Implications of Sampling Methodology on Contraction Scour Depths at Bridge Foundations in Armored Stream Beds

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Stream Scour Studies

HEC 18 (2012)

- Guidelines for designing bridges.
- Equations derived from flume studies.
  - Channel geometry
  - Hydraulic parameters
  - Grain size- D50- median grain size

HEC RAS

- Calculates scour and displays as a cross section.
Purpose

Find a relationship between sampling method and contraction scour depth.

Develop Sampling Protocol

- Varied sampling mythology, but not sampling source

Hypothesis

- D50 vary widely between sampling methods
- Scour depths to change by the sampling methodology
Study Area
Study Area
# Methods

## Surface samples
- Walking cobble count
- Aerial cobble count

## Volumetric samples
- Auger
- Shovel
- Barrier Device

## Compare results
- Observations
- Precision, bias, and error

## Calculate scour depth with HEC RAS
Walking Cobble Count
Aerial Cobble Count

- 1.2 m² frame
- Collect all surface particles within frame.
- No double counting
- No sampling sub armor.
Hand Auger Method

- 3 inch diameter opening
  - 76 mm.
  - $D_{\text{max}}$ 180 mm.
- Hard to use in gravel.
  - Couldn’t gain much depth.
Shovel Method

- Best for dry beds
- Poor visual control
- Slumping of walls
- Rushing water loses fines.
- Over sampled fines
Barrier Method

- Prevented fines from washing away.
- Defined sampling hole
- Greater depth.
- No double counting.
- Full range of sizes.
Sieve Analysis

- Wet sieved in lab
  - 23 kg. samples
  - ¾ bucket
- In lab
  - Very laborious
  - >4 hours per sample
  - Not including drying time
- Bulk Sampling in field
D₅₀ Measurements

The diagram illustrates the D₅₀ measurements for different methods:

- Shovel: 27.9 mm
- Shovel: 24.4 mm
- Auger: 15.6 mm
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- Barrier: 43.2 mm
- Barrier: 34.7 mm
- Barrier: 35.7 mm
- Walking CC: 73.9 mm
- Walking CC: 72.7 mm
- Aerial: 62.2 mm
- Aerial: 62.2 mm
- Aerial: 62.2 mm
Scour Depths Results

Vertically Exaggerated 2:1
$D_{50} = 62.21$
No channel scour

Finest measurement
$D_{50} = 11.09$
7.8 ft. scour
Conclusions

Contraction scour depths are affected by sampling, varying $D_{50}$.

- HEC 18 equations
- Channel geometry
- Vertical Stratification

Sampling protocol

- HEC 18 doesn’t define
- Submerged sediment for contraction scour
- Barrier methods are the best compromise