Hydrology and Hydraulic Modeling for Dam Safety Studies

(revised 2016)

Objective

The objective of the course is for participants to perform hydrologic and hydraulic modeling in support of Dam Safety studies. Course participants will be required to run HEC-HMS and HEC-RAS.

Topics presented will include: Development of Probable Maximum Precipitation (PMP); Using GIS to Develop a Hydrologic Model; Hydrologic Modeling for PMP/PMF Events; Developing Dam Breach Parameters; Dam Breaching Analysis using HEC-HMS and HEC-RAS; Unsteady Flow Modeling with HEC-RAS; and Using RAS-Mapper for Inundation Mapping. Each participant will have the opportunity to prepare model input and analyze model output during course workshops.

Course Prerequisites: Students who come to this class should have knowledge on how to use HEC-HMS and HEC-RAS. This knowledge can be in the form of a basic training class or on the job experience. The preparation of basic input data and analysis of the output from these software packages will not be covered. Experience in unsteady flow modeling is a plus but is not required.

HEC Instructors:

Cam Ackerman
Mike Bartles
Tom Brauer
Gary Brunner
Jon Fenske
Matt Fleming
Stan Gibson
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Mark Jensen
Will Lehman
Bill Scharffenberg

Monday, 7 March:

8:00 - 9:00 a.m.		**COURSE INTRODUCTIONS**
9:00 - 10:00 a.m.	1.1 Lecture:	**OVERVIEW OF H&H FOR DAM SAFETY** This lecture provides an overview of the process for performing the Hydrology, Hydraulics, and Mapping studies for a dam safety study. A discussion of Hydrologic Loading for Risk Assessment is included.
10:00 - 10:15 a.m.	**Break**	
10:15 - 11:15 a.m.	1.2 Lecture:	**DEVELOPMENT OF THE PROBABLE MAXIMUM PRECIPITATION (PMP)** Procedures for development of the probable maximum precipitation for the various regions of the United States are described.
11:15 - 12:30 p.m.	**LUNCH**	
12:30 - 2:00 p.m.	1.3 Workshop:	**DEVELOPMENT OF PMP** This workshop will demonstrate how to develop a PMP event for the eastern half of the U.S. using HMR51 and HMR52.
2:00 - 2:15 p.m.	**Review**:	Workshop 1.3 (Brauer)
2:15 - 2:30 p.m.	**Break**	
2:30 - 3:15 p.m.	1.4 Lecture:	**HYDROLOGIC MODELING FOR PMP/PMF EVENTS** Discussion of modeling rainfall, infiltration, runoff transform, and baseflow methods focused towards PMF level events. Overview of reservoir routing options within HEC-HMS.
3:15 - 4:45 p.m.	1.5 Workshop:	**DEVELOPING PMF INFLOWS TO RESERVOIRS AND ANALYZING SPILLWAY ADEQUACY** This workshop will demonstrate how to calculate the PMF inflow to a reservoir, route that flow through the reservoir, and evaluate the adequacy of the emergency spillway.
4:45 - 5:00 p.m.	**Review**:	Workshop 1.5

8:00 – 8:45 a.m.   2.1 Lecture: **PALEOHYDROLOGY OVERVIEW**
Discussion of geologic and botanical evidence as a source of information for incorporation into flood frequency analysis.

8:45 – 9:30 a.m.   2.2 Lecture: **INTRODUCTION TO HEC-METVUE** (Hanbali). Introduction to HEC-MetVue and instruction on how HEC-MetVue could be used to process historical storms and to develop hypothetical storms.

9:30 - 9:45 a.m.   **Break**

9:45 – 10:45 a.m.   2.3 Workshop: **APPLICATION OF METVUE FOR PMP AND OTHER HYPOTHETICAL STORMS**
This workshop will guide the students through application of HEC-MetVue for developing hypothetical storms.

10:45 – 12:00 p.m.   2.4 Lecture: **USING HEC-GEORAS TO DEVELOP GEOMETRIC DATA**
This lecture will describe how to use HEC-GeoRAS to prepare input data to an HEC-RAS model in support of a dam break analysis.

12:00 -1:00 p.m.   **LUNCH**

1:00 – 3:30 p.m.   2.5 Workshop: **USING HEC-GEORAS GEOMETRY PRE-PROCESSING**
Students will learn how to use HEC-GeoRAS to prepare the geometric input data for HEC-RAS.

3:30 – 4:00 p.m.   **Review**:   Workshop 2.5

4:00 - 5:00 p.m.   2.6 Lecture: **PERFORMING A DAM BREAK ANALYSIS WITH HEC-HMS** Discussion of how to perform a dam break analysis using HEC-HMS. Discussions of antecedent conditions/event for dam safety studies and downstream routing techniques.

Wednesday, 9 March:

8:00 – 9:00 a.m.	3.1 Lecture:	**DETERMINATION OF DAM BREACH PARAMETERS** Discussion of methods for estimating the parameters necessary for simulation of breaching earth dams.
9:00 - 10:15 a.m.	3.2 Workshop:	**DEVELOPING DAM BREACH PARAMETERS** This workshop will focus on estimating dam break parameters.
10:15 – 10:30 a.m.	**Review**:	Workshop 3.2
10:30 – 10:45 a.m.	**Break**	
10:45 – 11:30 a.m.	3.3 Workshop:	**DAM OVERTOPPING AND BREACHING ANALYSIS WITH HEC-HMS** This workshop will demonstrate how to perform a dam break analysis and downstream routing using HEC-HMS.
11:30 – 12:00 p.m.	**Review:**	Workshop 3.3
12:00 -1:00 p.m.	**LUNCH**	
1:00 - 2:00 p.m.	3.4 Lecture:	**UNSTEADY FLOW MODELING WITH HEC-RAS** This lecture will describe how to enter unsteady flow data and boundary conditions, perform the computations, and view results of an unsteady flow analysis.
2:00 - 2:15 p.m.	**Break**	
2:15- 3:45 p.m.	3.5 Workshop:	**UNSTEADY FLOW MODELING FOR DAM SAFETY STUDIES** Students will learn how to model a dam and the downstream area using unsteady flow routing in HEC-RAS.
3:45 - 4:00 p.m.	**Review**:	Workshop 3.4
4:00 – 5:00 p.m.	3.6 Lecture:	**USING HEC-RAS TO PERFORM A DAM BREAK ANALYSIS** This lecture will cover how to enter dam break parameters into HEC-RAS, performing the computations, and viewing pertinent results.

<u>Thursday, 10 March:</u>

8:00 - 9:45 a.m.	4.1 Workshop:	**PERFORMING A DAM BREAK ANALYSIS WITH HEC-RAS** This workshop will have students entering dam break parameters, running the model, and viewing results. A range of breach parameters will be tested during the workshop.
9:45 - 10:00 a.m.	**Break**	
10:00 - 10:30 a.m.	**Review**:	Workshop 4.1
10:30 - 11:45 p.m.	4.2 Lecture:	**COMMON MODEL STABILITY PROBLEMS WHEN PERFORMING A DAM BREAK ANALYSIS** This lecture will discuss stability problems that are often encountered when applying an unsteady flow model to a dam break situation.
11:45 - 12:45 p.m.	**LUNCH**	
12:45 - 1:30 p.m.	4.3 Lecture:	**DETECTING AND FIXING MODEL STABILITY PROBLEMS** This lecture will discuss methods for identifying and fixing model stability problems.
1:30 – 1:45 p.m.	**Break**	
1:45 - 3:30 p.m.	4.4 Workshop:	**DIAGNOSING AND FIXING COMMON STABILITY PROBLEMS**. Students will be given several data sets that have at least one model stability problem. The goal is to identify the problem and to fix it.
3:30 - 4:00 p.m.	**Review:**	Workshop 4.4
4:00 - 5:00 p.m.	4.5 Lecture:	**USING RAS MAPPER FOR INUNDATION MAPPING** This lecture will describe how RAS Mapper is used to develop inundation maps from HEC-RAS model results.

<u>Friday, 11 March:</u>

    8:00 - 9:00 a.m.   5.1 Workshop: **INUNDATION MAPPING FOR DAM SAFETY STUDIES** Students will gain hands on experience in using HEC-RAS results to develop inundation maps.

    9:00 - 9:30 a.m.   **Review:**   Workshop 5.1

    9:30 - 10:00 a.m.   5.2 Lecture: **CONSEQUENCE MODELING FOR DAM SAFETY STUDIES** This lecture will discuss the application of the hydrologic and hydraulic analyses in modeling consequences.

    10:00 - 10:15 a.m.   **Break**

    10:15 - 11:00 a.m.   **POST TEST, COURSE CRITIQUE, AND CLOSING REMARKS**