

UTC Project Information	
Project Title	MPC-503 – Characterization of Crushed Bases in Wyoming
University	University of Wyoming
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Project Duration	September 30, 2013 to September 30, 2018
Brief Description of Research Project	<p>In Wyoming, the characterization of local subgrade materials was recently completed by the principal investigators in the ongoing research project (RS04(213)) funded by the Wyoming Department of Transportation (WYDOT). Subgrade materials of all soil types were collected from twelve locations throughout the state of Wyoming for a laboratory test program. Particularly, a resilient modulus (M_r) test procedure was developed by modifying the American Association of State Highway and Transportation Officials (AASHTO) T 307 (2007) and incorporating Wyoming's practices (Henrichs 2015). The resilient modulus of each subgrade material was measured, constitutive models for the resilient modulus were calibrated and a design catalog of M_r values for the subgrade materials was developed. Furthermore, M_r values of subgrade materials were estimated from the back-calculation of Falling Weight Deflectometer (FWD) deflection data collected from twenty-five test sites in Wyoming (Hellrung 2015). The back-calculated resilient modulus values were subsequently corrected to laboratory equivalent values.</p> <p>Since the ongoing research focuses on the characterization of unbounded subgrade materials, granular crushed base serving as one</p>

of the intermediate layers in a pavement system for both flexible and rigid pavement was not characterized. Although the resilient modulus of crushed base was estimated from the back-calculation method, extreme differences in resilient modulus values between the base and subgrade materials were observed with subgrades having higher resilient modulus values (Hellrung 2015). In an effort to combat the issue of extreme differences in base and subgrade back-calculated modulus values, a fixed-layer approach was utilized by fixing the base layer modulus so as to improve the accuracy of the back-calculation by reducing the calculated root-mean-square error (RMSE). Additionally, a wider range of back-calculated modulus values for the base layer, between 10,000 psi and 80,000 psi, was considered during the back-calculation process so as to obtain more realistic subgrade modulus values at which comparison of measured and back-calculated subgrade resilient modulus values was feasible. These current limitations along with having no measured base modulus for similar comparative studies, prevent the realistic characterization of the base properties and limit the comprehensive implementation of the Mechanistic-Empirical Pavement Design Guide (MEPDG) in Wyoming.

A research project funded by the Virginia Department of Transportation (VDOT) was recently completed with the primary objective of developing a catalog of resilient modulus values for aggregate base materials (Hossain and Lane 2015). The research generated representative base resilient modulus values for the implementation of MEPDG in Virginia. They concluded that there were large variations in resilient modulus values among different sources of granular crushed base aggregate in Virginia, and moisture variation can result in substantial change in resilient modulus values. Also, resilient modulus values of base aggregate depend on gradation, rock type and moisture content. The amount and nature of fines affect the moisture sensitivity of resilient modulus. They recommended that further research is needed to understand the moisture sensitivity and effect of plastic fines on the base resilient modulus.

Since the MEPDG, which is also being implemented by WYDOT, requires granular crushed base aggregate to be characterized using a resilient modulus value, a research to quantitatively characterize the properties of base aggregates is indispensable to fill in the current knowledge gaps. Furthermore, the effects of gradation, rock type and texture, moisture content and fine content on the modulus values of local base aggregates have yet to be determined. These factors potentially influencing the base modulus should be considered in the proposed research. Measured base modulus will be utilized to improve the estimation of modulus of local base materials through the calibration of constitutive models and development of a catalog of properties of local base materials.

Research Objectives:

	<p>The proposed research serves as a complementary study to enhance the pavement design in Wyoming through the characterization of base materials. This research project has the following objectives:</p> <ol style="list-style-type: none"> 1) Characterize the properties of local base materials; 2) Understand the effects of rock type, moisture content, fine content and gradation on base modulus; 3) Improve base modulus estimations; and 4) Facilitate the full MEPDG implementation in the state of Wyoming.
<p>Describe Implementation of Research Outcomes (or why not implemented)</p> <p>Place Any Photos Here</p>	<p>Calibrate constitutive models, design chart and design table for the estimation of resilient modulus for base materials are recommended for implementation by the WYDOT. The recommended methods could be incorporated into the MEPDG software, AASHTOWare, for pavement design.</p>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>Properties, especially the resilient modulus, of local base materials have been characterized. This study will enable WYDOT engineers to estimate the resilient modulus of the base materials for future pavement design without the need to conduct laboratory resilient modulus testing. The outcomes of this research will facilitate the implementation of MEPDG in Wyoming.</p>
<p>Web Links</p> <ul style="list-style-type: none"> • Reports • Project Website 	<p>https://www.ugpti.org/resources/reports/details.php?id=936</p>