Hydraulic Analysis of Instream Structures and Channel Rehabilitation Projects Using HEC-RAS

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Presentation Objectives

- HEC RAS Background
- Geometric Data Requirements
- Use as a Design Tool
- Example Applications
- Conclusions
HEC – RAS Background

- 1-Dimensional Model
- Velocity “stream-wise”
- Steady and Unsteady Flow
- “Looped Networks” & Split-Flow
- Structures

HEC-RAS Geometry

- Geometric Model from Channel Morphology
  - Dimension
  - Pattern
  - Profile
  - Resistance, (Channel and Floodplain Roughness)
HEC-RAS Geometric Data Input

Roughness and Velocity Head Losses
HEC – RAS Applications

- Study Scale vs. Design Scale
Stream Barbs
Monitoring Channel Profile vs. Pre-Project Profile
As-Built Channel Shear vs. Pre-Project Shear

Engineered Log Jams
Step Pools

Legend
- WS  2 Year Q
- Crit  2 Year Q
- Ground
- LOB
- ROB

Reach #1

Step Pools

Legend
- EG  PF 3
- WS  PF 3
- Crit  PF 3
- Ground
- LOB
- ROB
Step Pools
Channel Design

As-Built Channel Profile vs. Existing Profile
As-Built Average Channel Velocity

Stationing (feet)

Elevation (feet)

Velocity (ft/s)

As-Built Profile
Existing Profile
Velocity

Channel Design

Channel Design
Table 2: Permissible Shear and Velocity for Selected Lining Materials

<table>
<thead>
<tr>
<th>Boundary Category</th>
<th>Secondary Type</th>
<th>Shear Stress (kPa)</th>
<th>Velocity (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt</td>
<td>Fine-silt silt</td>
<td>0.02 - 0.05</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Sandy silt (noncohesive)</td>
<td>0.03 - 0.04</td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td>Alluvial silt (cemented)</td>
<td>0.05 - 0.05</td>
<td>1.58</td>
</tr>
<tr>
<td></td>
<td>Silty silt (noncohesive)</td>
<td>0.045 - 0.055</td>
<td>1.75 - 2.28</td>
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<tr>
<td></td>
<td>Firm silt</td>
<td>0.075 - 0.15</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Fine gravels</td>
<td>0.05 - 0.075</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Gravel</td>
<td>0.05 - 0.1</td>
<td>2.5 - 3.5</td>
</tr>
<tr>
<td></td>
<td>Alluvial gravels</td>
<td>0.05 - 0.1</td>
<td>2.5 - 3.5</td>
</tr>
<tr>
<td></td>
<td>Gravel to cobble</td>
<td>0.05 - 0.1</td>
<td>2.5 - 3.5</td>
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</tbody>
</table>

Legend

- Laursen (Copeland)
- Engelund-Hansen
- Toffaleti
- Yang
- Ackers-White
- MPM

Sediment Potential for D50: Coarse Gravel
In river work, computer modeling is an insidious procedure in which an air of surety hides questionable assumptions. A computer gives numerical answers, but the basis on which the computation rests are hidden. There is too much reliance on computer models with no field measurements to support the computations.
Conclusions

- Collect the best field measurements that you can!
  (There is no substitute for good topo or dimension pattern and profile)
- Expeditious development of the geometric data model allows us to concentrate on the modeling and running the “what ifs”
- The model is only as good as the data used….
- AND THE ASSUMPTIONS MADE BY THE MODELER!!!!
Don't forget to consult your Fluvial Geomorphologist!

Yeah... You friggin Engineers have caused enough trouble!