MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 21-437 (project 487) | May 2021

Investigation of Cross Timber Bridge Decks as a Sustainable Solution for Repair of Deficient Rural Wood Bridges

the **ISSUE**

Cross-laminated timber (CLT) is a sustainable, lightweight, high-strength versatile building material. Although it was introduced in Europe nearly 20 years ago, CLT is a relatively new building material in the United States. One primary reason for its delayed entry into the U.S. market is because CLT is not yet recognized as a structural system for seismically active regions of the country. One sub-assembly that has not been fully investigated is a horizontal diaphragm for floors, roofs, or bridge decks. At the time of this work, no CLT diaphragm testing had been done on buildings or bridges.

the **RESEARCH**

Ten E1 category CLT panels (the most commonly available grade of panel) were used to form the diaphragm, which was approximately 16.4 ft. by 14 ft. The diaphragm was set up as a cantilever beam according to ASTM specifications. A 110-kip actuator was used to apply a concentrated load at one end of the diaphragm while a steel base serving as a fixed boundary condition was at the other end. The Consortium of Universities for Research in Earthquake Engineering test protocol with a reference displacement of 75.6 mm (3 inches) was applied to the floor diaphragm specimen, which included a number of string potentiometers to collect displacement data. The diaphragm behaved in a predictable manner and the connectors failed in tension first, even with a chord designed per the National Design Specification for wood. The CLT panels then separated, resulting in a total failure. This dataset will be made available to those working on CLT diaphragm provisions for refinement of ongoing revisions.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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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

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the **FINDINGS**

The diaphragm was anticipated to fail in shear, but shear failure of the structural screws connecting the CLT panels to chord members occurred first. This resulted in an increased tension load acting on the steel splices. Due to this, the steel splice connectors failed in tension. The nails failed in shear and the connectors became dislodged. This led to separation of CLT panels in the north-south direction, which resulted in total failure of the diaphragm.

the **IMPACT**

The CLT diaphragm test presented in this report is a step toward understanding the behavior of CLT diaphragms under seismic loading. The results and method will allow for better modeling and validation of models for CLT bridge decks constructed/designed using CLT and subjected to lateral loads such as earthquakes.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1038

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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