Credit Information

Open Channel Hydraulics and Design

This webinar is open to the public and is designed to qualify for 6.5 PDHs for professional engineers and 6.5 HSW continuing education hours for landscape architects in all states that allow this learning method. Please refer to specific state rules to determine eligibility.

HalfMoon Education is an approved continuing education sponsor for engineers in Florida (Provider License No: CEA362), Indiana (License No. CE21700059), Maryland, New Jersey (Approval No. 24GP00049300) and North Carolina (S-0130). HalfMoon Education is deemed an approved continuing education sponsor for New York engineers and landscape architects via its registration with the Landscape Architecture Continuing Education System (LA/CES).

The Landscape Architecture Continuing Education System has approved this course for 6.5 HSW PDHs. Only full participation is reportable to the LA CES.

This Association of State Floodplain Managers has approved this course for 6.5 CECs for floodplain managers.

Attendance will be monitored, and attendance certificates will be available after the webinar for those who attend the entire course and score a minimum 80% on the quiz that follows the course (multiple attempts allowed).

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Advanced HEC-RAS Modeling

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- Tuesday, December 17, 2024 | 8:30 am - 4:00 pm CST

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- Thursday, December 19, 2024 | 8:30 am - 5:30 pm CST

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Agenda:

Understanding Open Channel Flow

- Course expectations
- Concepts of open channel flow design not covered by textbooks
- Steady and unsteady flow
- Uniform and normal flow
- Reynold's number
- Laminar and turbulent flow
- Definitions
- Conservation principles
- Conservation of mass – continuity
- Hydraulic radius
- Hydraulic efficiency
- Effective diameter
- Channel shapes and properties
- Hydraulic elements chart for partially full circular pipe
- Conservation of energy and the energy equation
- Local energy losses
- Specific energy diagram
- Energy correction factor
- Example of solving a converging channels problem
- Hydraulic and energy grade lines
- Review

Fundamentals of Open Channel Flow

- Froude number
- Critical depth
- Flow regimes of super and subcritical flow
- Manning's equation
- Normal depth
- FHWA Hydraulic Toolbox
- Channel slope definitions
- Compound channels
- Example of solving a compound channel for flow
- Example of solving a compound channel for normal depth
- Conservation of momentum
- GVF Gradually varied flow
- Types of GVF curves
- Examples of different types of open channel flows
- Where the calculation of flow depth and discharge starts in a flow system
- Review

Flow Resistance in Open Channels

- Flow resistance and resistance coefficients
- Boundary shear stress and resistance
- Resistance coefficients
- Resistance coefficients for rigid boundaries
- Resistance coefficients for natural boundaries
- Turbulent equations for natural boundaries
- Size distribution of alluvial material
- Friction factors (ASCE) for natural channels
- Cowan's equation for additive resistance
- Bed forms and bed form resistance
- Vegetated surfaces and resistance
- Solution of normal depth in a compound channel with variable resistance
- Stage discharge diagram
- Lotter effective n
- Brief introduction to HEC-RAS
- Effect of sediment transport on resistance
- Review

Principles of Open Channel Flow Design

- Classification of gradually varied flow curves
- Upstream and downstream control
- Review of gradually varied flow
- Synthesis of composite gradually varied flow profiles
- Locations of choked flow in channel transitions
- Channel transitions and example of a reservoir to steep channel transition
- Standard step method to find the length of a GVF curve
- Example of the standard step method to find the length of a M_1 GVF curve
- Rapidly varied flow
- Hydraulic jumps
- Hydraulic jumps with GVF
- Conjugate depths of hydraulic jumps
- Locating hydraulic jumps in composite GVF profiles
- Example of creating a composite GVF profile
- Optional assignments to sketch composite GVF profiles
- Finding the location of a H.J. between two GVF profiles
- Choked flow in transitions
- Calculating flow depths in open channels
- Review

Stable Channel Design

- Example of solving an open channel problem with diverging channels
- Alluvial channel design
- Flood and storm runoff
- Sedimentation, erosion, and deposition
- Sediment transport
- Fluvial geomorphology
- Local scour
- Channel bank and bed protection
- Tractive force and permissible maximum velocity methods
- Riprap protection
- Hydraulic structures (including culverts) used in open flow channels
- Flow measurement structures
- Considerations for designing an open channel
- Review

Faculty

Open Channel Hydraulics and Design

William Rahmeyer is an emeritus professor of Civil and Environmental Engineering at Utah State University (USU), and he was on the faculty at USU for 31 years and for 10 years as research faculty at Colorado State University. He is the past department head of Civil and Environmental Engineering at USU as well as the senior professor of the Hydraulics and Fluid Mechanics program of the Utah Water Research Laboratory. He served at USU as the director of the Hydro Composite Modeling Program, the division head of Water Engineering, the interim division head of the Structures Division and the Transportation Division, and as the Undergraduate Curriculum Division Head. Professor Rahmeyer is a part-time senior associate for Ayres and Associates in Fort Collins, Colorado, where he conducts national workshops in hydraulics, culvert flow, and urban drainage for the National Hydraulic Institute of FWHA.

Advanced HEC-RAS Modeling

Dr. Gregory H. Nail is an associate professor in the Engineering Department at the University of Tennessee at Martin where he teaches a variety of courses including fluid mechanics, hydraulics and hydrology, and hydraulic and hydrologic modeling. He holds a professional engineer's license based on having passed both the civil and mechanical discipline-specific exams. Dr. Nail worked as a research hydraulic engineer for the United States Army Corp of Engineers for 11 years. He is a former member of the Executive Committee of the Tennessee American Water Resources Association, and he has lectured on various HEC-RAS modeling topics at the Annual Tennessee Water Resources Symposium and at other venues. Dr. Nail earned his B.M.E. degree from Auburn University and his M.S. and Ph.D. degrees from Texas A&M University.

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Agenda:

Introductions and One-Dimensional Steady Flow HEC-RAS Review

- Introduction and overview
- Basic definitions and assumptions
- Conservation of energy and energy losses
- Computational enhancements

Unsteady One-Dimensional Open Channel Hydraulics Background and Theory

- Basic assumptions
- Conservation of mass
- Conservation of momentum
- Computational algorithm
- Boundary and initial conditions

Two-Dimensional Open Channel Hydraulics Background and Theory

- Basic assumptions
- Conservation of mass
- Conservation of momentum
- Boundary and initial conditions
- Computational mesh and algorithm
- HEC-RAS and historical perspectives

Demonstration 1 – Building an Unsteady 1D HEC-RAS Model without GIS

- HEC-RAS user interface
- Generating the geometry
- Generating the boundary and initial conditions
- Initial conditions
- Unsteady flow computational simulation
- Viewing of results

Demonstration 2 – GIS Basics

- Introduction and overview
- Geographic versus projected coordinate systems
- Raster versus vector files
- ArcMap versus ArcCatalog
- ArcMap interface basics
- Digital elevation model
- Other files

Demonstration 3 – Building an Unsteady 1D HEC-RAS Model with GIS

- RASMapper interface and the projection file
- Digital elevation models and geometry creation
- Generating the boundary and initial conditions
- Unsteady flow computational simulation
- Display and interpretation of results

Demonstration 4 – Building a Basic 2D HEC-RAS Model

- RASMapper interface and 2D geometry
- 2D mesh generation
- 2D boundary and initial conditions
- Other miscellaneous computational parameters
- 2D computational simulation
- Display and interpretation of results

Demonstration 5 – 2D HEC-RAS Model with Connections

- RASMapper Interface and mesh generation
- Spatially varied Manning's n
- Connections
- 2D computational simulation
- Viewing and interpreting results

Demonstration 6 – 1D/2D HEC-RAS Model and Other Considerations

- RASMapper interface and combined 1D/2D mesh generation
- Manning's n and connections
- External 2D flow area boundary conditions
- Other miscellaneous computational parameters
- 1D/2D computational simulation
- Viewing and interpreting result

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