Transportation Literature Search

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Permit Vehicle Loads

Prepared for
Wisconsin Highway Research Program
Structures Technical Oversight Committee

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Transportation Literature Searches are prepared for WisDOT staff and principal investigators to heighten awareness of completed research in areas of current interest. The citations below are representative, rather than exhaustive, of available English-language studies on the topic. Primary online resources for the literature searches are OCLC's WorldCat and TLCat, U.S. DOT's TRIS Online, the National Transportation Library (NTL), TRB's Research in Progress (RiP) and other academic, engineering and scientific databases as appropriate. Links to online copies of cited literature are noted when available. Hard copies may be obtained through the WisDOT Library at library@dot.state.wi.us or 608-264-8142.

SUMMARY

In our search of the above and other databases, we found six citations pertaining to standard and oversize, overweight permit vehicle loads, including a recently published NCHRP Synthesis on bridge rating practices and permit vehicles. Four of the citations were published by federal agencies, one by the state of Texas, and another in an academic journal. One was published in 2006, two in 2004, one in 2001 and two in 2000.

KEYWORDS

Permit vehicle, load, standard, OSOW, oversize, overweight.

CITATIONS

Title: NCHRP Synthesis 359, Bridge Rating Practices and Policies for Overweight Vehicles
Author(s): Gongkang Fu, Clementine Fu
Date: 2006
Doc ID/URL: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_359.pdf
Description: 117 pp.
Contents: This synthesis focuses on overweight vehicle bridge permit processes. Information on state and provincial bridge rating systems, bridge evaluation practices and permit policies as they relate to overweight and oversize vehicles is highlighted and discussed. This report is intended to assist in the understanding of the reasons for nonuniform permitting practices. The report reviews specifications, software types, treatment of nonstandard configurations, and allowance for in-place dead loads; processes of permit review; and personnel assigned to permit review. A survey was distributed to transportation agencies at the state level in the United States and to Canadian provinces. A literature search was undertaken to identify relevant research reports, papers, and other publications for review and summation. Additional information was acquired from telephone interviews with targeted individuals and organizations to supplement the survey and literature search. Gongkang Fu and Clementine Fu, Troy Michigan, collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

Title: Behavior of steel bridges under superload permit vehicles
Author(s): Michael P. Culmo, John T. DeWolf, Michael R. DelGrego
Date: 2004
Doc ID/URL: *Transportation Research Record 1892*, 2004: 107-114.
Description: 8 pp.
Contents: The need for more power in the United States has spurred a major power plant building program. These plants are usually located where natural gas pipelines cross the power grid, which is generally in more remote areas.

To build these plants, construction companies are increasingly using the highway system to move large pieces of plant equipment to the project site. Traditional permit vehicles on highways have had limited gross vehicle weights ranging from 100,000 to 250,000 lb. Special heavy-load vehicles have been developed to spread the loads both longitudinally and transversely and to allow engineers to move loads in excess of 1,000,000 lb successfully without the need for temporary support of existing structures. The different types of vehicles that are available and their effect on steel bridges are considered. Simplified methods of analysis including live load distribution, dynamic load allowance (impact), and trailer layout options are investigated. Strain gauge data are presented from an actual 1,000,000-lb permit vehicle that crossed a three-span composite steel bridge in Connecticut. Results of the gauging are compared with the estimates of live load stress from the structural analysis.

Title: Monitoring prestressed concrete box-beam bridge for superloads
Author(s): Osman Hag-Elsafi, Jonathan Kunin
Date: 2004
Doc ID/URL: *Transportation Research Record 1892*, 2004: 126-136.
Description: 11 pp.
Contents: Monitoring Coeymans Creek Bridge in New York State for superload permit trucks is discussed. The superloads were boiler modules carried on 16-axle trailers, driven by one or two tractor-power units during the bridge crossing. The bridge is an integral abutment structure consisting of 11 prestressed concrete box beams with a composite concrete deck. Approval of the superload permits was based on an engineering analysis that recommended crossing of the bridge in two configurations: the first required that a crabbed trailer be towed across the bridge; the second called for a trailer to be driven in a diagonal crossing fashion. Crabbing, that is, locking trailer wheels to remain parallel to the bridge centerline during the crossing, was recommended for moves of gross weights equal to or exceeding 1,775 kN (400 kips), and diagonal crossings were recommended for those lighter than 1,775 kN (400 kips). The low rating of the structure and the unusually heavy loads motivated the need for investigating actual stress levels in the bridge beams during the superload moves. There was also interest in comparing the two recommended crossing patterns and investigating the level of fixity provided by the integral abutments. The beams were instrumented, and strain data were collected during four of the moves. Analysis of the collected data indicated that the stresses in the beams remained below what would have caused cracking and that, for this bridge, crabbing had no clear benefits over diagonal crossing. The analysis also indicated that the bridge has good transverse load distribution and a significant level of end fixity provided by the integral abutments.

Title: Live load distribution in girder bridges subject to oversized trucks
Author(s): Sami W. Tabsh, Muna Tabatabai
Date: January 2001
Doc ID/URL: Journal of Bridge Engineering, Vol. 6 (1), January 2001: 9-16.
Description: 8 pp.
Contents: A significant challenge facing motor carriers and engineers in this nation is the limitation of vehicle size and weight based on pavement and bridge capacity. However, the current demands of society and industry occasionally require a truck to carry a load that exceeds the size and weight of the legal limit. In these cases, engineering analysis is required before a permit is issued to ensure the safety of the structures and roadways on the vehicle's route. A truck with a wheel gauge larger than the standard 1.83 m (6 ft) gauge requires additional engineering effort because the wheel load girder distribution factors (GDFs) established by AASHTO cannot be used to accurately estimate the live load in the girders. In this study, the finite-element method is used to develop modification factors for the AASHTO flexure and shear GDFs to account for oversized trucks. The results of the analysis showed that the use of the proposed modification factors with the specification-based GDFs can help increase the allowable loads on slab-on-girder bridges.

Title: Alternatives to Weight Tolerance Permits
Author(s): David L. Luskin, Robert Harrison, C.M. Walton, Zhanmin Zhang, Jerry L. Jamieson, Jr.
Date: October 2000
Doc ID/URL: FHWA/TX-00/0-4036-1, Research Report 0-4036-1.
http://www.utexas.edu/research/ctr/pdf_reports/4036_1.pdf
Description: 92 pp.
Contents: A complex web of government regulations in the United States establishes maximum weights for vehicles on public roads. The primary purpose is to ensure compatibility of roadway design and operations with vehicle weight and dimensions. Of particular concern are the roadway impacts of heavy trucks, whcih far exceed those of passenger cars. As a rule of thumb, an “eighteen-wheeler” truck that weighs 80,000 lb has the same pavement impact as about 9,200 cars traveling the same distance. The use of heavier vehicles often produces savings in transportation costs. As load capacity increases, a truck can make the same number of deliveries in fewer trips;

this produces savings in driver labor, in vehicle wear and tear, and in other inputs. The challenge in vehicle weight regulation is finding the right balance between allowing these savings in transportation costs and preserving the roads and bridges. The trend has been toward higher limits, with a significant jump in 1974 when the maximum gross vehicle weight (GVW) allowed on interstate highways rose from 73,280 lb to the current 80,000 lb. Such reforms have gained momentum from various studies that have found the benefits to exceed the costs. In 1989, the Texas legislature passed HB 2060 creating an annual permit for a vehicle to operate above the general legal weight limits. The name "2060" has stuck to the permit, despite later amendments under HB 1547 (enacted in 1995). This report examines this controversial permit and makes recommendations for modifying current truck weight regulations in Texas.

Title: Permit vehicle routing using reliability-based evaluation procedures
Author(s): J.R. Casas
Date: 2000
Doc ID/URL: *Transportation Research Record 1696,* 2000: 150-157.
Description: 8 pp.
Contents: The works carried out within the framework of the development of an automatic system for permit vehicle routing on the Spanish National Highway network are described. The focus is on the methodology adopted for analysis of the old existing bridges. Because information about bridge properties (geometry, material strength) and design live load is unknown, the evaluation procedure combines the information provided by in situ measurements and inspection with a reliability-based evaluation. The reliability index for the most critical limit states derived from the maximum effects due to actual traffic on the bridge is adopted ad the comparison value to define a passage criterion. Any permit crossing the bridge alone or with traffic restrictions leading to a lower reliability index will not be allowed on the bridge. The actual traffic load is obtained from existing traffic records using a model of traffic flow. The method is applied to 10 bridges fully representative of the old and nondocumented bridges most often encountered on Spanish highways. The final result is definition of the standard permits as presented in Eurocode 1 that are allowed on the bridge. From the most unfavorable permit, a criterion is derived concerning the actual vehicle permits.