Shear Strength Analysis on Bank Soil of The Mad River

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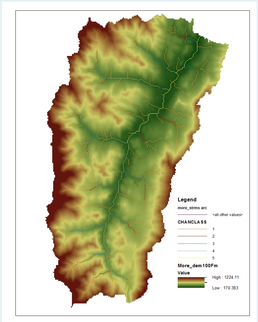
Abstract

During the summer of 2015 I conducted field studies in the Mad River.

I collected soil from six different locations where the bank was failing or falling into the Mad River and I tested the strength and particle size of that soil to determine the cohesion and the level of stress that the soil can take before failure.

Introduction

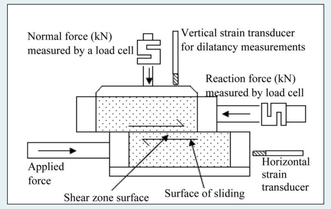
The Mad River, located in the towns of Waitsfield, Duxbury, MoreTown, Faytson, and Warren; flows northbound right into the Winooski River in which flows into Lake Champlain. With further studies and tests on the river, the condition of the lake can be better predicted. My project focuses on the shear strength of soil on the banks of the Mad River and how properties of that soil relate and/or affect that strength. Properties are determined through various tests, such as infiltration test, soil moisture content, particle size analysis, and matric suction. All these data types can be related to the shear force data collected form a direct shear test and/or a borehole shear test. Knowing the shear force that the bank soil can withstand, I can then determine the force (from water flow) at which a bank will fail, by either a strong storm/rainfall or just the amount of time it'll take. Furthermore, with bank failure in mind (and knowing precisely what was in the bank), we'll know what was dumped into the Mad River, which will carry on into the Winooski, and further along into Lake Champlain.



Materials and Methods

Gathering Samples:
Myself and two other interns would venture out to the town of Waitsfield with an auger, Shelby tubes, Shelby tube driver, and other field equipment (screwdriver, sharpies, plastic wrap, etc). We hiked though woods and walked through farms to three different locations of the Mad River and one location of Shepard Brook that feeds into the Mad River. I would collect soil samples from the river banks of these locations using the Shelby tubes and properly store them to bring back to the lab.

Lab Testing:
I would place the soil samples gathered from the field into a machine called the Direct Shear Test (DST). The soil would first undergo a vertical compression followed by a horizontal force that would shear the soil until it slips, or fails. The soil is completely saturated the entire time in order to mimic the effect of a river.



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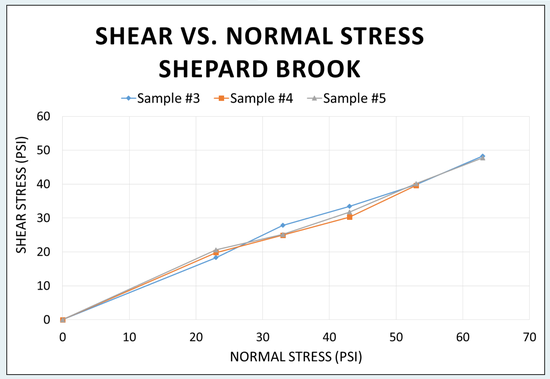
Acknowledgements

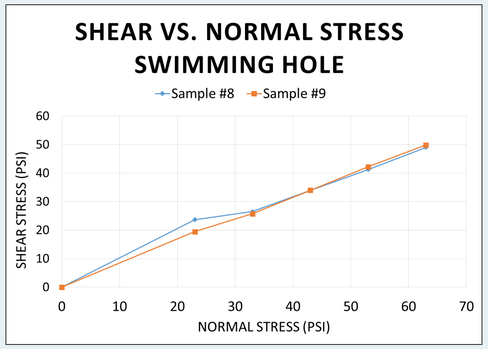
I acknowledge and appreciate my fellow interns, Alex Adamski and Sean Brennan who also did field studies in the Mad River, and helped me gather my data.

I also acknowledge my mentor, Jodi who showed me the bank locations and helped me setup and figure out the lab equipment for my testing.

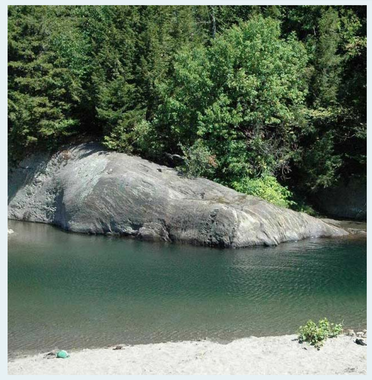
Results

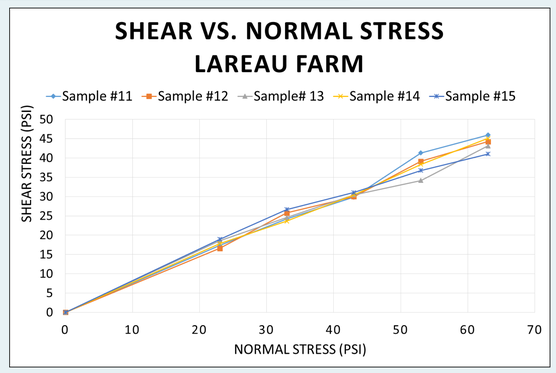
	Units	Sample 3	Sample 4	Sample 5	Sample 8	Sample 9
Site	N/A	Shepard Brook	Shepard Brook	Shepard Brook	Mad River	Mad River
Vegitation/Soil	N/A	Grassy	Grassy	Grassy	Sandy	Sandy
Cohesion	Kpa	2.6573	4.0353	3.3282	6.7403	0.983
Friction Angle	Degrees	35.7	32.97	34.7	33.2	37.725
R Squared Value	N/A	0.9925	0.9758	0.989	0.979	0.998
Trendline Equation	N/A	y = 0.719x + 2.657	y = 0.648x + 4.035	y = 0.692x + 3.328	y = 0.654x + 6.74	y = .774x + .983





	Units	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15
Site	N/A	Lareau Farm				
Vegitation/Soil	N/A	Japanese knot wood, bushes, trees				
Cohesion	Kpa	-0.2431	1.62	4.864	1.325	7.52
Friction Angle	Degrees	36.642	34.481	30.472	34.67	28.52
R Squared Value	N/A	0.9844	0.9875	0.986	0.9975	0.989
Trendline Equation	N/A	y = 0.744x - 0.243	y = 0.687x + 1.62	y = 0.588x + 4.864	y = 0.672x + 1.325	y = 0.543x + 7.522





Discussion/Conclusion

That Mad River, under research becomes something more than a swimming site, a landmark, or a popular traction. The Mad River becomes a scientific study that is observed for what it carries. Rivers carry water and water carries fish, soil, twigs, seeds, food, and leaves. By testing for the shear strength of bank soil, researchers can better understand the conditions of those banks and what would enter the river if those banks were to fall in. During the summertime, my group and I examined certain areas of the Mad River where the banks were already in the process of failing and my results show that the shear strength of soil is around 50 psi if completely saturated and consolidated. Shear strength is a term used to describe the magnitude of the shear stress that a soil can withstand. This means that my project was based around finding data and information useful the study of bank failure of the Mad River. Unless hit by a mad storm, those banks aren't going to be completely washed away for years, but each year they degrade more and more, and it's our job to know more about it.

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