MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 17-324 (project 379) | March 2017

Plastic-Aluminum Composites in Transportation Infrastructure

the **ISSUE**

Plastic-aluminum composite beams are alternatives to more standard structural materials and can be used in a wide variety of transportation applications. These materials are strong, lightweight, and have constituents that can be fully recycled in the event of extensive damage. This report gives the first accounting of their potential use.

the **RESEARCH**

In this work, an analysis of the fundamental mechanics of plastic-aluminum composites were completed. The pertinent literature was reviewed, the deboss geometries that bonded the two materials were discussed, the material properties were investigated, and several physical tests were performed to quantify different strengths and properties of the beams. Finally, a numerical model was developed using the finite element method on one geometry of the deboss regions and results were compared with physical experiments. Conclusions and recommendations for future work are presented for this novel composite.

Many physical experiments were performed on the plastic-aluminum composite I-beams discussed in this report. Although this report is only an initial investigation of these beams, several quantifiable results are discussed in detail.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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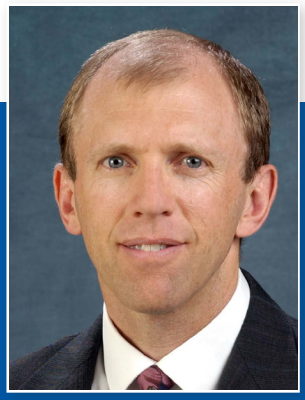

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Plastic-Aluminum Composites in Transportation Infrastructure

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the **FINDINGS**

Highlights include the following:

- The web plastics with the three highest modulus values all have 38% talc filler content.
- The metal deactivator addition had essentially no effect on the modulus values. The addition of the metal deactivator resulted in less than a 1.0% decrease in modulus between each comparison.
- An increase in talc content from 0% to 20% in the flange plastics resulted in the modulus of elasticity almost doubling.
- None of the beams exhibited tertiary creep.
- The results over a range for Poisson's ratio of 0.44-0.48 are consistent.
- The load per deboss region that can be resisted before the plastic begins to yield and extensively deform matched experiments to within 10%.
- The physical experiment resisted a higher load, supporting the likelihood of hoop stress existing around the flanges due to residual stresses induced during extrusion.

the **IMPACT**

This type of material is one of the very few available that combines high stiffness, high strength, and full recovery when recycled. These composites could be used in many different applications, and could provide significant economic benefits depending on the application.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=869

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7938 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.