

# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 19-373 (project 501) | February 2019

## Development of Alternative Bridge Superstructures for South Dakota Local Roads



### the **ISSUE**

Double-tee bridges may need replacement after only 40 years of service due to rapid deterioration. With only one supplier of double-tee girders in South Dakota, new prefabricated bridge systems are needed to provide local governments more options when designing new bridges or replacing deteriorated ones.

### the **RESEARCH**

To investigate the feasibility and performance of alternative bridge structures, three full-scale prefabricated bridge specimens were tested at the Lohr Structures Laboratory at South Dakota State University: (1) a fully precast bridge consisting of two precast inverted tee girders supporting five precast full-depth deck panels, (2) a glulam timber bridge consisting of three glulam girders and 13 glulam deck panels connected using epoxy, and (3) a glulam timber bridge consisting of two glulam deck panels placed in the longitudinal direction of the bridge and connected, incorporating three glulam stiffeners. Each specimen, which represented approximately one lane of traffic, was subjected to cyclic loading representative of the AASHTO Fatigue II limit state, then tested to failure under increasing monotonic loads. Fatigue II loading was included in this study to investigate the effect of the maximum stress ranges that could result from an average daily truck traffic (ADTT) of 15 for 75 years of service. Stiffness tests were performed after every 10,000 or 50,000 fatigue load cycles to investigate bridge deterioration. Finally, a strength test was carried out for each specimen to study the bridge performance under AASHTO service and strength limit states, and to understand the bridge failure mode.



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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)

Nadim Wehbe  
South Dakota State University  
nadim.wehbe@sdstate.edu

### Co-Investigator(s)

Mostafa Tazarv  
South Dakota State University

### Research Assistant(s)

Michael Mingo, GRA, MS  
Zachary Carnahan, GRA, MS

### Project Title

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Bridge Superstructures for  
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### Sponsors | Partners

USDOT, Research and  
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South Dakota Department of  
Transportation

## the FINDINGS

Based on the design, construction, testing, and cost estimate, all three proposed bridge systems, full-depth deck panels supported on inverted tee girders and two glulam timber bridges, were found to be viable alternatives to precast double-tee girder bridges. The proposed bridge systems are relatively simple to construct, do not need skilled labor, and are in-line with accelerated bridge construction strategies. The cost of timber bridges was lower than double-tee bridges and the proposed precast bridge was estimated to be slightly more expensive than a double-tee bridge. The AASHTO method of design for timber bridges was found viable. The girders of glulam girder bridges should be used designed as fully-non-composite sections.

## the IMPACT

1. Developed new alternatives to double-tee bridges,
2. Provided three prove-tested, durable, and easy to construct, bridge alternatives for local governments
3. A final report to disseminate the findings to DOTs, bridge engineers, local governments, and bridge owners,
4. Education of two MS students,
5. Integration of the experimental findings into graduate and undergraduate-level courses.

For more information on this project, download the entire report at <http://www.ugpti.org/resources/reports/details.php?id=934>

### Research Website:

<https://sites.google.com/people.unr.edu/mostafa-tazarv/research/alternative-to-dt-bridges>

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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