ABSTRACT

TITLE:	Too Much Moisture: A Strength Comparison of Hardware Loaded in Saturated and Unsaturated Sandstone
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ABSTRACT: The purpose of the study was to determine whether there was a significant strength reduction in the forces withstood by bolts in wet sandstone when compared to dry sandstone. The research aimed to inform the climbing community about the use of fixed protection in wet conditions in a specific rock type. The specific objective was to answer the question, "Are bolts significantly weaker when used in wet sandstone than when used in the same rock type that is dry?" Experimentation took place at a uniform slab of sandstone in the Durango, Colorado area. Twenty bolts were placed at a consistent depth. Half of the tested hardware was subjected to a violent thunderstorm-style rain event where a large amount of water was rapidly applied to the surface of the bolts and the surrounding rock. A manually operated winch was used to extract the bolts from their holes, and a dynamometer was used to display the value of the force withstood before failure occurred. When considering the observed strengths of both categories of bolts there was a negligible difference between the loads supported. The saturated hardware supported an average load even higher than the unsaturated hardware. Resultantly, the observed differences in strength were not significant. After reviewing the data, it was determined that bolts loaded in saturated sandstone failed at an insignificantly lower load than their dry counterparts. Bolts in saturated sandstone will not fail under a lower load than bolts in the same rock type that is dry.