

# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 19-387 (project 512) | June 2019

## Prestress Losses and Development of Short-term Data Acquisition System for Bridge Monitoring



### the ISSUE

To improve bridge design, it is essential to understanding the effects of live loads on existing bridges. For example, for prestressed, precast concrete girder bridges, an accurate estimation of the prestress force is needed for proper design. However, obtaining information on the behavior of in-place bridges can be challenging.

### the RESEARCH

Researchers used a short-term data acquisition system to obtain bridge behavior data under live loads. They also used embedded instrumentation to quantify prestress losses.

Based on the measured data, the traffic on the Nibley Bridge near Nibley, UT) regularly exceeded American Association of State and Highway Transportation Officials (AASHTO) HS-20 truck loading specifications, with recorded strains of up to  $59.26 \mu\epsilon$ . The largest loading events approached (but did not exceed) the HL-93 design loads. Because the monitoring took place over a relatively narrow span of time, it was theorized that the maximum strains experienced by the bridge girders could be even higher than the measured values.

In general, the elastic shortening losses were under-predicted. This in likely due to an overestimation of the elastic modulus of the concrete. For both the interior and exterior girders, the long term prestress losses were over predicted by the AASHTO load and resistance factor design (LRFD) methods. The over prediction of the long-term losses can be attributed to over-prediction of the creep and shrinkage losses. Overall, the long-term prestress losses for Site B and Site D were over-predicted by 31.5% and 11.1%, respectively for the AASHTO LRFD refined method.



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University of Denver  
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### Project Title

Prestress Losses and  
Development of Short-term  
Data Acquisition System for  
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### Sponsors | Partners

Bridge Diagnostics, Inc.

Nibley City

USDOT, Research and  
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## the FINDINGS

Long-term changes in strain were monitored and used to calculate the long-term changes in prestress for an exterior and interior girder. In general, the elastic shortening losses were under-predicted. This is likely due to an overestimation of the elastic modulus of the concrete. For both the interior and exterior girders, the long term prestress losses were over predicted by the AASHTO LRFD Methods. The over prediction of the long-term losses can be attributed to over-prediction of the creep and shrinkage losses. Overall, the long-term prestress losses for Site B and Site D were over-predicted by 31.5% and 11.1%, respectively for the AASHTO LRFD Refined Method.

## the IMPACT

The measured prestress losses provide valuable information that show that improvements can be made to the design procedures. It is likely that multiple bridges in various climates will need to be studied before changes are made but this can be part of that process. The short-term data acquisition system itself is useful and cooperator Bridge Diagnostics, Inc. has used our experience to improve it. The data is also valuable. We didn't expect the large strains that we measured.

For more information on this project, download the entire report at <http://www.ugpti.org/resources/reports/details.php?id=950>

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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