# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 22-480 (project 632) | September 2022

## Improving Design and Construction of Transportation Infrastructure through Bedrock Characterization


## the ISSUE

Bedrocks have natural variability depending upon the geological process. This creates increased uncertainty in the subsurface condition for the design and construction of the transportation infrastructure. The limited understanding of bedrock behavior and absence of defined properties lead to unforeseen construction challenges, especially with deep foundations in soft rocks.

## the RESEARCH

This study focuses on understanding the mechanical and deformation behaviors of Wyoming bedrocks to improve the design and construction of transportation infrastructure in the state. Fifty-six samples were tested under different confining stresses. Test rock samples are mostly sandstone (30%), siltstone (23%), shale (14%), and others (33%). Triaxial and uniaxial compression tests are conducted using GCTS RTR-1500 rapid triaxial rock testing equipment on hard rocks and GeoJac triaxial equipment on soft and soil-like rocks. Physical properties such as moisture content, porosity, and specific gravity of tested specimens are measured before compression testing. Laboratory compressive tests are performed to measure the stress and strain of each rock specimen, and elastic properties are determined from the linear stress-strain relationship. Shear strength parameters, such as cohesion and friction angle, are also determined. Tensile strength and material constant for each rock sample were also determined.

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

Colorado State University
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

Improving Design and Construction of Transportation Infrastructure through Bedrock Characterization

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WYDOT

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## the **FINDINGS**

This report presents the results of laboratory tests and prediction equation analyses to relate mechanical properties to physical properties for claystone, shale, and siltstone. The extensive study compiled available test data on shale, claystone, and siltstone from the literature for prediction equation analyses. Two sets of prediction equations are proposed: one based on test data from the literature and Wyoming, and another based solely on Wyoming data. Statistical analyses are conducted to evaluate the performance of proposed prediction equations, which are compared against prediction equations from the literature.

## the **IMPACT**

The research recommendations provide a set of engineering properties of most bedrock encountered in Wyoming by the Wyoming Department of Transportation. These measured properties will improve the design efficiency and increase reliability of our transportation infrastructure. Furthermore, costs associated with site investigation and laboratory testing will be reduced.

For more information on this project, download the main report at https://www.ugpti.org/resources/reports/details.php?id=1106


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.