CALIFORNIA DEPARTMENT OF WATER RESOURCES

# SCHISM Simulation of Suspended Sediment Transport Experiments

Han Sang “Hans” Kim, Ph.D.

(hansang.kim@water.ca.gov)

California Water and Environmental Modeling Forum 2022

# Purpose

1. SCHISM Training Tool
   - Simple introduction to sediment transport module.
   - Highlights key parameters governing sediment incipient motion and transport.

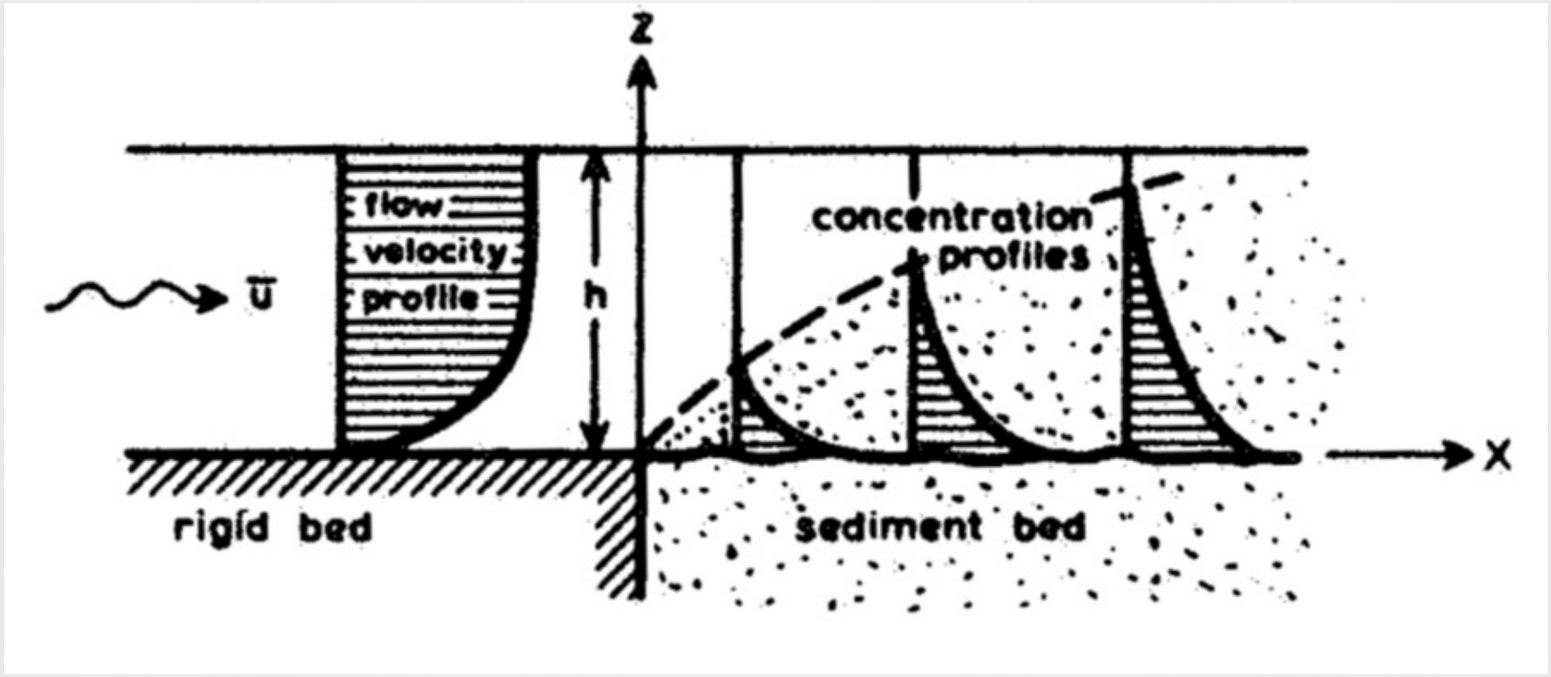
2. Contribution to SCHISM community
   - SCHISM has been widely used for large domains (e.g., California Bay-Delta), but additional validation case doesn't hurt.

Mesh for Bay-Delta SCHISM

CALIFORNIA DEPARTMENT OF
WATER RESOURCES

# Laboratory Experiments: Net-Entrainment

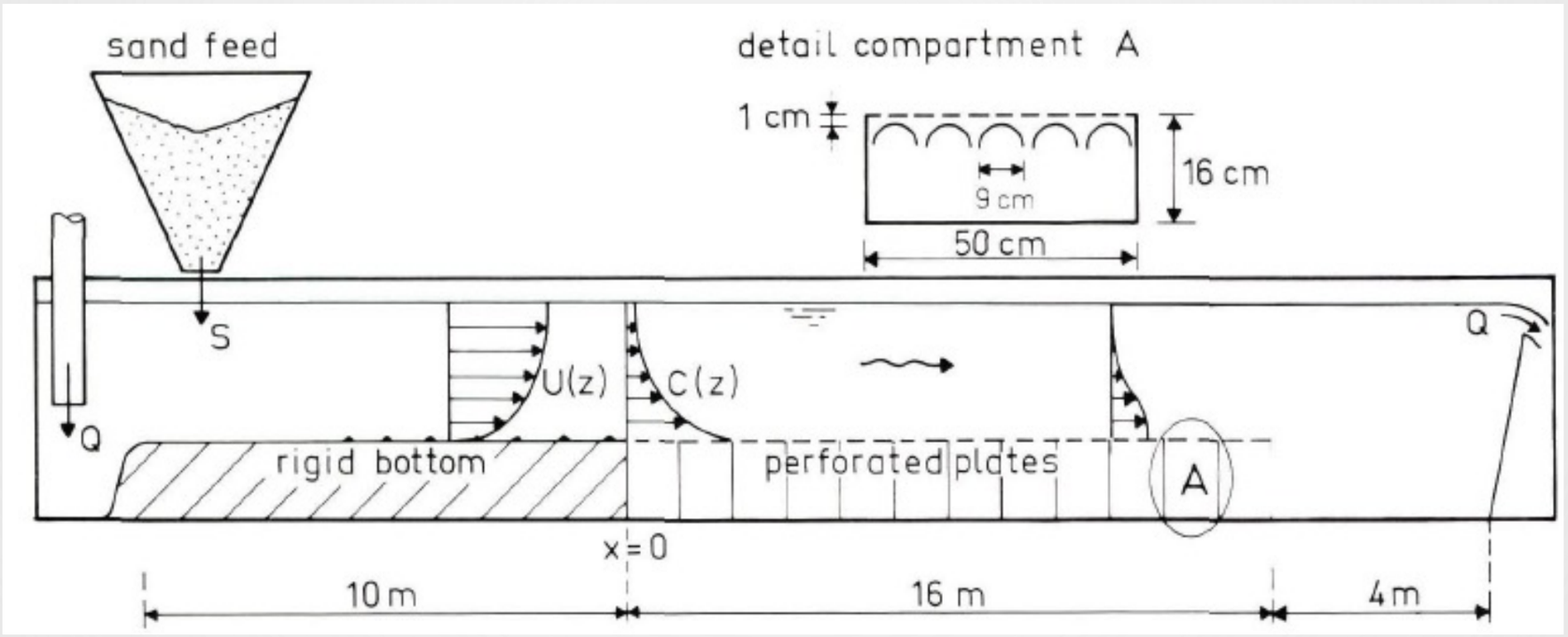
- Flume study by van Rijn (1981)
- Initially clear water flow over sand bed in flume.
- Sediment in water column has been entrained from the bed.
- Specifications:
  - $H$ = 0.25 m; $U$ = 0.67 m/sec; $d_{50}$ = 0.23 mm; $\omega_s$ = 2.2 cm/sec




Schematic of entrainment process (van Rijn, 1981)

# Laboratory Experiments: Net-Deposition

- Flume study by Wang and Ribberink (1986)
- Sediment particles are introduced at the inlet.
- Perforated bed prevents particles from re-suspension once settled.
- Specifications:
  - $H$ = 0.4 m; $U$ = 0.56 m/sec; $d_{50}$ = 0.095mm; $\omega_s$ = 0.65 cm/sec

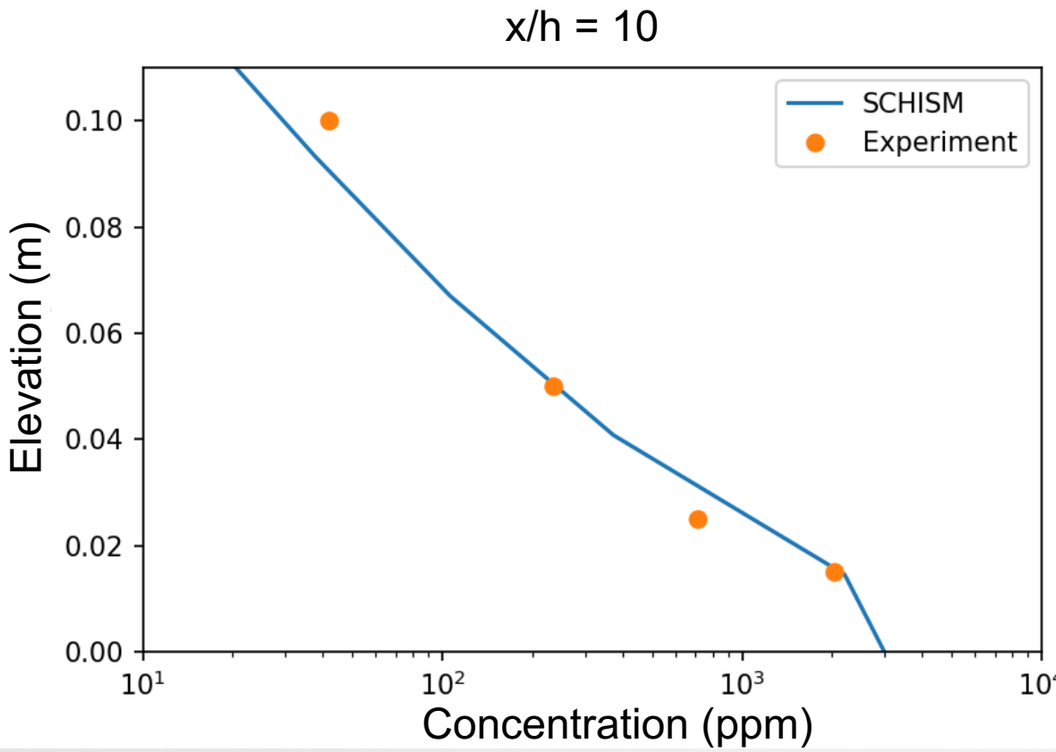


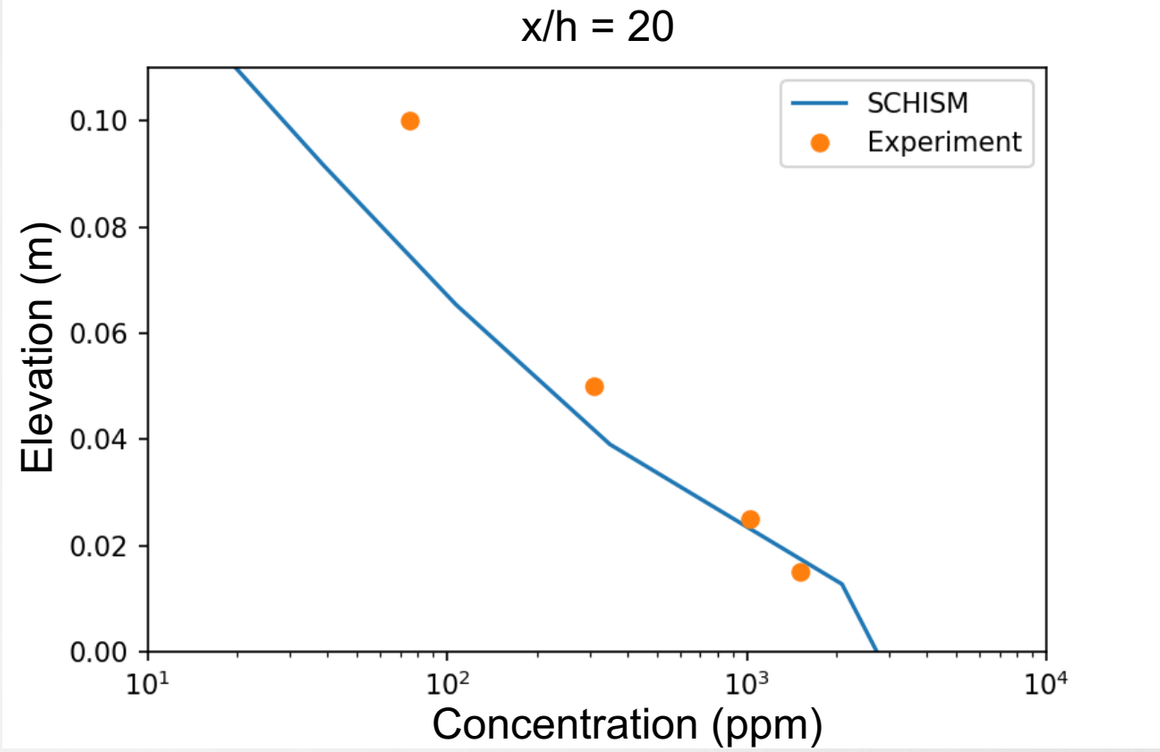

Experiment setup (Wang and Ribberink, 1986)

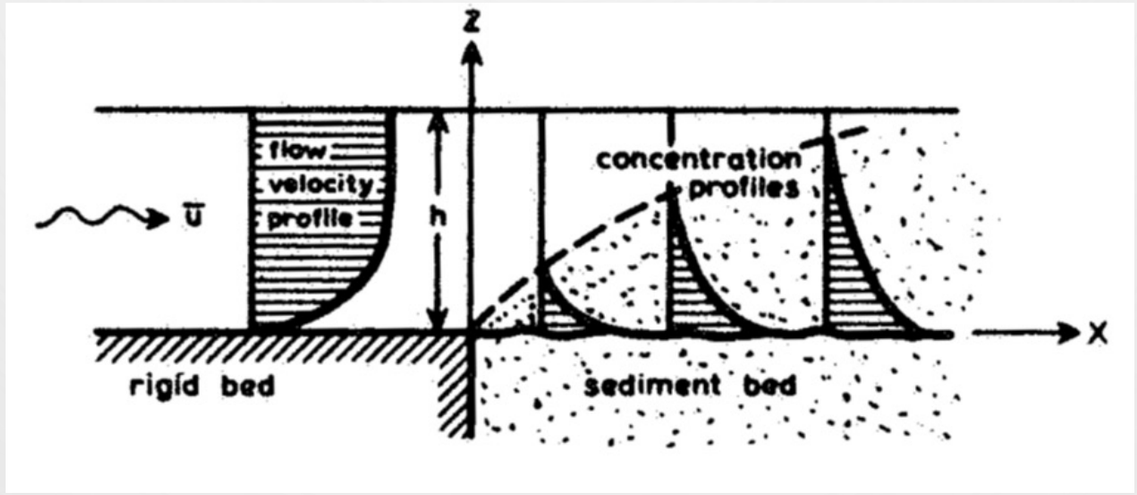
# Modeling Approach

- Create computational domain in 3-D using exact dimensions.
- Obtain fully-developed flow then compare modeled sediment concentration with the measurement.
- Use built-in SCHISM options to replicate experiment environment.
  - For net-entrainment, non-erodible bed to “turn off” entrainment.
  - For net-deposition, constant sediment concentration was applied.
    - SCHISM does not have option to specify concentration profile.
    - Point source not applicable.
- Calibration through sediment module input (for net-entrainment)
  - Erosion rate in the order of 0.1 ($kg/m^2sec$)
  - Critical shear stress set to 0.17 Pa (Soulsby and Whitehouse, 1997)

# Results: Net-Entrainment

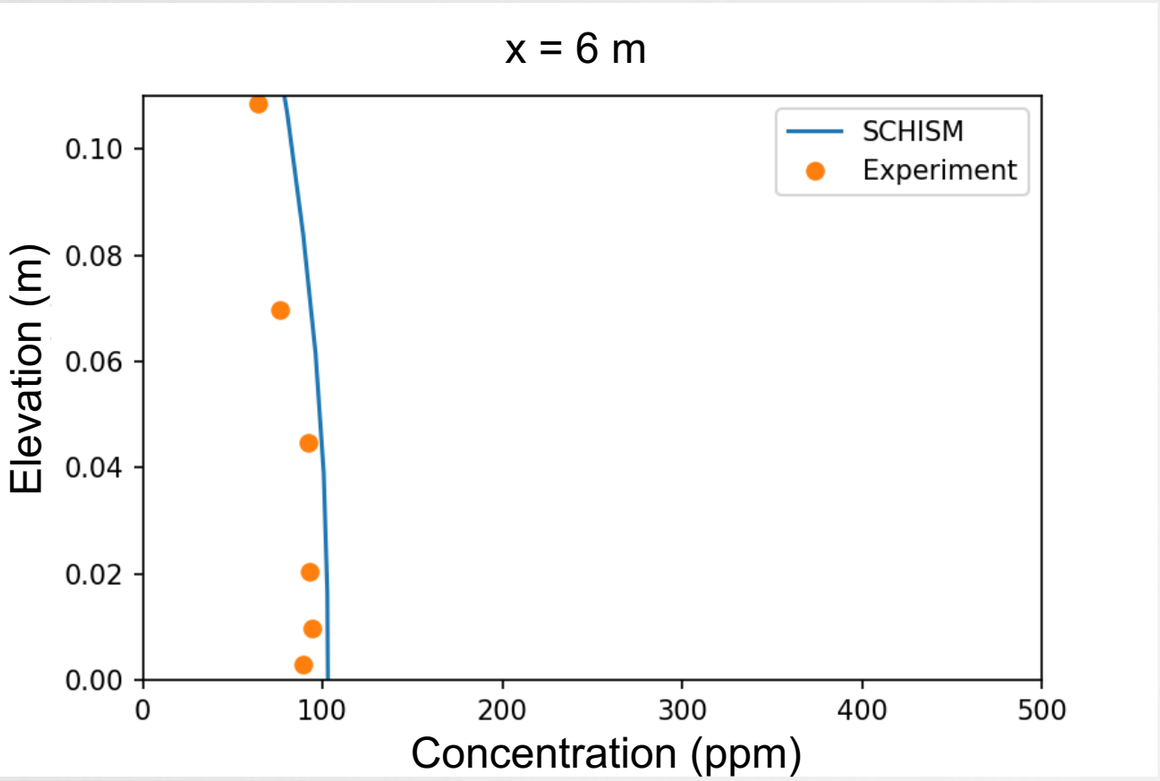


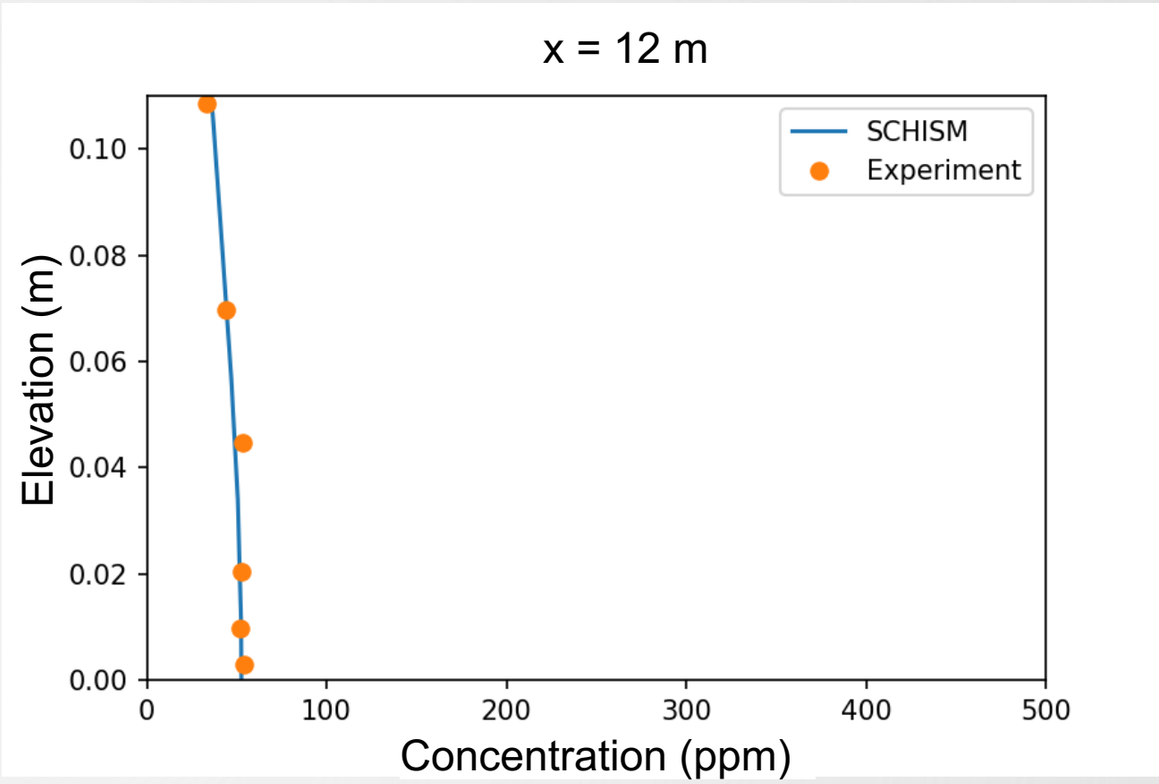



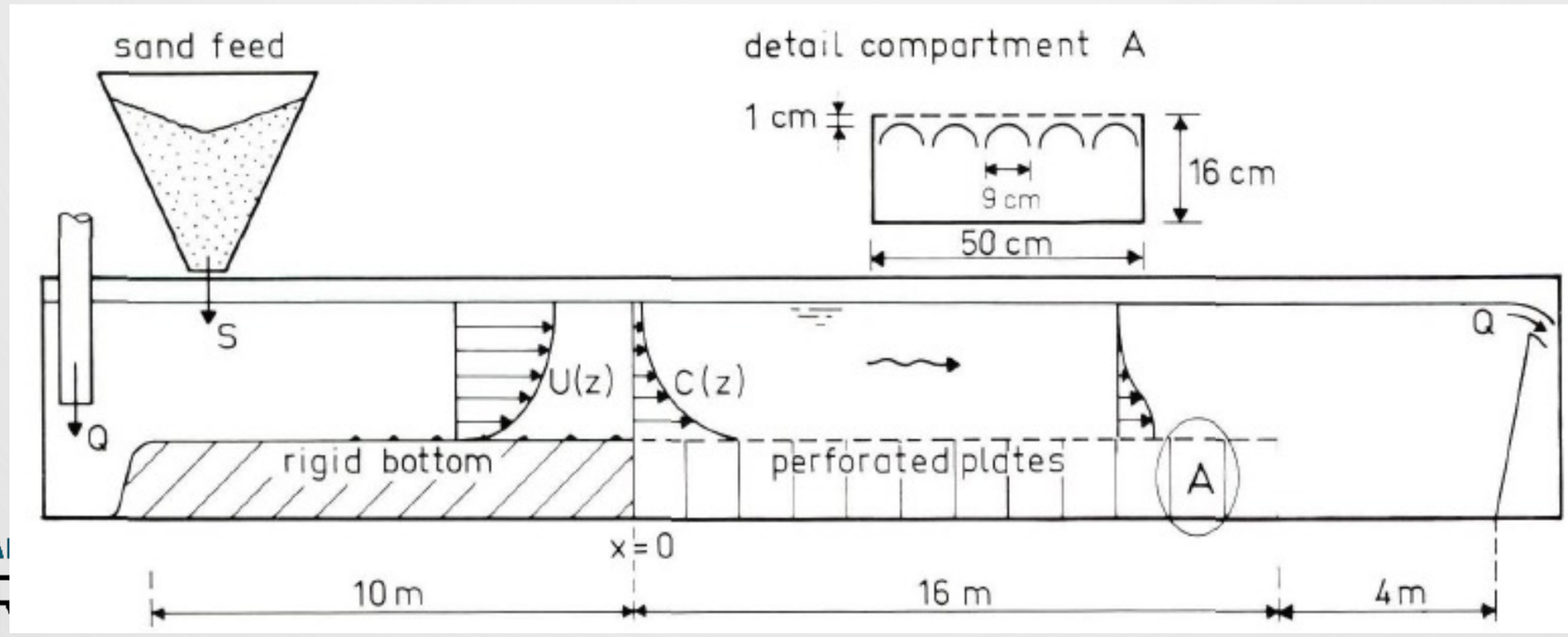




CALIFORNIA DEPARTMENT OF
WATER RESOURCES

# Results: Net-Deposition




CALIFORNIA DEPA
WATER R

# References

Rijn, L. C., van. (1981). The development of concentration profiles in a steady, uniform flow without initial sediment load. Report M1531, Part II, Delft Hydraulic Laboratory, Delft, The Netherlands.

Soulsby, Richard L. and Richard J.S. Whitehouse. “Threshold of Sediment Motion in Coastal Environments.” (1997).

Z. B. Wang & J. S. Ribberink (1986) The validity of a depth-integrated model for suspended sediment transport, Journal of Hydraulic Research, 24:1, 53-67.

# Acknowledgement

Kijin Nam, Ph.D., P.E. at California Department of Water Resources

CALIFORNIA DEPARTMENT OF
WATER RESOURCES

# Follow us on social media

CADWR

CA_DWR

calwater

cadepartmentofwaterresources

CALIFORNIA DEPARTMENT OF
WATER RESOURCES