findings

The resulting load ratings were generally less conservative than the conventionally calculated ratings.

In fact, as shown in the table at right, the new, higher ratings justified removing postings for six of the 12 posted bridges (see highlighted bridges in the table).

Implementation

The Iowa DOT's OBS has identified several situations in which determining bridge load ratings through diagnostic bridge field testing may be advisable for eliminating unnecessary bridge embargoes and ensuring that posted weight limits are not too low:

- Re-evaluating older bridges
- Determining capacity for bridges with unknown or insufficient design data
- Evaluating the need to impose temporary load restrictions on damaged bridges
- Reducing the number of bridges restricting a reasonable flow of overweight trucks
- Verifying the effectiveness of new strengthening techniques
- Removing load restrictions imposed on additional bridges due to implementation of new test-vehicle weight laws
- Determining the behavior of structures under heavy loads with calculated load ratings below anticipated capacity needs

Outcomes/Benefits

Implementing diagnostic bridge field testing to rate bridges can benefit both owner-agencies and the traveling public:

- Bridge postings, when needed, will be only as restrictive as necessary without sacrificing safety.
- Where postings already exist, either their removal or retention, possibly with higher weight limits, may be validated.
- Where existing postings are eliminated or posted weights are increased, access is increased.

Effect of Diagnostic Test Results on Bridge Postings

Tested Bridges	Span (#, length)	Bridge Type	Data Analyzed*	Posting before Testing	Posting after Testing
IA-92 west of Massena	1, 40'	Girder	A,B	Yes	Yes
IA-57 in Butler County	1, 50'	Girder	A,B	Yes	Yes
IA-136 in Dubuque County	3, 210'	Girder	A,B	Yes	Yes
US-18 east of Hartley	2, 100'	Girder	A ¹ ,B	Yes	Yes
IA-183 north of Pisgah	3, 96'	Girder	A,B	Yes	Yes
IA-60 near Sibley	1, 43'	Girder	A,B	Yes	Yes
IA-31 west of Quimby	1, 50'	Girder	A,B	Yes	No
US-30 near Wheatland	4, 368'	Girder	A,B,D	Yes	No
US-63 in Davis County	3, 210'	Girder	A,B	Yes	No
IA-78 in Keokuk County	4, 292'	Girder	A,B	Yes	No
IA-93 in Sumner	1, 61' 6"	Girder	A,B	Yes	No
IA-5 in Appanoose County	1, 51' 3"	Girder	A,B	Yes	No
I-80 in Jasper County	3, 100'	Slab	A,C	No	No
I-80 in Jasper County	5, 178'	Slab	A,C	No	No
I-80 in Poweshiek County	3, 114'	Slab	A,C	No	No
US-20 westbnd on-ramp no. Wellsburg	5, 198'	Slab	A,C	No	No

*A=strain data, B=load fractions, C=equivalent strip width, D=neutral axis

¹ Positive and negative moment region strain data