Flume and Rainfall Simulator for Overland Flow Studies

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Laser Scanner — Artificial Grass to Reduce Erosion — Flume Bed — Head Tank — Point Gauge — Lower Stopper

Technical Specifications

- Flume
  - Length (L)   3.0 m
  - Width (w)   0.5 m
  - Depth (d)   0.04 m
  - Slope   0 to 15°
  - Upper Stopper   L = 0.20, w = 0.5, d = 0.04 m
  - Lower Stopper   L = 0.15, w = 0.5, d = 0.04 m

- Water Supply
  - Flow Rate Measurements   Water-meter
  - Flow Rate   33 to 1033 cm³/sec

- Flow Velocity
  - Velocity Measurements   Dye Tracing Technique
  - Dye Used   Lycopene
  - Test Length   1.24 m

- Water Depth
  - Depth Measurements   2 Point Gauges
  - Accuracy   0.1 mm

- Rainfall Simulator
  - Nozzle Lechler 461.008   71 mm/hr
  - Nozzle Lechler 460.788   36 mm/hr
  - Height above Flume Bed   3.0 m
  - Area Covered   2 m²

- Available Sediment
  - Median Grain Size (D_{50}) 0.233, 0.536, 0.719 and 1.022 mm

- Bed Roughness
  - Roughness Measurements   Laser Scanner
  - Accuracy   1 mm
  - Scan Area   1 m²

Applications

The flume and other available equipments can be used for following studies:

- Overland flow studies
- Hillslope studies
- Soil stability studies
- Interception studies
- Calibration of field equipment
- Sediment detachment and transport studies

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Evaluation of Sediment Transport Equations Under Overland Flow Conditions

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Background

- Empirical and physically-based equations are used in most water erosion models for soil detachment and sediment transport.
- Most equations were derived for streamflow conditions due to non-availability of experimental data for overland flow conditions.
- But hydraulic and sediment transport conditions in streamflow are different from overland flow conditions (depth, velocity, slope, etc), which makes the use of streamflow transport equations questionable.

Methodology

- Seven well-known and widely-used sediment transport equations are critically analyzed and a literature review of previous tests has been made.
- 1214 flume experiments are being carried out to collect the hydraulic and sediment parameters under four different conditions:
    1. Smooth bed
    2. Rough bed
    3. Smooth + Rainfall
    4. Rough + Rainfall

Study Objectives

- To study the effect of bed roughness, rainfall amount and intensity on sediment transport capacity in the laboratory under different flow conditions.

- To evaluate the performance of existing soil transport equations using the laboratory data, and identify the best-performing transport equations.

- To adapt the best performing transport equations by including the effects of bed roughness and rainfall effects.
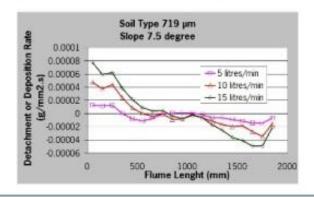
Preliminary Results

- Interaction of detachment and deposition along flume is dependent on the discharge at same slope.

Soil Type 719 µm
Slope 7.5 degree

Detachment or Deposition Rate ($g/mm2.s$) vs Flume Length (mm)

- 5 litres/min
- 10 litres/min
- 15 litres/min

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