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Autor(en): **Sanders, Wallace W.**

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Distribution of Wheel Loads on Highway Bridges

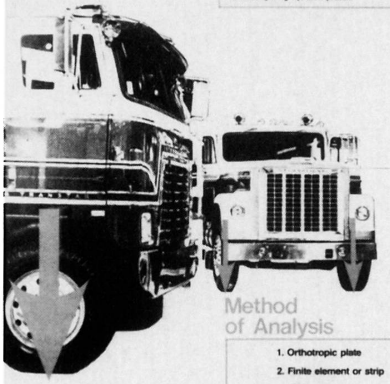
Wallace W. SANDERS, Jr.
Prof. Dr.
Iowa State University
Ames, IA, USA

The current criteria for the distribution of wheel loads in the U.S. bridge specifications have been undergoing change and expansion for over 50 years. The changes have primarily been introduced as modifications for a specific bridge type or condition with variations in the factors considered. As a result, the approach to the criteria has varied and resulted in inconsistencies in the codes. There now is a need for a complete review of load distribution in bridges recognizing a consistent approach to all bridge types and the availability of high speed computation.

There are a number of methods of analysis that can be used to develop load distribution behavior. These methods include: orthotropic plate, finite element or strip, grillage analogy, folded plate, influence surfaces. Using the selected methods, the effects of aspect ratio, bridge stiffness parameter, edge effects, load position, skew, continuity and diaphragms need to be evaluated for the broad types of bridges.

This study is needed and should result in a consistent criteria format based on similar parameters. It should consider all factors which affect behavior. The option should be available and encouraged to use one of the theories for complex structures, while providing a simple format for simple bridges.

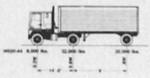
DISTRIBUTION OF WHEEL LOADS ON HIGHWAY BRIDGES



Abstract

The current criteria for the distribution of wheel loads in the U.S. bridge specifications have been undergoing change and expansion for over 50 years. The changes have been primarily introduced as modifications for a specific bridge type or condition with variations in the factors considered. As a result, the approach to the criteria has varied and resulted in inconsistencies in the codes. There now is a need for a complete review of load distribution in bridges recognizing a consistent approach to all bridge types and the availability of high speed computation.

Design Criteria



Percentage of Live Loads:

One or two lanes	100%
Three lanes	90%
Four lanes or more	75%

Traffic Lanes:
12 ft. wide lanes (with 10 ft. wide trucks), spaced across the entire bridge roadway width. Lanes shall be placed in numbers and position to maximize effect.

Interior Beams: Wheel Load Fraction (typical)

Kind of Floor	Bridge Designed for One Traffic Lane	Bridge Designed for Two or More Traffic Lanes
Timber: 6" Glued Laminated Panels on Glued Lam. Stringers	S/6.0	S/5.0
Concrete: Steel I-Beam Stringers or P.C. Girders	S/7.0	S/5.5
Concrete Box Girders	S/8.0	S/7.0

Exterior Beams:
a. Simple beam reaction, or
b. Load fraction = $S/(4 + .25S)$
(> 4 steel stringers; S = 6 – 14)

Special:
Spread Box Girders: Interior Load Fraction = $\frac{2N_L}{N_B} + k\frac{S}{L}$

Composite Box Girders: Load Fraction = $0.1 + 1.7R + \frac{0.85}{N_w}$

Method of Analysis

1. Orthotropic plate
2. Finite element or strip
3. Grillage analogy
4. Folded plate
5. Influence surfaces

Factors Affecting Design

1. Aspect ratio
2. Bridge stiffness parameter
3. Edge effects
4. Load position
5. Skew
6. Continuity
7. Diaphragms (type, location)

Specification Problems

1. Criteria format not consistent
2. Basis for criteria varies
3. Critical factors not considered
4. New bridge types require special studies
5. Loading conditions changed
6. Inconsistent safety factors
7. No criteria for rating

Current Design Practice

1. Timber deck/timber stringers
2. Concrete deck/steel I-beams
3. Concrete deck/P.C. girders
4. Steel grid decks/any stringer
5. Concrete deck/concrete T-beams
6. Segmental box girders
7. Concrete deck/spread box beams

Future Criteria

1. Load distribution criteria centralized
2. Simple criteria for "simple" bridges; Complex theories for "complex" bridges encouraged
3. Adaptable to all types of bridges
4. Separate design and rating criteria
5. Complete criteria for moment and shear