A U-shape In-situ Scour Testing Device

presented
by

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Outlines

- Introduction
- Device development
- Experiment measurement
- Conclusions

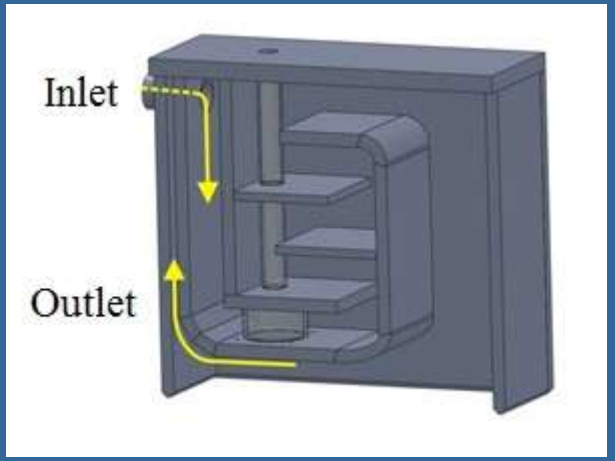
Introduction

A study of time-rate scour in cohesive soils is led by FHWA : ESTD and ISTD;

Advantage of in-situ device: soil properties are not changed;

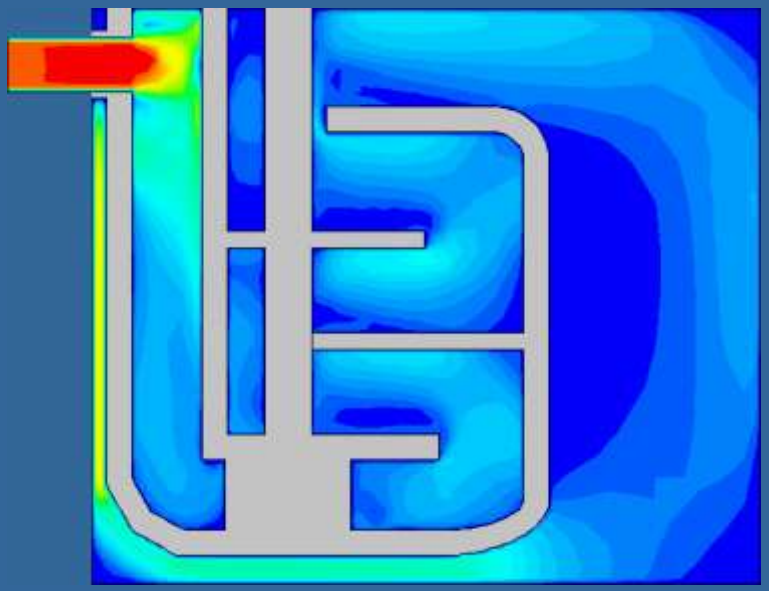
The proposed ISTD can measure the erodibility of sediments underneath the riverbed with a better controlled shear stress.

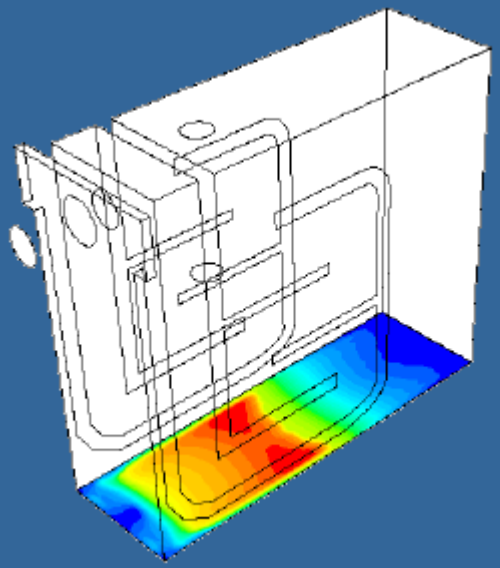
Device development

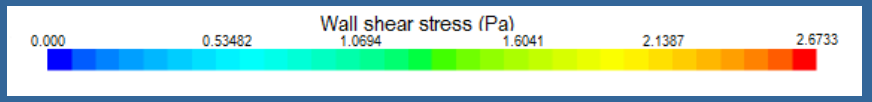


- U-shape: reproduce horizontal flow in open channels
- High-ratio (15:1) between inlet and outlet: energy dissipation VS falling velocity

The design is improved by CFD simulation.





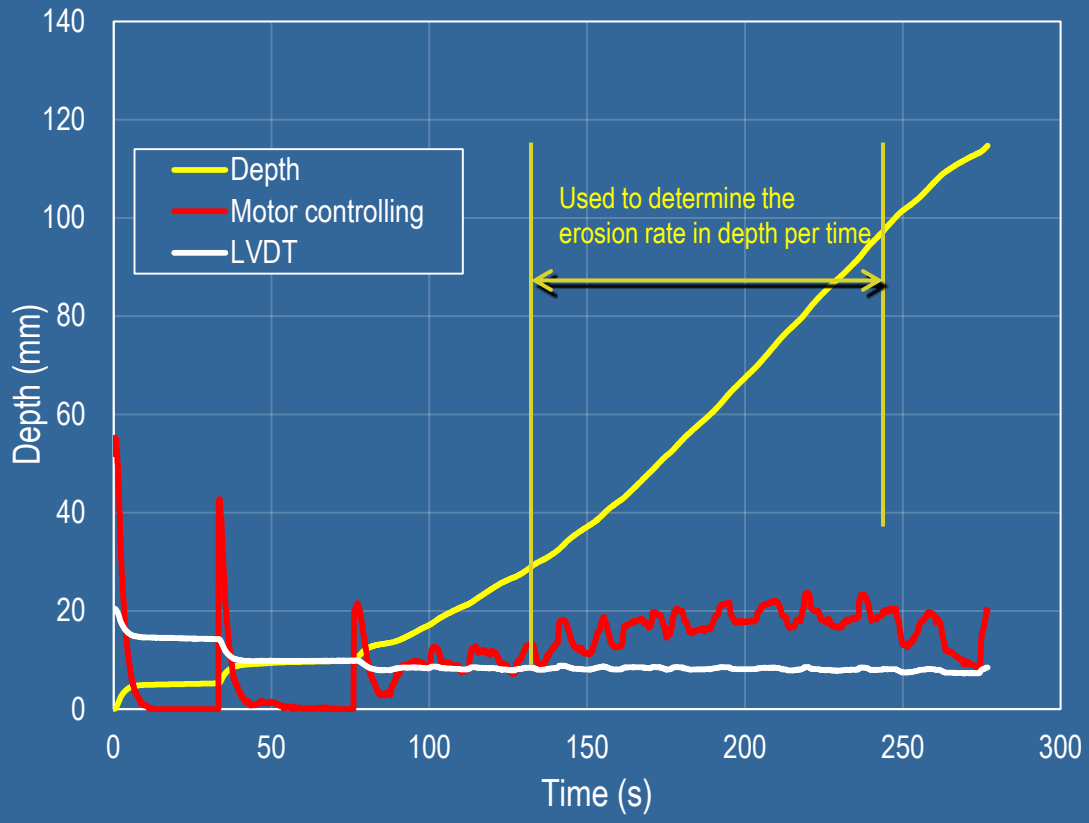


Flow condition: uniform inlet velocity of 1.2 m/s. The average flow velocity in the gap (20 mm) was 0.5 m/s, generating a uniform shear stress of 2.5 Pa.

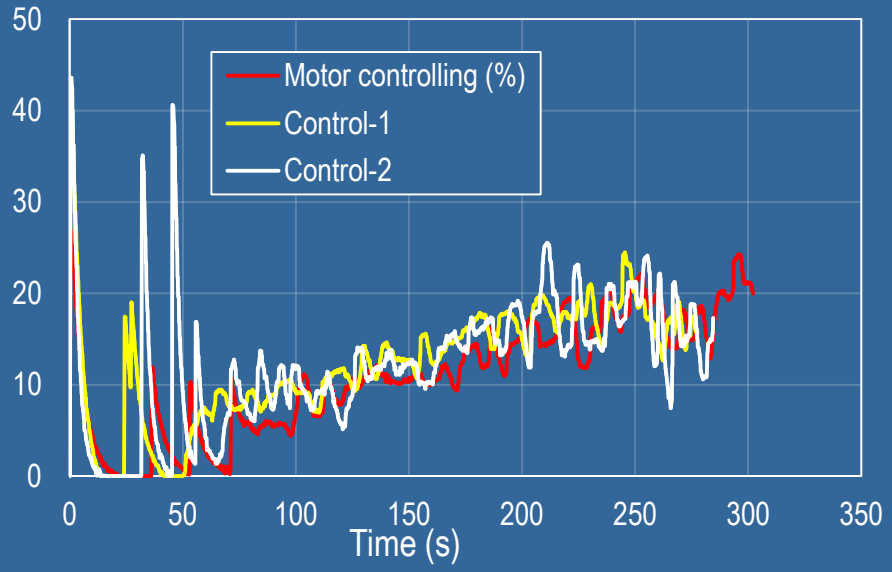
Operation procedure

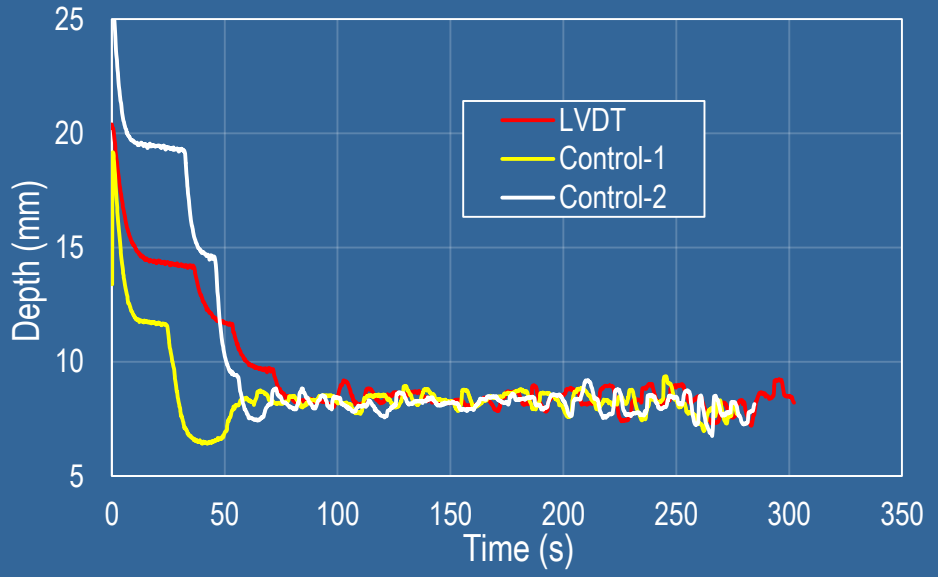
1. Compact and flatten the sand, fill the tank;
2. Lower the U-shape device until the gap sensor is 20mm above the sand.
3. Set a desired gap (8mm);
4. Start the pump with a certain power. The motor moves the device to the desired gap using a PI controller;
5. Record the moving distance of the device and the time.

Erosion video

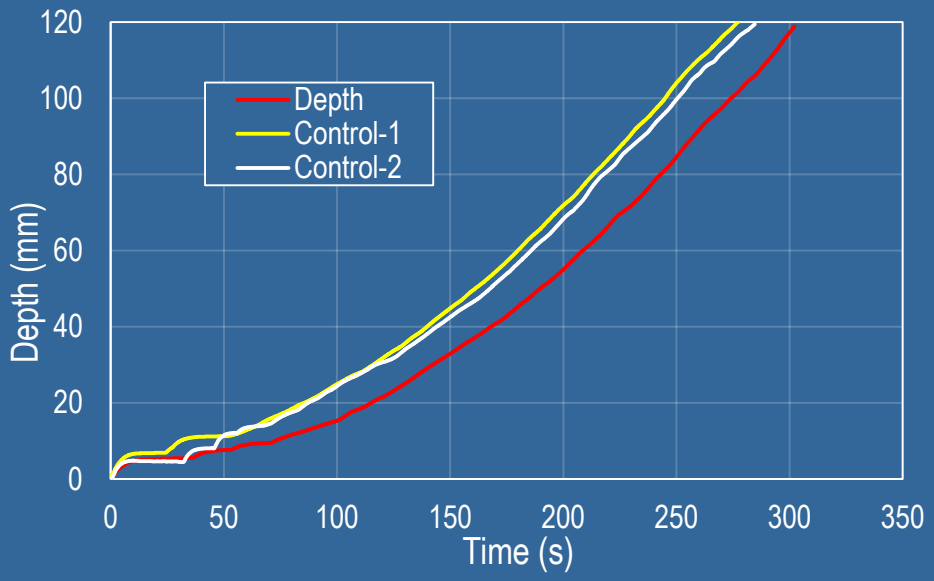


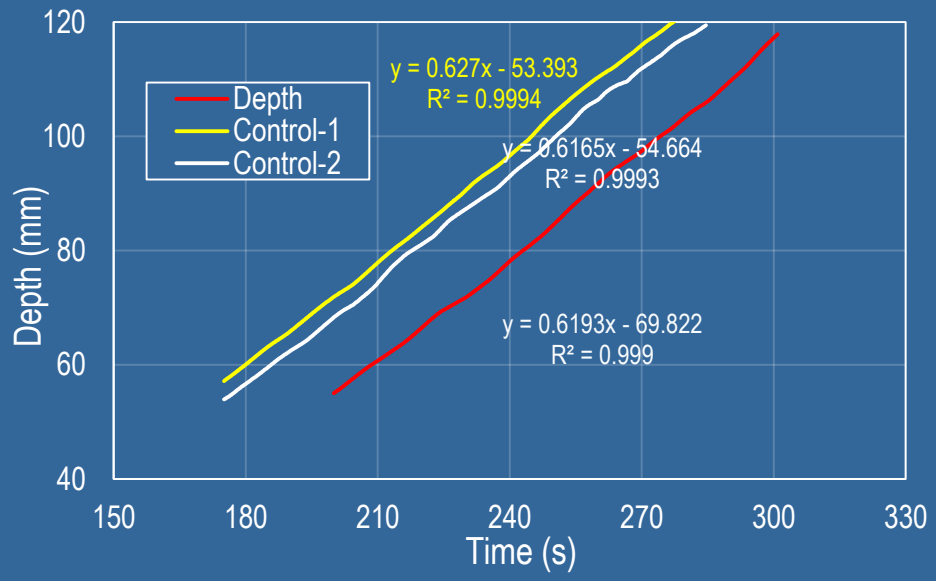
A typical recorded data to determine the erosion rate of 1 mm sands





Repeatability of the ISTD test with identical condition: sand compaction, pump power, same desired gap





All three ISTD test reveal that the erosion rate of 1 mm sands at a certain pump power is close to 0.62 mm/s.

Conclusions

- The u-shape ISTD lab device generates a well-controlled horizontal flow in a small gap;
- CFD simulation proved the wall shear stress is uniform distributed;
- It can measure the erodibility of sediments underneath the riverbed.

Thanks and questions?