

# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-546 (project 675) | August 2024

## Transition of Allowable Stress Rating to Load and Resistance Factor Rating for Timber Bridges



### the **ISSUE**

Currently, there is no consensus on measuring a timber bridge's ability to safely carry predetermined truck loads. The most notable concern is that a weight limit varies with rating methods, and state departments of transportation estimate the limit based on past experience without scientific rationale. Two rating categories are available: Allowable Stress Rating (ASR), which was widely used when most timber bridges were constructed; and the Load and Resistance Factor Rating (LRFR), which the FHWA has required for bridge design since 2007. However, transportation agencies do not have sufficient information whether ASR furnishes a better rating for timber bridges compared with LRFR or vice versa. Without an understanding of how these ratings apply to timber bridges, agencies cannot properly manage bridges and efficiently allocate funds for maintenance and traffic control.

### the **RESEARCH**

The research focused on rating timber bridges with and without hollow structural steel beam repair. On the basis of previously performed laboratory and field tests plus finite element modeling, load effects were computed for two benchmark bridges utilizing three categories of 17 rating vehicles in conjunction with published rating manuals.



A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

Colorado State University  
North Dakota State University  
South Dakota State University

University of Colorado Denver  
University of Denver  
University of Utah

Utah State University  
University of Wyoming



### Lead Investigator(s)

Y. Jimmy Kim  
jimmy.kim@ucdenver.edu

### Research Assistant(s)

Jun Wang, Postdoc

### Project Title

Transition of Allowable  
Stress Rating to Load and  
Resistance Factor Rating for  
Timber Bridges

### Sponsors | Partners

Colorado Department of  
Transportation

USDOT, Research and  
Innovative Technology  
Administration

### the FINDINGS

Upon elucidating the flexural behavior of timber bridges, live load-carrying capacities were quantified by the ASR and the LRFR methods. Parametric studies were carried out to explore the repercussions of average daily truck traffic, which is one of the principal factors degrading bridge structure performance.

### the IMPACT

The research clarifies the technical appropriateness of ASR and LRFR through three-dimensional finite element analysis and establishes the foundation of understanding rating protocols for timber bridges. Based on the research, and to facilitate a convenient transition from LRFR to ASR, a conversion factor was proposed.

For more information on this project, download the Main report at <https://www.ugpti.org/resources/reports/details.php?id=1186>

For more information or additional copies, visit the Web site at [www.mountain-plains.org](http://www.mountain-plains.org), call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.



This publication was produced by the Mountain-Plains Consortium at North Dakota State University. The contents of this brief reflect the views of the authors, who are responsible for facts and the accuracy of the information presented herein. This document is disseminated under the program management of the USDOT, Office of Research and Innovative Technology Administration in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.



NDSU does not discriminate in its programs and activities on the basis of age, color, gender expression/identity, genetic information, marital status, national origin, participation in lawful off-campus activity, physical or mental disability, pregnancy, public assistance status, race, religion, sex, sexual orientation, spousal relationship to current employee, or veteran status, as applicable. Direct inquiries to Vice Provost, Title IX/ADA Coordinator, Old Main 201, 701-231-7708, [ndsuoaaa@ndsu.edu](mailto:ndsuoaaa@ndsu.edu).