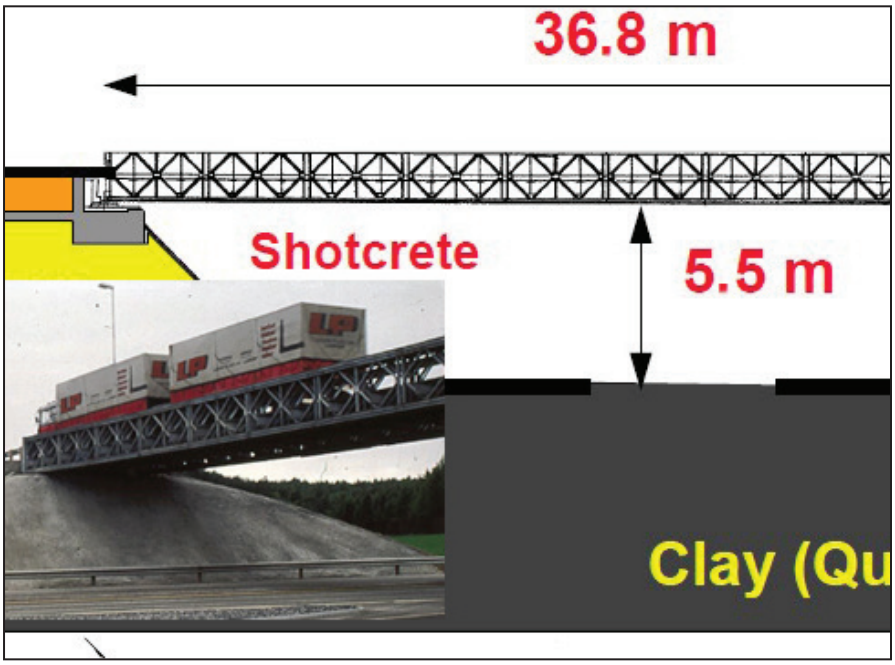
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 17-328 (project 422) | December 2017

Seismic Evaluation of Expanded Polystyrene (EPS) Geofoam Bridge Support System for Overpass Structures



the ISSUE

Expanded polystyrene (EPS) geofoam is a super-lightweight, closed-cell, rigid plastic foam-like material used in many civil engineering applications. Previously, embankments with conventional fill materials have been used for bridge approach and bridge support systems, and, depending on ground conditions, intermediate or deep foundation systems have usually been required. However, similar to a geosynthetic reinforced soil (GRS) bridge abutment, EPS geofoam blocks could be used for bridge support without the installation of other foundation systems, or the use of significant ground improvement. Unlike GRS bridge abutments, an EPS bridge support system can be built rapidly on soft ground due to its extreme lightweight characteristics. Research is needed to evaluate the performance of this novel approach under extreme loading such as those produced by seismic events such as earthquakes.

the RESEARCH

This report has investigated the use of EPS geofoam embankment to support bridge systems without the use of deep foundation systems or ground improvement. The viability of the system to support dead, live and earthquake loading was evaluated using laboratory, analytical and numerical methods for the cases of rectangular prismatic shaped and trapezoidal prismatic shaped embankments. Numerical evaluations were done to assess the internal and external seismic stability in terms of inter-layer and basal sliding, horizontal sway and rocking modes. The evaluations showed that with a cable restraint system, the EPS bridge support system would have sufficient capacity to resist shaking from large earthquakes in areas with high seismicity.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

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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

Seismic Evaluation of Expanded Polystyrene (EPS) Geofoam Bridge Support System for Overpass Structures

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Norwegian Public Roads Administration

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the **FINDINGS**

Numerical evaluations were done to assess the internal and external seismic stability in terms of inter-layer and basal sliding, horizontal sway and rocking modes. The critical acceleration (i.e., acceleration producing a factor of safety equal to 1.0) for inter-layer and basal sliding for rectangular prismatic and trapezoidal prismatic shaped embankments was found to be about 0.6 g for both cases. The modeling suggests that interlayer sliding does not initiate for acceleration values less than or equal to about 0.8 g; whereas basal sliding may occur for values exceeding 0.6 g. The inclusion of shear keys was included as a mechanism to increase the resistance to interlayer sliding. These evaluations suggest that for horizontal excitation levels of 1.0 g, the required shear key coverage between two EPS layers is about 8 percent of the surface area of the interlayer sliding plane.

the **IMPACT**

The report findings show that EPS bridge support systems are possible for simple overpass and pedestrian bridge structures, most likely constructed of steel or other light-weight materials. This allows accelerated bridge construction (ABC) on soft ground conditions without the need of deep foundation systems; thus, saving the cost and time associated with such systems.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=900

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.