EMI Rock Mechanics – Plot Tool Usage Instructions

Introduction:

The EMI Rock Mechanics database plot tool was designed to facilitate the retrieval, analysis, and inference of specific rock mechanics data. The database supporting this tool contains thousands of entries of test data collected from a variety of EMI-based rock mechanics tests. These tests include Unconfined Compressive Strength, Brazilian Tensile Strength, Cerchar Abrasivity Index, Punch Penetration, Cohesion, Direction Shear, Triaxial Confining, and Density. This tool is designed to allow the user to plot two of these test results against each other for a given rock characteristic, and from there build a statistical model describing the relationship. More detailed usage instructions can be found below.

Instructions:

The following form, shown in **Figure 1**, is used to build a request for data. There are four separate columns in the form that will be described in the following sections.

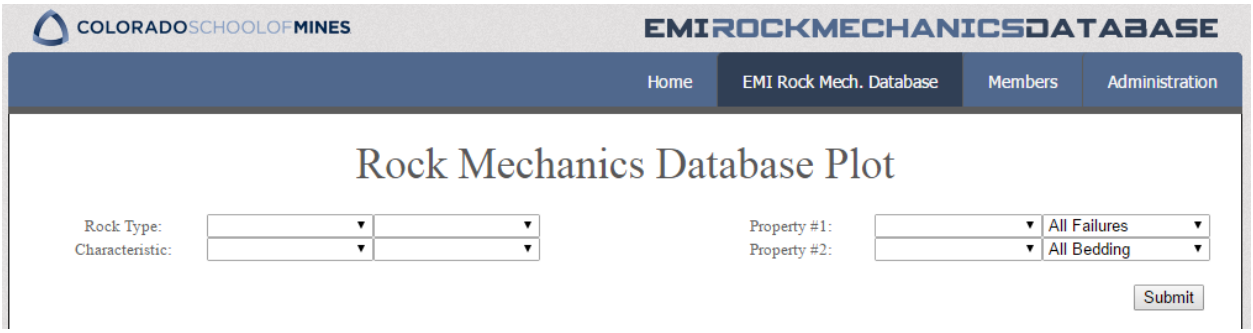


Figure 1. Data request form.

The first two columns in this form are used to select one (or two) specific rock type(s) from the database. The first column is used to select the first rock type and is mandatory, whereas the second column is used to select the second rock type and is optional. In other words, no less than one and no more than two distinct rock types may be selected at one time. **Figure 2** shows an example query with Sandstone selected as the first rock type and the second rock type left untouched. Of course, another rock type could be selected in the second column, but that option was not utilized in this scenario.

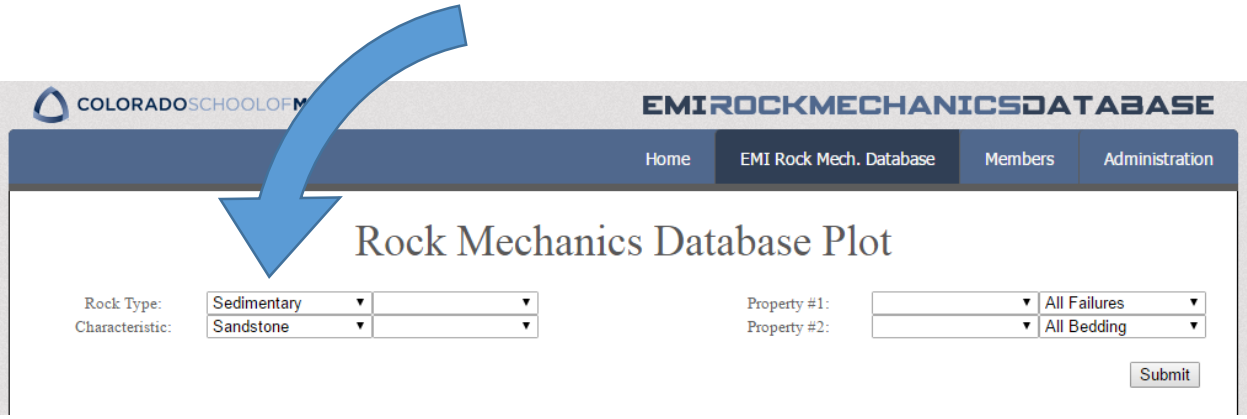


Figure 2. Data request form with a single rock type selected.

The third column is where the EMI tests, or properties, can be selected. Two distinct properties must be chosen in this step so that an XY plot can be generated of the selected data in a subsequent step. Some property pairs work well together, while others may return uncorrelated or empty results. The reason for this is that the application chooses only samples from the database which have been subjected to the test pair selected by the user. Some pairs, (eg. Unconfined Compressive Strength vs. Triaxial Confining) rarely return any useful results, while many other pairs often return correlated results. **Figure 3** shows a continuation of the sandstone example, choosing Unconfined Compressive Strength and Brazilian Tensile Strength as the selected properties.

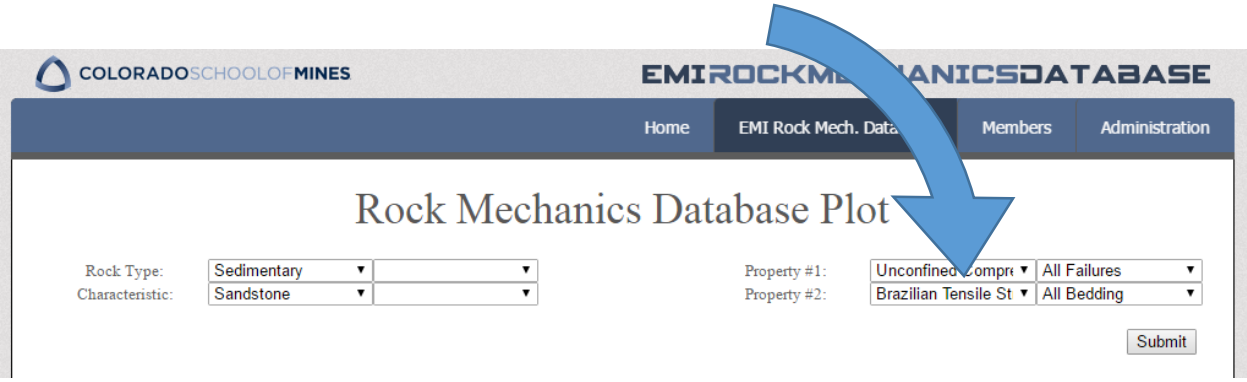


Figure 3. Data request form with UCS/BTS selected as the property pair for the plot.

Finally, the fourth column allows for further filtering of the data returned from the database. The first row allows for filtering based on the type of failure experienced during the test (Structural/Non-Structural/All). **Note:** This only applies to Brazilian Tensile Strength, Triaxial Confining, and Unconfined Compressive Strength results. The second row allows for filtering based on the bedding direction of the samples that are returned. **Note:** At the time of writing, there is not currently enough data to support this feature. It will not have any effect on the results. **Figure 4** shows a continuation of the sandstone example with the results filtered by Non-Structural Failure.

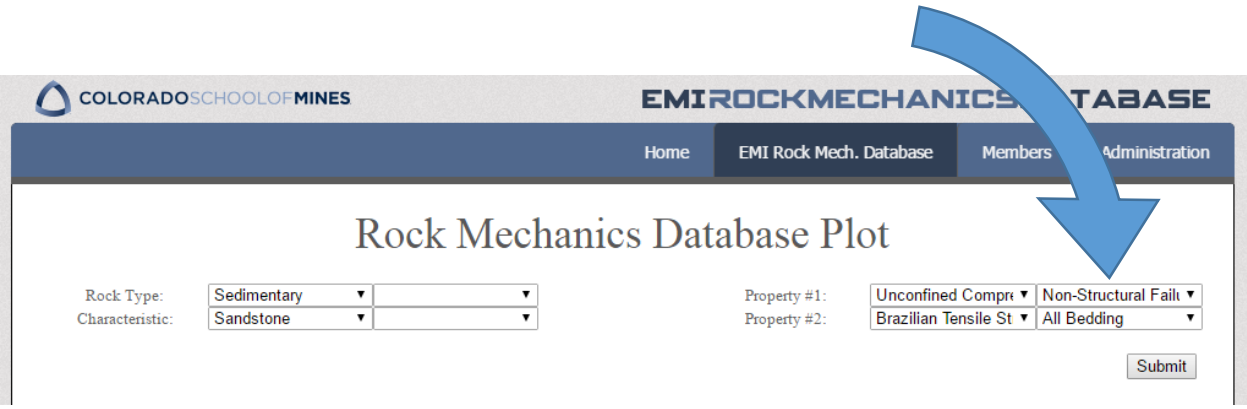


Figure 4. Data request form with results filtered by Non-Structural Failure.

Once the form has been filled out, click the "Submit" button to submit the form and view the results. If results have been found for the requested parameters, a graph and statistical model will be displayed on the screen. Otherwise, an error message will appear. Trying broader search parameters or different properties will often be enough to resolve this issue.

Hovering over the graph allows for an identification of each individual data point in the result set. Data points are color coded in the key (in the bottom right corner) to differentiate results from each rock type in the result set.

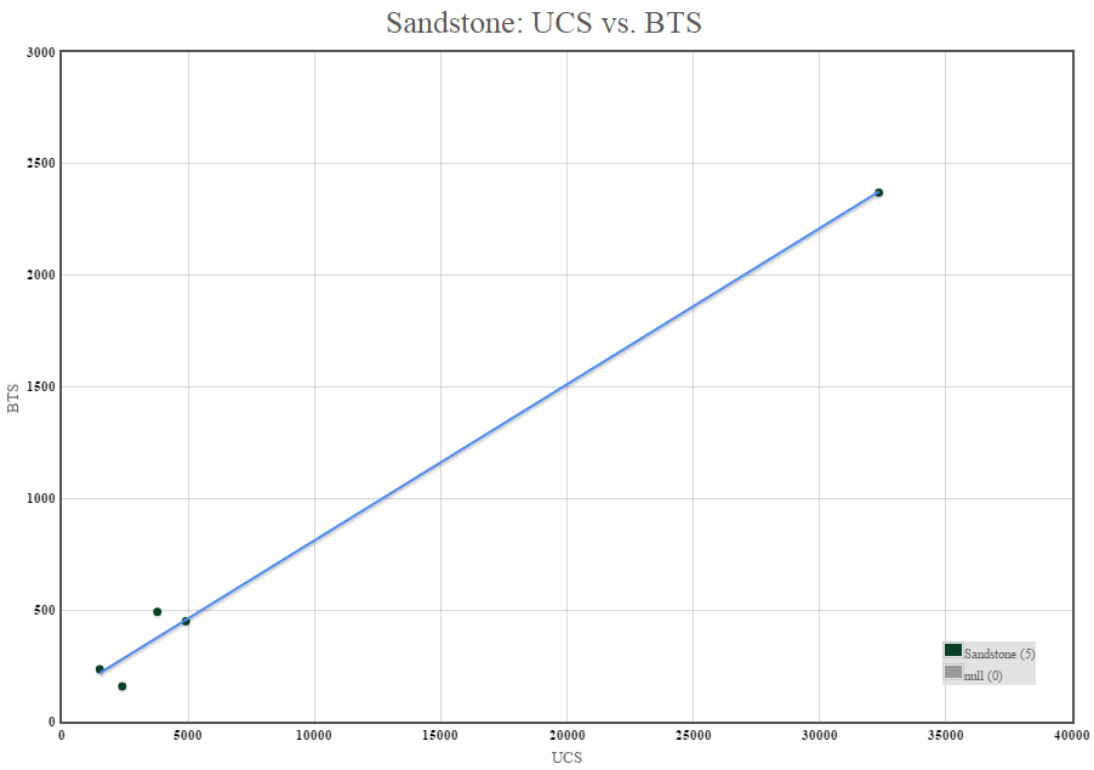
In the table below the graph labeled "Regression Data", the first column contains a dropdown box which may be used to customize the statistical model. The following regression types are supported: Linear, Exponential, Logarithmic, Power, Square, and Cubic. In the subsequent columns, the model parameters (coefficients), R^2 value, p-Value, and sample count are shown.

Finally, the last two tables on the page show basic statistics about the results returned from each test that correspond to the search parameters. The result set from the sandstone example is shown in **Figure 5**.

Last Remarks:

The development of an EMI Rock Mechanics Database is a slow process due to the quantity and uniformity of data required to make such a tool effective. This database is still in its early stages, and although it certainly does return useful information, it lacks some depth and specificity of information. This will be resolved as more data is collected, verified and added to the database.

Author: Ryan Hunt (ryhunt@mymail.mines.edu)



Regression Data

Type	Coefficients	r^2 Value	p-Value (lin. reg. only)	M (samples)
Linear y = ax + b	a = 0.06994287561635958 b = 112.54923264489503	0.9916365187702998	0.000320000000000098	5

UCS Statistics

Average	Maximum	Minimum	Standard Deviation
8986.22	32350.00	1500.00	11739.92

BTS Statistics

Average	Maximum	Minimum	Standard Deviation
741.07	2370.88	157.95	824.58

Figure 5. Sample result set using a linear regression model.