

# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 21-426 (project 565) | January 2021

## Field and Analytical Study for Deteriorating Precast Double-Tee Girder Bridges



### the **ISSUE**

Because of their relatively low cost and ease of construction, bridges using double-tee (DT) girders are widely used on local road networks across the United States. It has been found that rapid deterioration of longitudinal joints between DT girders, which can significantly degrade the structural performance of these bridges, frequently occurs. Nevertheless, there is a lack of studies focusing on integrated field testing with visual inspection and structural analysis for the evaluation of existing DT bridges.

### the **RESEARCH**

This study discussed the structural performance of deteriorating DT girder bridges that have been in service for many years. This included field testing of two single-span DT girder bridges in South Dakota for live load distribution factors (LLDFs) and dynamic load allowance (IM) factors. These bridges encompassed Bridge A with seven 762-mm-deep precast DT girders and Bridge B having eight 584-mm-deep girders. An investigation into the determination of LLDFs for individual DT girders for Bridges A and B was conducted using three approaches: girder, stem, and joint approaches. The damage on Bridges A and B was then inspected and quantified for use in the analytical analysis of their finite element models. Each model was calibrated with field data. With the calibrated models, a parametric study was conducted on the LLDFs of Bridges A and B with different design parameters. The considered parameters were span length, location of diaphragms, concrete strength, deck width, and width-length ratio.



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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)

Junwon Seo  
South Dakota State University  
junwon.seo@sdsu.edu

### Co-Investigator(s)

Nadim Wehbe  
South Dakota State University

### Research Assistant(s)

Brian Kidd, GRA, MS

### Project Title

Study on Structural  
Performance Evaluation of  
Double-Tee Bridges

### Sponsors | Partners

South Dakota State University  
Faculty time and effort

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Innovative Technology  
Administration

## the FINDINGS

1. It was determined that the American Association of State Highway and Transportation Officials (AASHTO) load and resistance factor design (LRFD) specifications were conservative for the tested DT girder bridges, with two exceptions. An exterior DT girder on Bridge A and an interior DT girder on Bridge B exceeded the AASHTO LRFD LLDFs by 2.6% and 2.9%, respectively. The AASHTO standard codified LLDFs were significantly higher than the field LLDFs in all cases.
2. The girder approach had an average percent difference of 34% and 91% when compared with the AASHTO LRFD and AASHTO standard specifications, respectively. The joint approach produced average percent differences similar to the girder approach, but the stem approach was the most conservative approach.
3. The analytical LLDFs generally decreased as the span length increased. The other parameters showed insignificant changes in the LLDFs. The AASHTO LRFD interior LLDFs were consistent with the analytical LLDFs. However, the AASHTO LRFD exterior LLDFs did not decrease with span length because the lever rule was still used in the AASHTO LRFD specifications. bridge girders and the field performance of those girders.

In general, the researchers were able to develop correlations between damage observed during visual inspections of DT bridge girders and the field performance of those girders.

## the IMPACT

The research team believes the findings from visual inspection, field testing, and structural analysis can be used by bridge engineers to assess the safety and serviceability of bridges. The team developed a partnership with bridge engineers at the South Dakota Department of Transportation to conduct visual inspections and field testing of the DT bridges. It is anticipated that county transportation agencies will use the research findings and recommendations to determine the structural performance of in-service DT bridges.

For more information on this project, download the entire report at <https://www.ugpti.org/resources/reports/details.php?id=1023>

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.



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