Validity of Using a Schmidt Hammer to Assess Rock Strength

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Abstract

A Schmidt hammer is a device designed to test the strength of concrete. More recently, the hammer has been used as a preliminary measure of rock strength. We took readings from the outcrop at Seth Green Drive, Rochester, NY and compared them to a more conventional measurement of strength, fracture density. The correlation of the best fit line relating the Schmidt hammer readings to fractures density was weak (R^2=.076). As a result, we concluded that, at least for the strata examined there is no correlation between rock strength as measured by the Schmidt Hammer and fracture density.

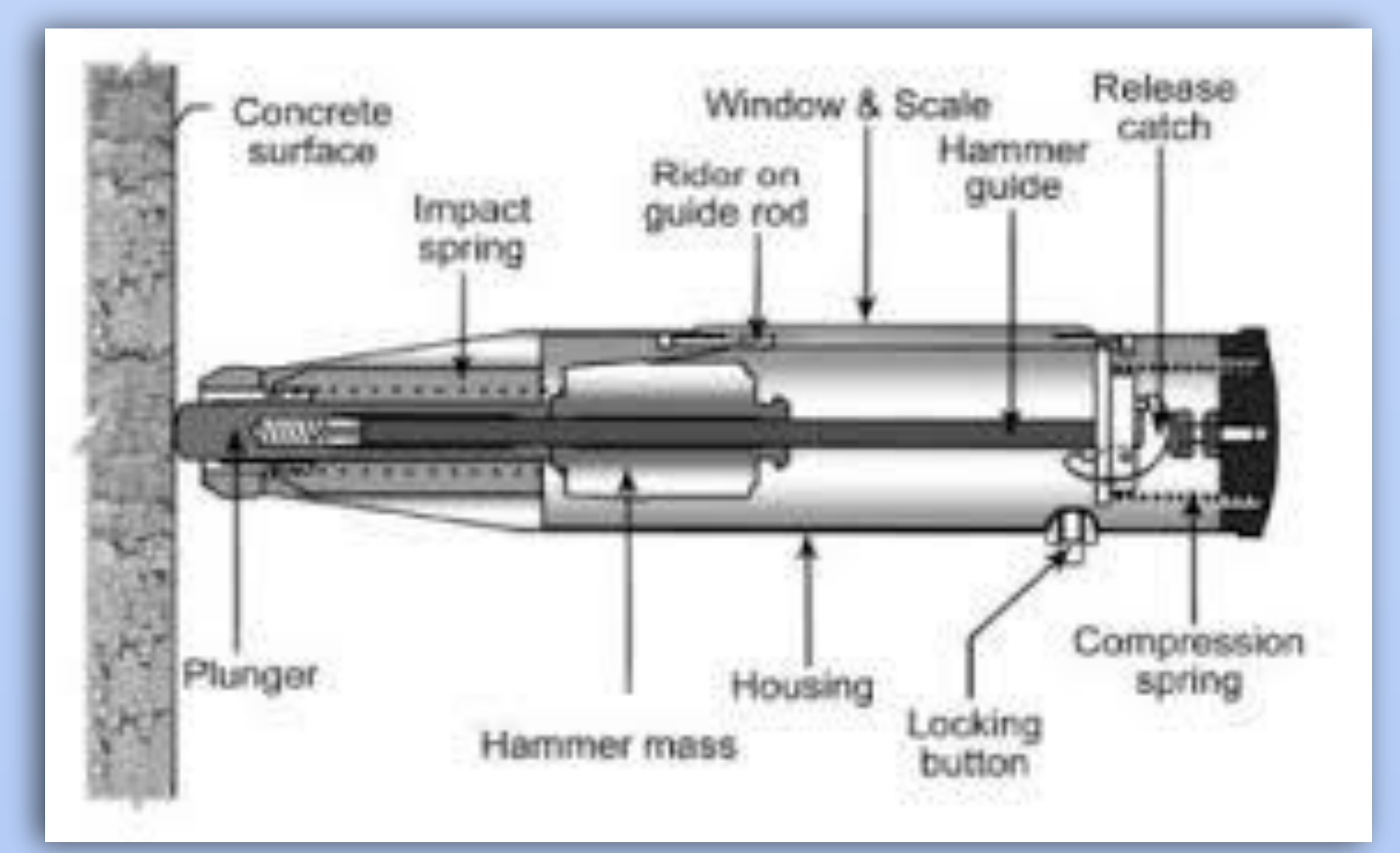

Figure 1: Cross sectional diagram of a Schmidt Hammer (From Jude Aruna Gayan via LinkedIn SlideShare)

Methods

The first step was selecting the outcrop we would use to test. We settled on the Rochester Gorge outcrop at Seth Green Drive, because both team members had visited it on previous trips and were comfortable delineating between the different packages.

We hiked to the bottom of the gorge and worked upwards, stopping at a representative section of each outcrop. We took 12 measurements at each and discarded the highest and lowest result, and averaged the data. We also took a picture at each location, to calculate fracture density. Fracture density is calculated by summing the lengths of all fractures in the study area, and dividing by the surface area.

Figure 2: A photo taken at one of the sample locations. The measuring stick is 2 meters.

To calculate fracture density, we imported our photos into Adobe Illustrator, outlined the area with a box, and then traced all the fractures with straight line segments. To create a scale, we measured the length of the two meter stick in each image in pixels. We then took the box dimensions, and segment lengths down in excel, converted their length in pixels to length in meters, and computed fracture density.

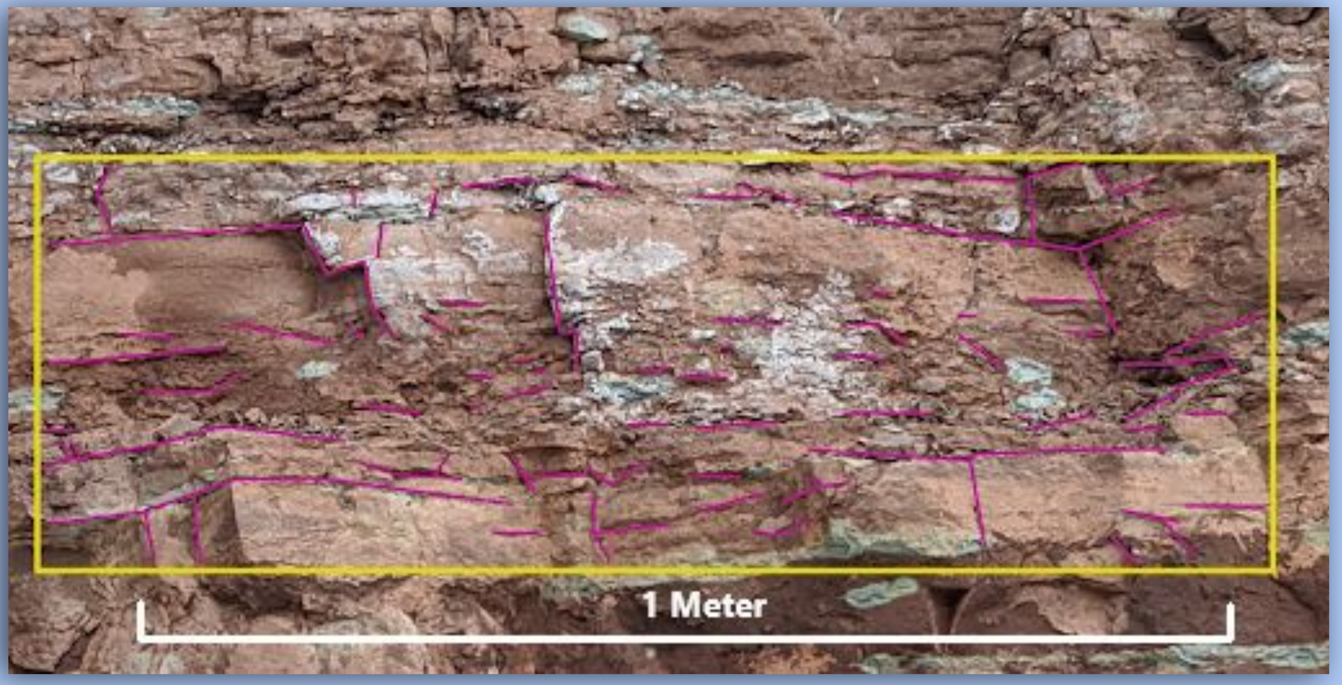

Figure 3: The same outcrop as shown in figure 2 with study area and fracture lines (in purple) overlain in Adobe Illustrator

Analysis

To test whether our Schmidt hammer readings and our fracture density calculations were correlated, we graphed them on a scatter plot. With fracture

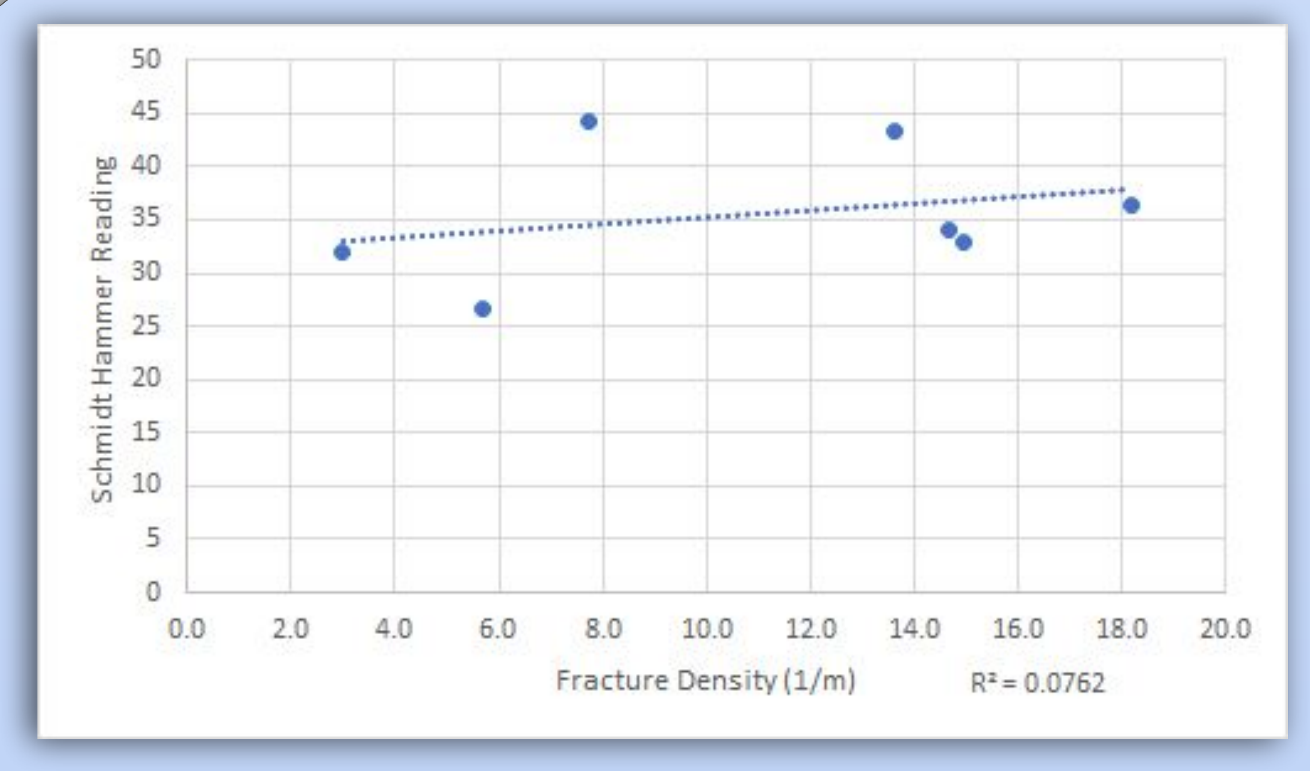

Figure 4: A graph plotting hammer reading and fracture density for each layer at the site.

Density for each layer as the x-axis, and average Schmidt hammer reading at the y-axis. We then plotted a best fit line for the data, and calculated an R^2 value of .076 for our data set.

Discussion

The results of our analysis are fairly conclusive that in the setting we used it, Schmidt hammer readings are not at all correlated with the more widely accepted fracture density. Certain limitations of our experiment could be interesting avenues of future research.The first was that our data ranges were fairly wide. We believe the variability was due to the softness of our local lithology. Two layers had to be skipped entirely because they were too fissile to even cock the hammer. A setting with more igneous/metamorphic rocks, with strength more similar to industrial concrete, may have yielded better results.

Conclusion

The low R^2 value we found in our analysis leads us to conclude that Schmidt hammer readings and fracture density have no correlation in the sedimentary strata of Western New York

Acknowledgements

We would like to recognize Professor Scott Giorgis for his guidance and instruction, and the Geological Science department at SUNY Geneseo for use of equipment.