



# OKLAHOMA Transportation RESEARCH

## PROJECT TITLE

FEASIBILITY STUDY OF GRS SYSTEMS FOR BRIDGE ABUTMENTS IN OKLAHOMA: INFLUENCE OF FACING AND AGGREGATE FILL ON PERFORMANCE

FINAL REPORT ~  
FHWA-OK-19-09  
ODOT SP&R 2262

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## INVESTIGATORS

Kianoosh Hatami, PhD, PEng  
Ridvan Doger, PE  
Jérôme Boutin  
*The University of Oklahoma*

## ODOT SPONSORS

Shannon Sheffert  
Shelly Williams  
Walt Peters  
Gregory Garland  
Chris Clarke  
Zachary Gutierrez

## Office of Research & Implementation

*Oklahoma Department of  
Transportation  
200 NE 21st Street,  
Oklahoma City, OK  
73105-3204*

*Implementation of Research  
for Transportation Excellence*

## MORE INFORMATION

[odot-spr@odot.org](mailto:odot-spr@odot.org)

# HIGHLIGHTER

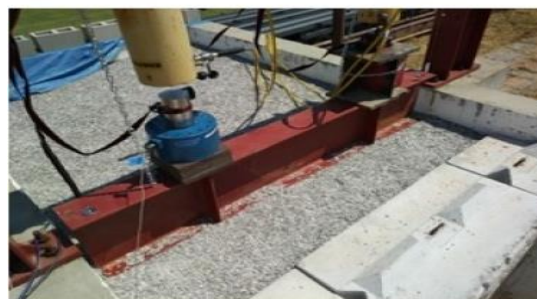
## FEASIBILITY STUDY OF GRS SYSTEMS FOR BRIDGE ABUTMENTS IN OKLAHOMA: INFLUENCE OF FACING AND AGGREGATE FILL ON PERFORMANCE

July 2020

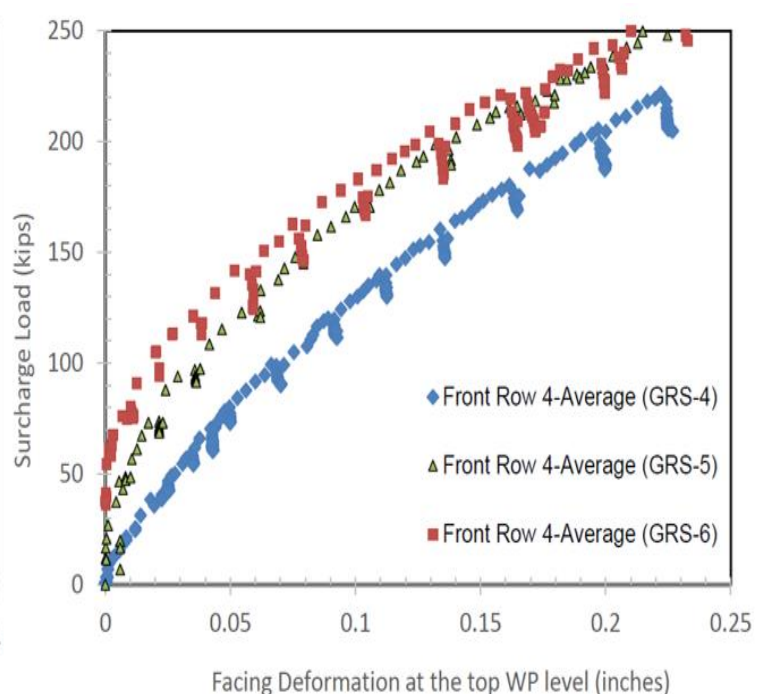
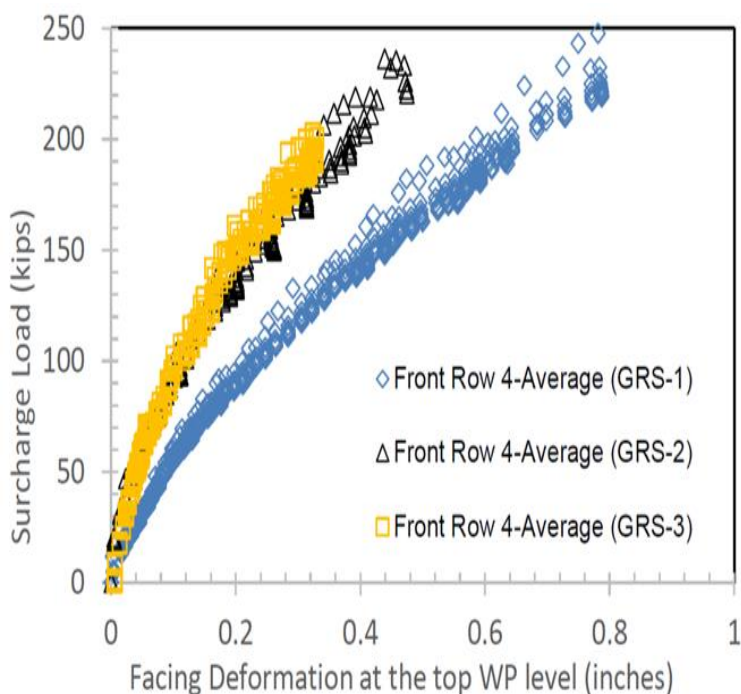
**OVERVIEW** Geosynthetic Reinforced Soil (GRS) technology consists of closely-spaced layers of geosynthetic reinforcement and compacted granular fill material. The GRS Integrated Bridge System (IBS) technology has been developed primarily over the last decade through extensive support and promotion by the Federal Highway Administration as a viable and cost-effective bridge construction



alternative to the conventional, deep-foundation abutment systems for local and county roads across the United States. While the economic advantage of GRS-IBS (illustrated in the photo, right) over the conventional abutment systems has been demonstrated in many projects in different states, it has been observed that their cost savings and reduced construction time could significantly diminish in the case of larger and taller GRS abutments. Therefore, one main purpose of this study was to test and quantify the anticipated advantages of large concrete blocks for the facing of GRS-IBS abutments through large-scale laboratory tests at OU (shown in the photo below) and a possible field project.



**RESULTS** In this study, a set of six instrumented full-scale (8 ft-high) GRS abutment models were constructed and load tested at an outdoor test station to study the influences of facing type, reinforcement spacing, fill aggregate and compaction effort on the structural performance and construction speed of GRS bridge abutments in the field. Different GRS models examined include open-graded and dense-graded aggregates, hollow concrete masonry units (CMU) and larger (i.e. 24" × 24" × 48") solid concrete blocks, 8-inch and 12-inch reinforcement spacing, and reduced versus recommended compaction efforts. Results of the study showed that use of large concrete facing blocks instead of CMU can indeed improve both the structural performance and construction speed of GRS bridge abutments. Models with large-block facing tested in this study (i.e. Models #2 and #3) were easier to compact during construction and consistently showed smaller deformations relative to the otherwise identical control model (Model #1). The influence of backfill compaction on the structural performance of GRS abutments was also demonstrated and quantified. It was shown that models built using recommended compaction effort (i.e. Models #4 and #5) showed significantly smaller settlements and facing lateral deformations under the surcharge load when compared to the control model that had been built with reduced compaction effort (Model #1).



It was also observed that repeat construction of GRS abutments by the research team during the course of this project led to faster construction of subsequent model abutments. The practical implication of this finding is that widespread adoption and more frequent construction of GRS-IBS projects by the counties and cities across the state can lead to further cost savings and reduced traffic disruptions due to shorter construction periods. Finally, regular survey of three recent GRS-IBS projects in Caddo County, OK during the period of this project has shown that all three bridges have performed very well with no sign of differential settlements or other serviceability problems. One of these GRS bridges was built using the same large concrete blocks that were used in the full-scale tests reported in this study and constitutes the first large-block-facing GRS-IBS in Oklahoma.

**POTENTIAL BENEFITS** Results of this study have provided further verification that GRS-IBS projects can indeed serve as viable and cost-effective solutions for the reconstruction or replacement of numerous local and county bridges that are functionally obsolete or structurally deficient relative to the current stability and performance requirements.