MPC-635
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Project Title

Field Evaluation of Geogrid-Reinforced Pavement Systems on Soft Subgrades

University

University of Utah

Principal Investigators

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Research Needs

The inclusion of geogrid reinforcement and geotextile filtration/separation within pavement systems bearing on soft subgrades can provide significant reductions in the thickness of the Untreated Base Course (UTBC) and the Granular Base (GB), thereby substantially reducing the cost of the pavement system and improving the long-term performance. UDOT participated in the development of the *Guide for Geosynthetics for Subgrade Improvement*, which gives guidance on how to design with Geogrid. However, our current knowledge is insufficient to know with certainty that these procedures and guidelines produce the most efficient design.

Research Objectives

The primary objectives of this research project are to instrument and monitor test sections within a UDOT roadway project that will allow the comparison of the field performance of pavement systems bearing on soft subgrades that are designed and constructed in two main ways: Without reinforcement and with geogrid or geogrid-like reinforcement. In addition, the effectiveness of geotextile separator at the interface of the subbase and the subgrade will be determined. Specific objectives are identified below. Because of the uncertainty associated with the roadway project that will be selected for this research, and what tasks will be permitted by the UDOT Project Management Team and the Design-Build Contractor (if a Design-Build project is selected), the last four objectives will only be accomplished if appropriate research tasks are permitted by these entities and sufficient funding is available to accomplish them.

- Compare the performance of pavement systems designed without any reinforcement and with geogrid or geogrid-like reinforcement within the base course.
- Compare the performance of pavement systems designed with a total thickness of the pavement structure equal to the frost depth vs. designed to a thickness based on mechanical properties only.

- Determine the effectiveness of a geotextile filter/separator at the interface of the GB and the subgrade.
- Determine the location of geogrid within the base course that will provide the maximum reinforcing benefit to the pavement system.
- Determine if other geogrids or geogrid-like reinforcing systems are the equivalent of the current specifications for biaxial geogrid provided in the *Guide for Geosynthetics for Subgrade Improvement*.
- Determine the cost-benefit of geosynthetic composite vs. geotextile alone at the interface of the subbase and the subgrade.

Research Methods

The primary research methods that will be used in this research project are as follows:

1. Identify a roadway project that will be suitable for this research.
2. Review available project geotechnical data and, if necessary, perform additional tests to determine appropriate locations for test sections that will have comparable soft subgrade conditions.
3. Obtain and install instrumentation within the pavement system of each test section to measure the performance.
4. Provide Quality Assurance (QA) during construction of the subbase and base courses within the test sections to assure that material and compaction specifications are met.
5. After completion of the test sections, perform field tests to provide baseline information regarding the thickness and stiffness of each of the components within the pavement system and underlying subgrade.
6. Monitor the performance of the pavement system within each of the test sections for a period of at least three (3) years after the roadway is placed in service.
7. Analyze performance data and compare the performance of each component of the pavement system within each test section. Determine final conclusions and recommendations from the data and analyses.
8. Write interim and final reports.

Expected Outcomes

It is expected that the results of this research will result in changes to the software used to design pavement systems bearing on soft subgrades, and the portion of the Four Corners guidebook (*Guide for Geosynthetics for Subgrade Improvement*) related to pavement systems bearing on soft subgrades will be modified and improved. It is also expected that additional geogrid or geogrid-like materials will be identified that will be equivalent to or better than the standard biaxial geogrid typically used to reinforce pavement systems bearing on soft subgrades.

Relevance to Strategic Goals

USDOT Strategic Goal: State of Good Repair

When properly designed, constructed, and maintained, geogrid-reinforced pavement systems help to improve the performance of roadway infrastructure to ensure that they function as designed within their useful lives at a reduced cost. Successful completion of the proposed research project will result in better methods of design and analysis of both unreinforced and geogrid-reinforced pavement systems within the State of Utah and surrounding states. The final result will be better maintenance, reliability, and performance of one of the key components of our transportation infrastructure – our roadways.

Educational Benefits

One graduate student from the Department of Civil & Environmental Engineering at the University of Utah will be funded to work on this project. In addition, it is expected that two undergraduate students will work on this project, with funding provided by the Office of Undergraduate Research Opportunities program at the University of Utah. The results from this project will be incorporated into several graduate level classes in the areas of materials and geotechnical engineering

Technology Transfer

The results from this research will be presented at the annual UDOT Engineering Conference, the Annual Transportation Research Board Meeting, and a special seminar to be sponsored by UDOT in which UDOT engineers and engineers from other governmental agencies and commercial companies will be invited. Papers will also be published in relevant journals such as Transportation Research Record, Journal of Materials Engineering, and Transportation Geotechnics. Furthermore, a webinar will be arranged through the Mountain-Plains Consortium.

Work Plan

A concise list of the major tasks/steps in this research project is as follows:

1. UDOT will identify a roadway project that will be suitable for this research. It is currently anticipated that this research project will be conducted in conjunction with the West Davis Corridor project. (Month 1)
2. Review available project geotechnical data and, if necessary, perform additional tests to determine appropriate locations for test sections that will have comparable soft subgrade conditions. (Months 1-2)
3. Obtain and install instrumentation within the pavement system of each test section to measure the performance. (Months 3-6)
4. Provide Quality Assurance (QA) during construction of the subbase and base courses within the test sections to assure that material and compaction specifications are met. (Months 3-6)
5. After completion of the roadway where the test sections are located, but prior to it being placed in service, conduct CPT soundings to provide baseline information regarding the thickness and stiffness of each of component. (Months 6-7)

6. Monitor the performance of the pavement system within each of the test sections for a period of one year after the roadway is placed in service. (Months 6-18)
7. Analyze performance data and compare the performance of each component of the pavement system within each test section. Determine final conclusions and recommendations from the data and analyses. (Months 7-10)
8. Write interim and final reports. (Months 6 and 18)

Project Cost

Total Project Costs:	$217,333
MPC Funds Requested:	$ 64,000
Matching Funds:	$153,333
Source of Matching Funds:	Utah Department of Transportation, $120,000 Hanes Geo Components, $20,000 Tensar Inc., $13,333