Integrated Design and Hydraulic Analysis

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“Integrated Design” (???)

An engineer’s approach:

The River

∫ (Design Discipline & Tools) drestoration

...or bringing the design team together.
The Premise:

- Information is Good

The Solution:

- Clear and Accessible Presentation of Information

The Problem:

- Discipline-Specific Design Tools

The Solution:

- Clear, Project-Relevant Presentation of Data
Example Project

Big Harris Stream Restoration Project
- Cleveland County, North Carolina
- 7 Miles of Stream Channel Network
- Modeled Reach: 1200 Feet
- 3.8 Square Mile Watershed
- Funding Mechanism: North Carolina Ecosystem Enhancement Program

Example Disciplines:
- Stream Restoration Specialist
- Modeler

(Same Planet, Different World)

The Tool:
- Multi-Dimensional Numerical Hydraulic Model

Modeled Hydrologic Scenario:
- Bankfull Flow
Existing Conditions

- Topographic Survey Data May Not Accurately Reflect Site
- Survey Crew May Not Be Familiar With Survey Needs
- CAD operator May Not Be Familiar With Riverine Systems
Proposed Conditions

- CAD Design Can Be “Smooth”
- CAD Surface Can Provide “Infinite” Resolution
Desirable Model Features

Model Selection Criteria

• Ease of Use
• Wetting/Drying
• Supports Higher Froude Numbers
• Presentation of Results
• Low Cost, No Cost!
• Portability

Numerical Model Used Here:

• River2D
Model Development

• Geometric Domain
• Boundary Conditions

Data Manipulation Tools
1. CAD, GIS
2. Spreadsheet
3. Text File (Notepad)
4. Numerical Model
5. Data Viewer (Optional)
Domain Development

• Geometric Domain
• Discretization of Numerical Domain

Process Flow

• Points Extracted from CAD Surface
  • Text File of Points (x,y,z)
    • Model-Specific Text File Format
      • Sketch Boundary and Mesh
Mesh Refinement

Mesh Refinement Objectives

- Increase Resolution of Domain and Numerics
- Check for Grid Dependence
- Resolve Areas of Interest
Results: WSEL (Water Surface Elevation)
Results: Depth
Results: VMAG  
(Velocity Magnitude [Speed])
Results: VMAG
(Velocity Magnitude [Speed])

Zoom with Vectors
Results: SVMAG (Shear Velocity Magnitude)
Back to the Big Harris

Modeling Objectives

• Provide Feedback to Stream Restoration Designers
• Numerically Evaluate (Validate?) Channel Design Approach
• Modeling Effort Commensurate with Need

Modeling Results

• Support Channel Design Approach
• Presentation of Data Suitable for Reporting and Presentation

Model Level-of-Effort

• Similar to Typical 1-Dimensional Models (e.g., HEC-RAS)