

PROSPECT Course #352

Advanced 1D/2D Modeling with HEC-RAS

April 4-8, 2022

Objectives

This is an advanced course in applying computer program HEC-RAS. The course provides participants with the knowledge to effectively use computer program HEC-RAS to analyze difficult hydraulic conditions in natural and constructed channels, utilizing one-dimensional and two-dimensional modeling techniques.

Topics include: Developing terrain models for 2D modeling; developing Manning's n layers; creating and modifying a 2D computational mesh; boundary conditions for 2D Flow Areas; hooking up 1D elements to 2D Flow Areas; running a combined 1D/2D model; viewing 1D/2D results with RAS Mapper; hydraulic structures inside of 2D areas; and detailed channel and floodplain modeling with 2D flow areas. Special topics for dam and levee breaching, and using 2D modeling for hydraulic structures, will also be included.

Prerequisites

Participants must have a good background in open channel hydraulics and be familiar with the HEC-RAS software. Basic HEC-RAS input and output data requirements will not be covered in this class. Students must be experienced engineers who have attended Steady Flow with HEC-RAS, and have also either attended Unsteady Flow Modeling with HEC-RAS or have experience applying HEC-RAS using the Unsteady Flow modeling components. Participants must be in positions where they are currently engaged in using HEC-RAS in hydraulic investigations

Instructors

Cameron Ackerman (Course Coordinator)
Stanford Gibson
Mark Jensen
Alex Kennedy
Alex Sanchez
Eric Tichanksy
Anton Rotter-Sieren
Steve Piper (RMA Contractor)

Day 1

Time		Topic	Objective	Instructor
0800-0900	L0	Introductions and pre-course activities	Welcome and discussion of class expectations	Ackerman
0900-0930	L1.1	Example HEC-RAS Modeling	Overview of HEC-RAS capabilities using example applications for 2D modeling. Introduction to the validation and verification of HEC-RAS.	Gibson
0930-1000	D1.2	HEC-RAS Demonstration	Demonstration of using HEC-RAS to create a 2D model (Steps to create a RAS Model)	Ackerman
1000-1015		Break		
1015-1100	L1.3	Subgrid Bathymetry	Discussion on the use of sub-grid bathymetry for finite volume computations in HEC-RAS. The benefits of variable cell size on computational performance will be discussed.	Jensen
1100-1130	L1.4	Introduction to the 2D Equations	This presentation discusses the underlying 2D hydraulic equations used in HEC-RAS.	Sanchez
1130-1230		Lunch		
1230-1315	L1.5	Creating an HEC-RAS Terrain	Developing a terrain model and creating dataset for 2D modeling	Ackerman
1315-1415	W1.6	Creating an HEC-RAS Terrain Workshop	Hands-on work creating an HEC-RAS Terrain dataset	Ackerman/ Kennedy
1415-1430		Break		
1430-1515	L1.7	Mesh Generation and Refinement	This presentation will discuss the basic concepts of creating a 2D Mesh in HEC-RAS and then how to improve and refine a 2D Mesh with Breaklines and Refinement Regions.	Jensen
1515-1545	D1.8	Vector Editing in RAS Mapper	Demonstration of using editing tools in RAS Mapper to create a mesh: polygons, breaklines, and refinement regions.	Jensen
1545-1700	W1.9	Mesh Generation and Refinement Workshop	This workshop will provide hands-on experience in using HEC-RAS Mapper to create a 2D flow area mesh and refine it to capture high ground using breaklines and refinement regions	Jensen/ Kennedy/ Rotter- Sieren

Day 2

Time		Topic	Objective	Instructor
0800-0845	L2.1	Boundary and Initial Conditions	The different types of boundary conditions and establishing initial conditions will be discussed.	Sanchez
0845-0915	L2.2	Running a 2D Model	Discussion of essential parameters and computational options for running a 2D model including equation choice, cell size considerations, and time step considerations.	Ackerman
0915-0930		Break		
0930-1100	W2.3	Creating a Simple 2D Model Workshop	Students will create their first 2D model. Refinement of the model will be performed to understand the effect of model parameters.	Ackerman/ Sanchez
1100-1130		Review		Ackerman
1130-1230		Lunch		
1230-1315	L2.4	Visualization of HEC-RAS Results in HEC-RAS Mapper	An introduction to RAS Mapper is provided, specifically for visualizing HEC-RAS results.	Kennedy
1315-1345	D2.5	HEC-RAS Mapper Demonstration		Kennedy
1345-1400		Break		
1400-1430	L2.6	Land Classification Data	This discussion will cover creating an Land Classification dataset for use with Manning's n values in RAS Mapper.	Gibson
1430-1515	W2.7	Land Classification Data	Student will learn how to bring land cover data into a Land Classification dataset and associated Manning's n values.	Gibson/ Rotter-Sieren
1515-1545		Review		Gibson
1545-1600	L2.8	Equation Selection	A discussion on the use of Diffusion Wave and Full Shallow Water Equations in HEC-RAS is presented. A discussion of scenarios where the equations are appropriate is also provided.	Sanchez
1600-1630	L2.9	Advanced Computation Options	Discussion of more advanced parameters and computational options for running a 2D model including equation choices, turbulence, and matrix solvers.	Sanchez
1630-1700	L2.10	1D vs 2D Modeling	This presentation discusses 1D vs 2D modeling and how to choose the appropriate modeling method.	Sanchez

Day 3

Time		Topic	Objective	Instructor
0800-0830	L3.1	Combined 1D/2D Modeling	Discussion of modeling channels with 1D rivers reaches/cross sections combined with floodplains/ levees using 2D Flow Areas	Jensen
0830-0930	W3.2	Combined 1D/2D Modeling Workshop	Use a combined 1D/2D model to evaluate a protected area using 2D Flow Area and a Lateral Structure to define a levee. Levee overtopping and breaching will also be analyzed.	Tichansky/ Jensen
0930-1000		Review		Tichansky
1000-1015		Break		
1015-1045	L3.3	Dam Breach with 2D Flow Area	Discussion of how to use 2D Flow Areas with 1D reaches and storage areas to perform a dam breach analysis. Discussion on using the SA/2D Connection for modeling a dam, outlets, and the dam breach.	Gibson
1045-1115	L3.4	Determination of Dam Breach Parameters	This presentation will discuss estimating dam breach parameters for modeling dam breach scenarios.	Gibson
1115-1215		Lunch		
1215-1345	W3.5	Dam Breach with 2D Flow Areas Workshop	Students will create an HEC-RAS model to utilize the breach functionality and evaluate parameters.	Gibson/ Tichansky
1345-1415		Review		Gibson
1415-1430		Break		
1430-1500	L3.6	SA/2D Connections	Discussion of how to use SA/2D Connections in a 2D Flow Area	Ackerman
1500-1530	D3.7	Terrain Modifications Demonstration	Introduction to cloning a terrain and adding a simple terrain modification.	Ackerman
1530-1700	W3.8	SA/2D Connections	In this workshop, students will utilize 2D Connections (internal hydraulic structures) inside of a 2D Flow Area to improve the river hydraulics model by overriding terrain elevations.	Ackerman/ Tichansky

Day 4

Time		Topic	Objective	Instructor
0800-0830		Review		Ackerman
0830-0900	L4.1	Simplified Bridge Modeling	Discussion on modeling a bridge using a 2D Connection using the 1D bridge modeling method.	Jensen
0900-1015	W4.2	Simplified Bridge Modeling Workshop	Students will utilize the 1D bridge modeling approach to modeling.	Jensen/ Ackerman
1015-1030		Break		
1030-1100		Review		Jensen
1100-1130	L4.3	Detailed Bridge Modeling	This lecture will cover how to use the new 2D Flow Area capability to perform very detailed multi-dimensional hydraulic analyses. Students will learn how to set up a model to get detailed water surfaces and velocities.	Sanchez
1130-1230		Lunch		
1230-1345	W4.4	Detailed Bridge Modeling Workshop	Students will develop a detailed bridge model to evaluate water surface elevations and velocities in detail.	Sanchez/ Jensen
1345-1415		Review		Sanchez
1415-1430		Break		
1430-1515	L4.5	Precipitation and Wind	This presentation will discuss the use of the Precipitation and Wind boundary condition in HEC-RAS.	Sanchez
1515-1615	D4.6	Precipitation and Wind Demonstration	Precipitation will be use to create a rain on grid model.	Sanchez
1615-1700	L4.7	1D/2D Direct Connections	Learn about hooking a 1D reach directly into a 2D Flow area, as well as having a 1D reach come out of a 2D Flow Area. The concept of 1D to 2D iterations will be introduced.	Gibson

Day 5

Time		Topic	Objective	Instructor
0800-0830	L5.1	Introduction to the 3D Viewer	An introduction to RAS Mapper is provided, specifically for visualizing HEC-RAS results.	Rotter-Sieren
0830-0900	D5.2	3D Viewer Demonstration	The 3D Viewer will be demonstrated	Rotter-Sieren
0900-1000	D5.3	RAS Mapper Demonstration	This demonstration highlights the various cool functionality in RAS Mapper including terrain modification, terrain resampling, data export, and data import.	Ackerman
1000-1130		Course Closing	Post-test, course evaluations, oral critique, and closing remarks	Ackerman