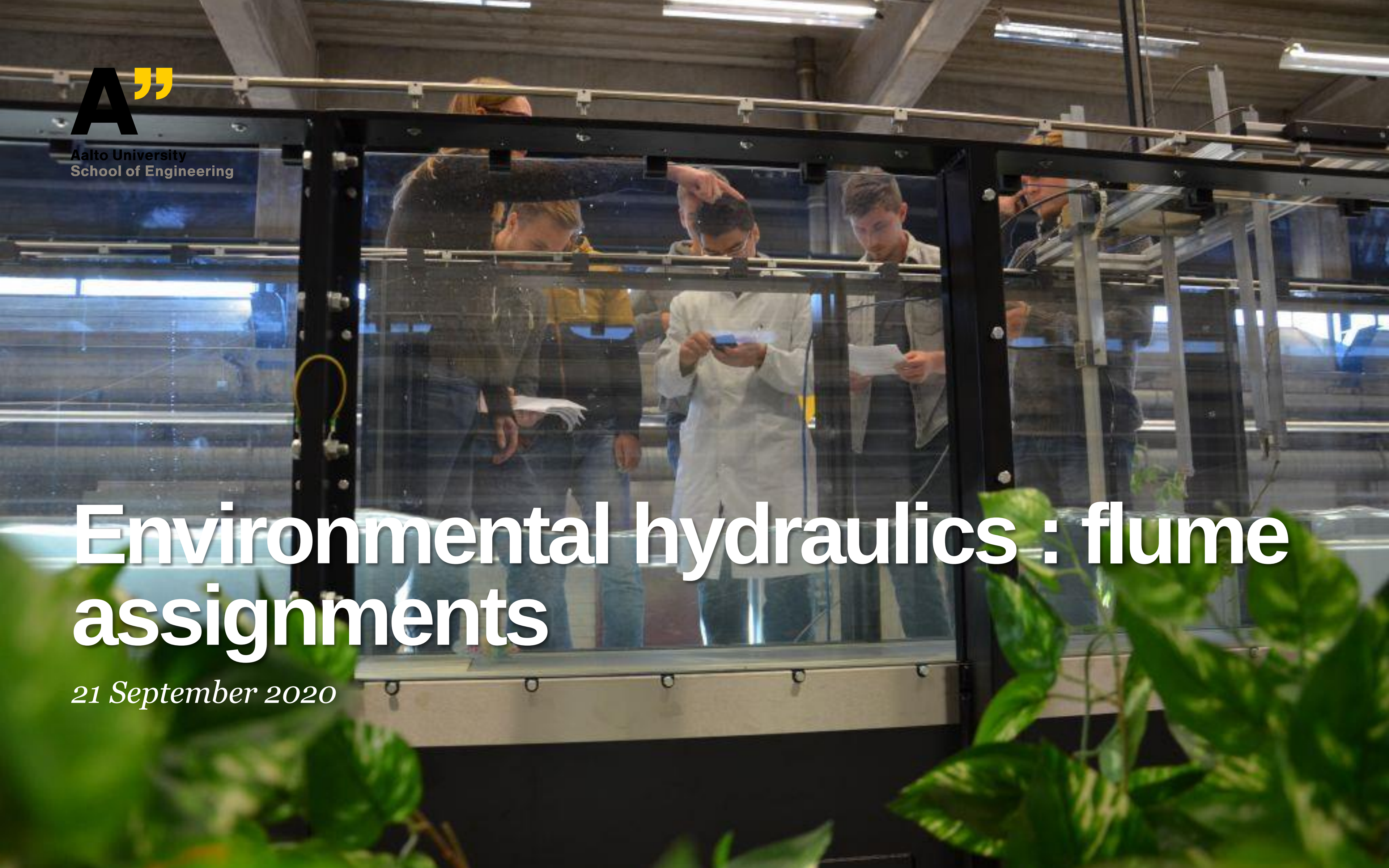


Aalto University
School of Engineering

Environmental hydraulics : flume assignments

21 September 2020

Three separate demonstration/measurement stations

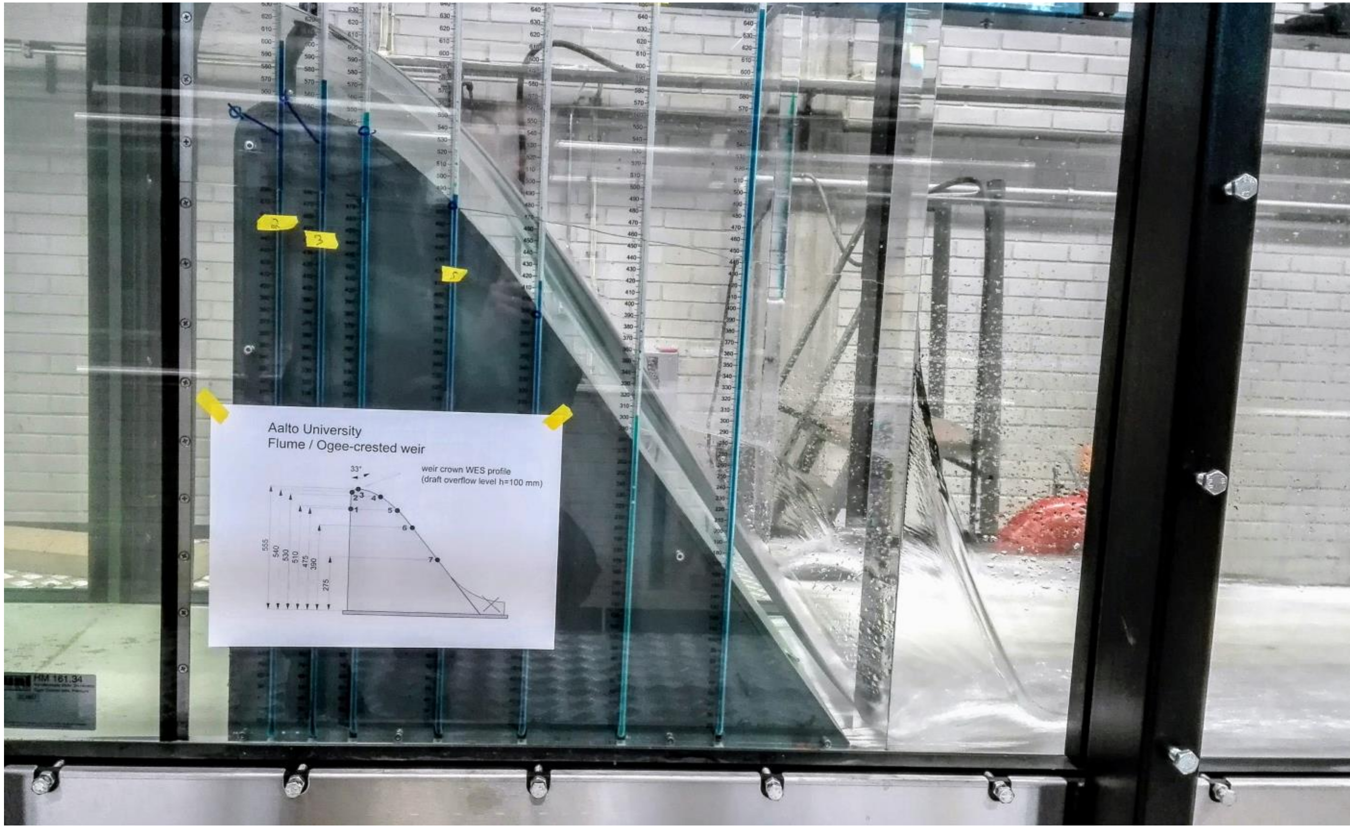
From upstream to downstream:

A. Ogee-crested weir with a manometer board
B. Measurement station for phenomena in environmental hydraulics
C. River flow applications and uncertainty

Six sets of questions

About one hour of online instructions to the lab and conducted measurements with supplementary photos and videos of the flow phenomena

Ogee-crested weir



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Station A: Ogee-crested weir with a manometer board (1/2)

Comparison of the manometer and water level readings over the crest of the weir. [15%]

- How do the water level readings differ over the weir crest, and why?
- How and why do the manometer and water level readings differ from each other at a given location?
- Why are the manometer and water level readings equal at the upstream face of the weir (the first measurement location)?

Station A: Ogee-crested weir with a manometer board (2/2)

Design principles of the weir crest. [15%]

- Why is the weir crest shaped this way (known as “WES profile”)?
- For which purposes are Ogee-crested weirs ideal?

Phenomena and measurements in environmental hydraulics

Phenomena and measurements in environmental hydraulics

https://drive.google.com/file/d/1K5qxwZwU1_-BdjYuWc2bmCXhHx9fGHQi/view?usp=sharing

Station B: Measurements for phenomena in environmental hydraulics (1/2)

Repeatability and effect of data post-processing on the computed variables [20%]. First, produce a post-processed ADV dataset by filtering and de-spiking the entire 60 s record of the raw data.

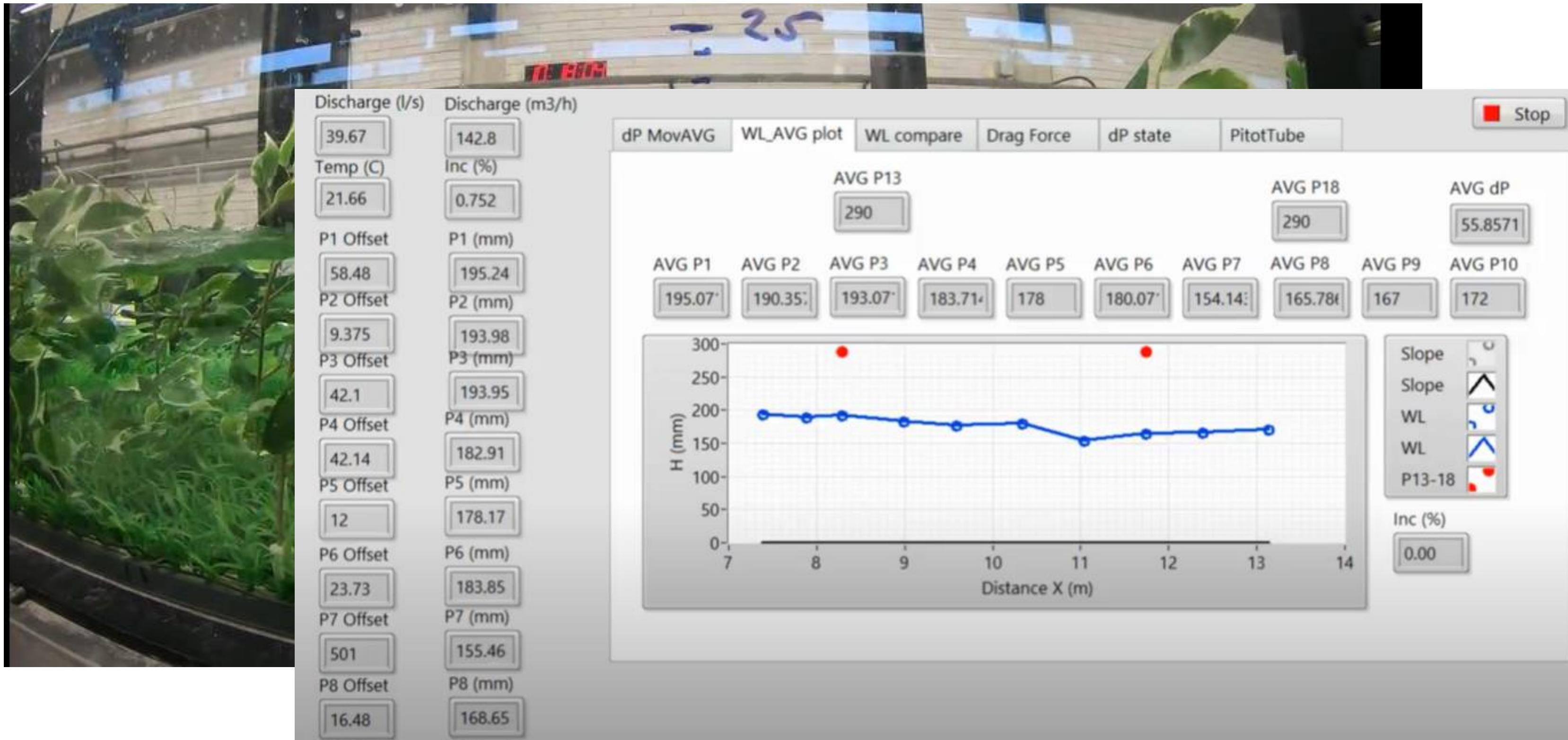
- What percentage of the data points were not filtered out (percentage good)?
- Can you think of ways how to decrease the uncertainty/error in the flow measurements conducted with ADV?
- How large are the absolute and relative differences in the Vx (longitudinal), Vy (transverse) and Vz (vertical) velocities between unfiltered and filtered data?
- Are the RMS (root mean square) velocities of the turbulent fluctuations Vx’, Vy’ and Vz’ lower for the filtered or unfiltered data? What explains this?
- Can you think of some types of flow/turbulence analyses for which filtering/de-spiking are particularly important, and why?
- Filter and de-spike the dataset your group recorded, and analyze the differences in Vx, Vy, Vx’ and Vy’ between the two datasets measured at the same location. Do you think the repeatability is good, and why (not)?

Station B: Measurements for phenomena in environmental hydraulics (2/2)

Effect of sampling duration on the distribution of data [15%]. In WinADV, prepare histograms of the longitudinal velocity (Vx) using the first 5 s, 25 s, and the whole 60 s of the filtered data series. Insert the three histograms to your report (pay attention to have the values on the axes readable).

- How does the increasing sampling duration affect the shape of the histogram for Vx?
- Report the maximum and minimum values of the streamwise velocity (visually based on the minimum and maximum bins of the histographs) for the three sampling durations. What explains the differences between the three sampling durations?
- What kind of factors should be taken into account when deciding the optimal sampling duration of a flow measurement?

River flow applications and uncertainty



Station C: River flow applications and uncertainty (1/2)

Using measurement data to compute further variables (the Darcy-Weisbach friction factor f). [15%]. Compute the friction factor for the examined flow condition assuming that the flow is uniform. The width of the flume cross-section is 0.6 m. Obtain the other required data from the recorded data file (you can use the average values).

- Report the average values for the variables needed in the computation of the friction factor.
- Report the computed value of the friction factor.
- Report the 95% confidence interval for water depth. In your opinion, how reliable measurement devices are such pressure sensors?

Station C: River flow applications and uncertainty (2/2)

Evaluating the uncertainty in the friction factor using error propagation theory [20%]. For this, determine the standard deviations of the discharge, water depth and bed slope based on the recorded dataset. The uncertainties in the flume width and gravitational acceleration are negligible.

- Report the standard deviations of the discharge, water depth, and bed slope.
- What is the uncertainty in the friction factor?
- Reflect on the relative importance of these different sources of uncertainty for estimating the friction factor in the presently investigated flow.
- Do you think the measurement uncertainty related to the determination of friction factor is similar or different in real channels compared to the flume environment, and why?