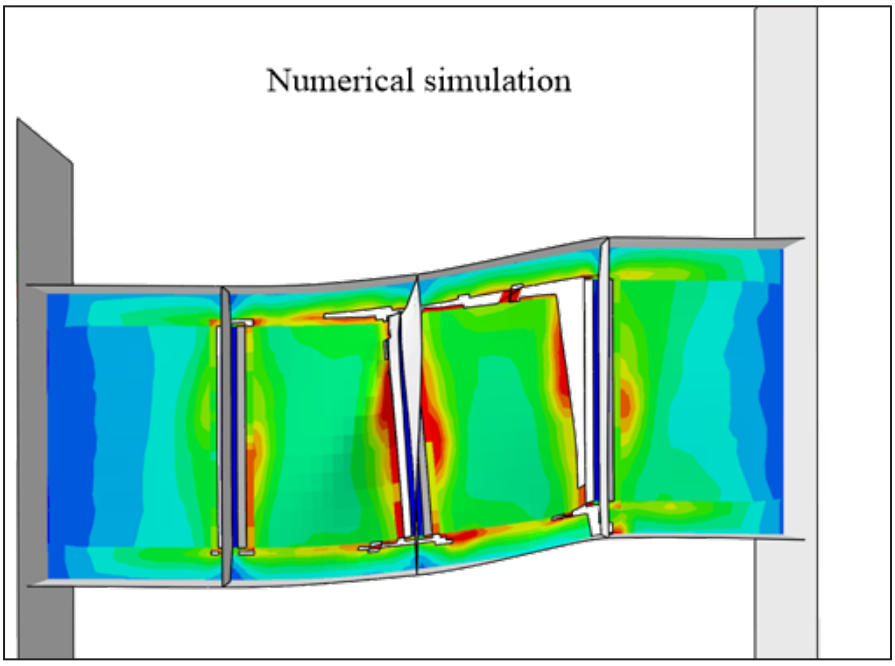
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 18-345 (project 446) | April 2018

A Modified Approach for Predicting Fracture of Steel Components Under Combined Large Inelastic Axial and Shear Strain Cycles



the ISSUE

Steel components in bridges and other structures are designed to withstand flexing under normal traffic and loading. However, earthquakes and other incidents may place extreme stresses on those components. Materials undergoing such extreme stresses can only withstand a small number of reverse loading (back-and-forth) cycles. Only limited research has been conducted on the performance of bridges under these conditions.

the RESEARCH

This study focused on developing a ductile fracture model and using the model to simulate complete failure in bolted and welded connections under monotonic and cyclic loadings.

In this study, a new ductile fracture criterion based on monotonic loading conditions is first developed and then extended to cyclic loading. Mathematical models were developed to calibrate the ductile fracture models and results from the literature on testing of small specimens were used to calibrate the mathematical models. Once the models were calibrated, finite element models of connections were developed and interfaced with the mathematical models to capture ductile fracture in connections.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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

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Project Title

A Modified Approach for Predicting Fracture of Steel Components Under Combined Large Inelastic Axial and Shear Strain Cycles

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the FINDINGS

New ductile fracture models were developed and the models were used to simulate ductile fracture in connection under tension and shear. The results show that ductile fracture in connections can be simulated with high level of accuracy which has not been done before.

the IMPACT

The report provides a methodology that, for the first time, allows fracture in steel connections under combined loads to be captured. The results and the modeling approach can be used to design and assess connections against failures.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=902

For more information or additional copies, visit the Web site at 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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