Compound Meandering Flume Experiment: Construction and Setup Adjustments.

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Background, Motivation, and Design

- Floodplain recovery
- Effects of density of vegetation in the floodplain on velocities of the water in the channel and the floodplain.
- Results will help determine the risk of damage structures and vegetation in a floodplain

Image 1. Our channel was roughly modeled after a scaled down version of this section of the Poudre river

Design: Our flume has a 30-degree crossing angle , 1 meter width, and a 0.5% slope.

Flume Construction: block preparation

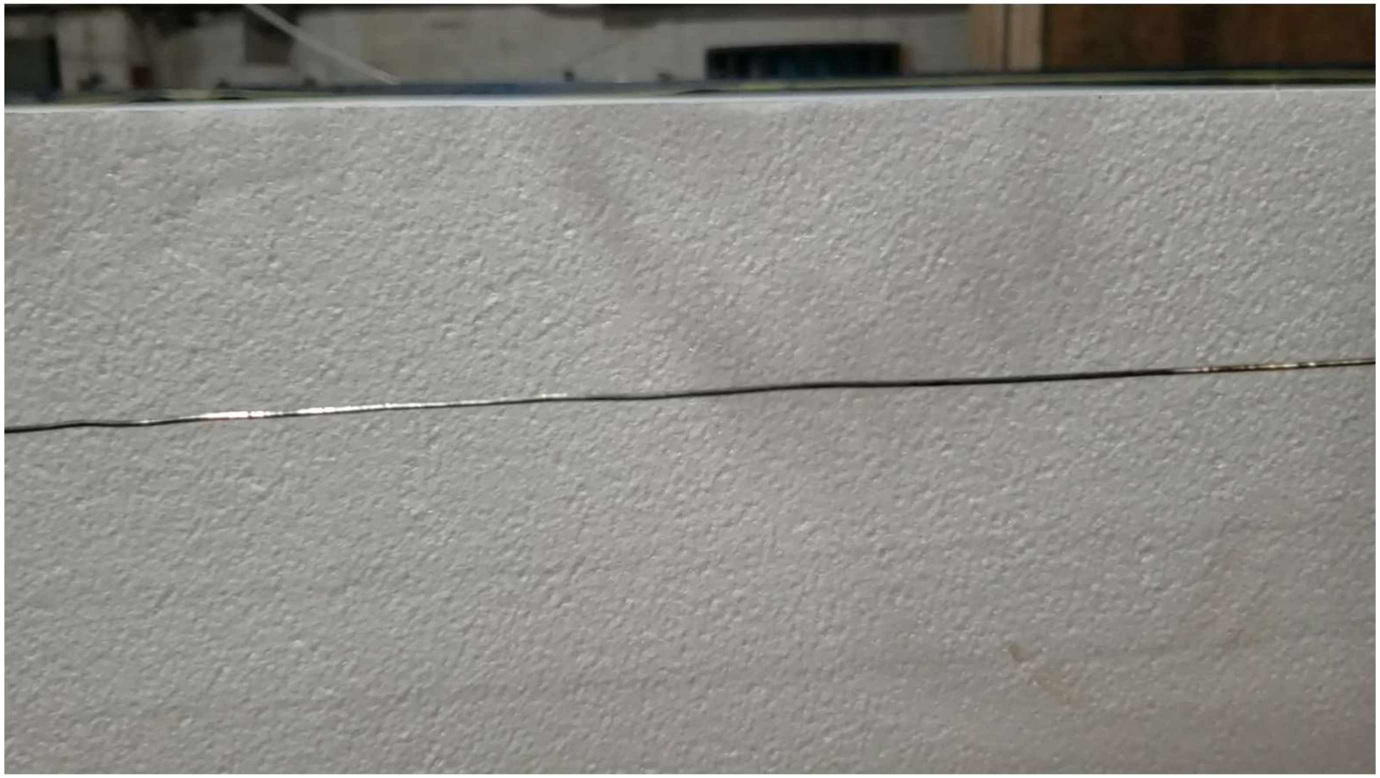
Image 2. The 1’ x 4’ x 8’ Expanded Polystyrene Foam blocks we used. The use of this material was inspired by the Shiono and Muto project (1).

Image 3. Nick and Danny cutting the slope into the blocks.

Image 4. Dry fitting the templates

Image 5. Danny and Nick using the small hotwire to cut out the channel shape.

Flume Construction: using the hotwire



Video 1. Cutting the foam with the hotwire

Flume Construction: using surveying measurements to place the blocks

Step 4:

- Elevation measurements at each block junction
- total station instrument because
- concrete underneath is not level.

- allowed us to assess which blocks needed to be slightly raised in order to achieve the desired 0.5% slope.

Image 6. A dry fit of the blocks shows which blocks need to be shimmed up

Flume Construction: gluing the blocks

Image 7. Gluing down the blocks was the next step.

Image 8. We glued the outer columns of blocks down first, then the inner two

Image 9. All the blocks glued down, and expanding foam having filled larger gaps

Flume Construction: preparing model vegetation, and painting foam

Image 10. a few trials of different ratios of All Purpose Foam Coat to figure out what ratio to use.

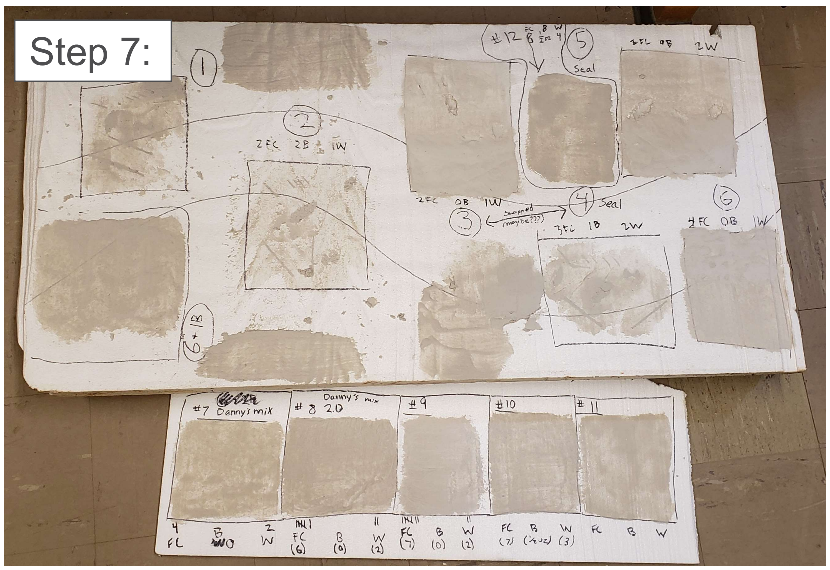


Image 11. Danny painting the foam.

Image 12. Next, we had to prepare the SFM targets on the floodplain, shown above.

Image 13. The model vegetation we will use. We have to make about 3,000 of these.

Flume Construction: problem solving

*Problem: blocks would float due to buoyant force
*Solution: Anchor them to concrete

Image 15. The completed flume

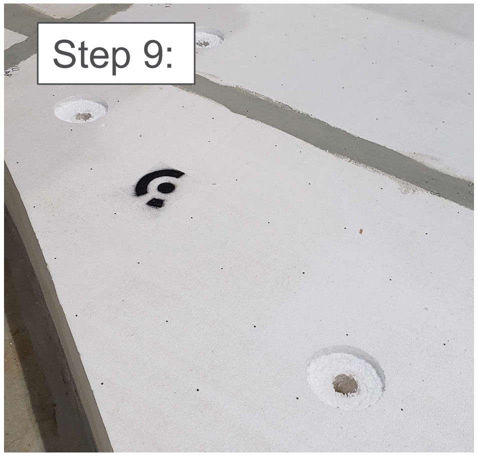


Image 14. The holes drilled in the foam for the metal rod to go through

Image 16. The wooden caps on the holes we drilled in order to place anchors

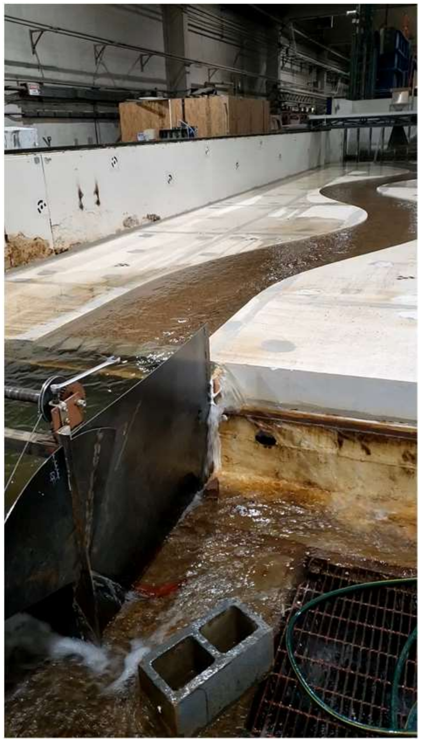
Flume Construction: measuring methods/devices

Image 17. An above view of the cart which is on a track

Image 18. The stand for the ADV instrument that is attached to cart

Image 19. The ADV device that will be mounted on the stand shown in image # 18.

The Flume in Action



Video 2. Flume running

Video 3. Channel filling up

Video 4. View of sediment feeder

Experimental Setup: fine tuning the sediment feed rate

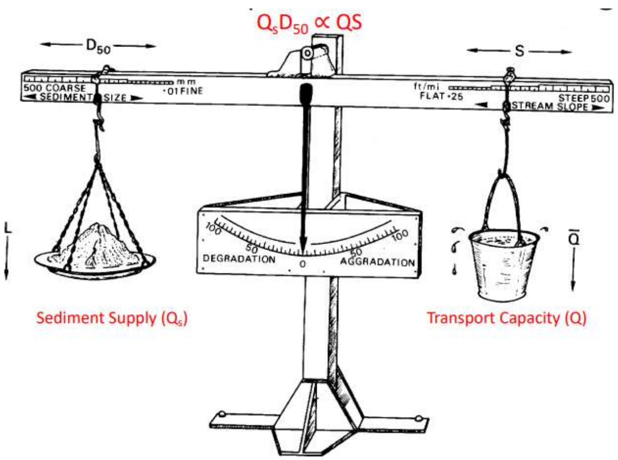


Figure 1. Lane's Balance: it demonstrates the goal for sediment transport to be neither degradation or aggradation.

- Depends on slope, sediment supply, and water inflow
- Degradation vs aggradation
- Slope is fixed

- In each trial, we will change other two variables
- Goal: Equilibrium of channel sediment transport

Sediment feed rate based on the rpm of the feeder

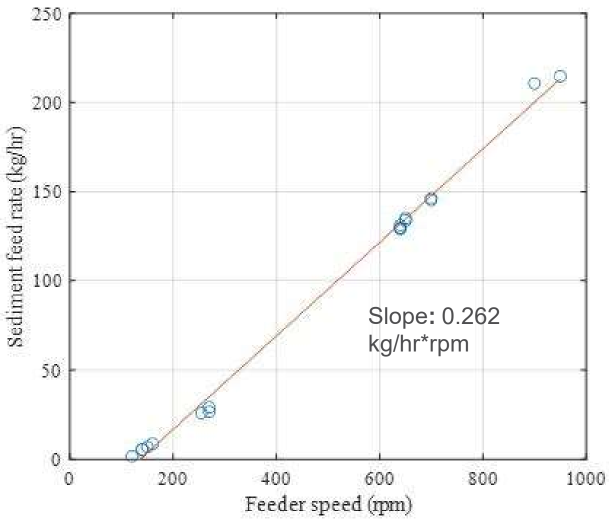


Figure 2.

Results

Trial	1	2	3	4
Depth (cm)	11	14	11	8
Sediment Feed Rate (kg/hr)	130	130	25	5
Results	Sediment build up	Bed scouring	Slight scouring	equilibrium

Discussion/Next Steps

The next steps for this project are running tests with 3 different vegetation densities to record measurements of the water velocities in the floodplain and channel. This will help develop a better understanding of where along the floodplain of a channel such as this in river restoration. During trials with increased flow, in order to flood the floodplain, the sediment feed rate and possibly the channel depth will have to be calibrated again. This will follow the same process as described earlier.

Conclusions

Key Finding: the desired sediment transport rate for flow in the channel is 5 mg/hr at a depth of 8 cm

Image 20. completed view of flume from tail box

Benefits from SURE experience:

From helping with this project, I learned a bit about sediment transport and channel design. It was also a new experience to work on such a large, long term project. It took us basically a year to and seeing it all come together is satisfying. We also had to problem solve frequently in building the design for the channel. Additionally, I learned about Lidar, SFM, and ADV, all techniques/tools which will help take measurements.

References & Acknowledgements

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(1) Shino, K., & Muto, Y (pp 221-261). *Complex flow mechanisms in compound meandering channels with overbank flow*. UK: Cambridge University Press, 1998. Print.

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Thank you

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