

Designing Efficient Culverts and Open Channels

March 12-14, 2007
Las Vegas, Nevada
March 26-28, 2007
Madison, Wisconsin

Learn proven techniques for:

- ✓ *Designing open channels, both natural and constructed*
- ✓ *Calculating water surface profiles*
- ✓ *Designing safe and efficient culverts*
- ✓ *Reducing construction and maintenance costs*
- ✓ *Estimating drainage area and time of concentration*

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COLLEGE OF ENGINEERING
UNIVERSITY OF WISCONSIN-MADISON
Department of Engineering Professional Development
432 North Lake Street Madison, Wisconsin 53706

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COLLEGE OF ENGINEERING ■ DEPARTMENT OF ENGINEERING PROFESSIONAL DEVELOPMENT

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Save time and money!
Inquire about our on-site courses.
Call 800-462-0876 today!

Course Focus

This course explains the theory and practice of culvert design and the design of open channels, both natural and constructed. It covers the hydraulics of streams, channels and ditches, as well as the practical considerations involved in calculating a water surface profile and designing for aquatic habitat and hydraulic jumps.

What You Will Learn

This course will teach you

- How to increase culvert capacity without taking a roadway out of service
- How to estimate allowable depth on the upstream side
- When to use drop inlets, round inlets or tapered inlets
- What you can do to reduce the rate of runoff
- What the best design choices are for different conditions

Revised Course

This course has been completely revised to include more details on the variables involved in the design of open channels and culverts. It also has new examples to broaden your understanding of what is possible in the design of hydraulic structures. Design manuals are included as part of the course notes.

Key Course Topics

- Channel slopes and shapes
- Allowable velocities
- Street and highway channels and ditches
- Water surface profiles
- Environmental considerations
- Estimating drainage area and time of concentration

Who Should Attend

This course will benefit anyone involved with the design (or design review) of storm drainage facilities, streets, highways and storm water detention systems. You don't need to be an engineer, but you should have a basic understanding of math and engineering concepts.

Hands-on Design Exercises

You will participate in several design exercises in which you will be generating numbers by hand calculation. **Please be sure to bring a calculator and a straightedge.**

Enrollment is Limited

To maximize your ability to interact with Dr. Rossmiller and to facilitate group discussion, we will limit course enrollment. Please enroll early to ensure your place!

Expert Instructor

Dr. Ronald L. Rossmiller recently retired as national program director for storm water management, HDR Engineering Inc., Bellevue, Washington. He has had extensive experience in state and local government, academia, and consulting. For 10 years he was a planner and designer of flood control systems for the Los Angeles County Flood Control District. He served for five years in the Iowa Department of Transportation, working on the hydrologic and hydraulic design of bridges and culverts. In 1972 he joined the Department of Civil Engineering at Iowa State University, where his responsibilities included teaching, research, and extension activities. From 1986 to 1990 he worked with the consulting firm of Wright Water Engineers, Inc., in Denver, Colorado. Dr. Rossmiller is a member of the American Society of Civil Engineers and the American Public Works Association. Since 1967 he has been active as a consultant in the general field of water resources engineering. He was involved with writing portions of the American Public Works Association's manual, *Urban Stormwater Management Facilities*. He participated in the effort to publish the 1992 ASCE manual and report on engineering practices, No. 77, *Design and Construction of Urban Stormwater Management Systems*. Dr. Rossmiller recently received an award from the University of Wisconsin–Madison College of Engineering for his many outstanding contributions to continuing engineering education.

Design With Confidence

This course will enable you to properly size your open channels and accurately predict their depths of flow (water surfaces). You will learn how to select the proper values and use the proper equations for effective drainage system design. You will be able to estimate peak flow rates and time of concentration. Poor estimates of these values can cause the flow rate to vary by hundreds of percent. There are literally dozens of different ways to estimate time of concentration (TOC), which can lead to answers an order of magnitude apart. You will leave *Designing Efficient Culverts and Open Channels* with a solid understanding of drainage design, along with an increased confidence in the results of your design calculations.

Earn Continuing Education Credits

By participating in this course, you will earn 21 Professional Development Hours (PDH) or 2.1 Continuing Education Units (CEU).

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Course Outline

Monday

7:30 Registration and Continental Breakfast (provided)

March 12–14 in Las Vegas, NV:

Riviera Hotel & Casino

2901 Las Vegas Boulevard South

March 26–28 in Madison, WI:

The Pyle Center

702 Langdon Street

8:00 Welcome and Introduction

Howard Rosen

Program Director

University of Wisconsin–Madison

8:10 Types of Open Channels

- Natural
- Constructed

Parameters

Allowable Velocities and Freeboards

- Without linings
- With linings

Water Quantity Considerations

- Design recurrence interval
- Maintenance

Water Quality Considerations

- Shading
- Riffles and pools
- Lining

Channel Considerations

- Slopes—flat and steep
- Street and highway channels and ditches
- Effect of lack of maintenance

Design Example

- Grass-lined channel (Manning's "n")

12:00 Lunch (provided)

1:00 Calculating Water Surface Profiles

- Types of flow and profiles
- Bernoulli's equation
- Specific energy
- Critical and normal depths
- Froude number
- Hydraulic jump

2:00 Break

2:15 Manning's Equation

- Friction and minor losses
- Weir and orifice equations

3:00 Design Examples

- Specific energy curve
- Critical depth and normal depth

4:00 Calculating Major and Minor Losses

- Manning's equation
- Junctions and transitions
- Friction and minor losses

5:00 Adjournment

Tuesday

8:00 Calculating Water Surface Profiles (continued)

- Characterize flow type
- Separate reach into segments
- Determine critical and normal depths
- Determine locations of controls
- Develop water surface profile
- Determine location and length of any hydraulic jumps

9:30 Break

9:45 Design Examples (continued)

- Calculation of a water surface profile
- Calculation of the location and length of a hydraulic jump
- Calculation of a drop in a channel

Hydraulic References

12:00 Lunch (provided)

1:00 Culvert Types and Definitions

Design Steps

- Allowable headwater (AHW)
- Design discharge
- Hydraulic design
- Selection of material
- Effect of a greater-than-design storm

Location

- Plan
- Profile

2:30 Break

2:45 Hydrologic Methods

- Rational formula
- Potter formula
- Regional equations
- NRCS method

Hydraulic Design

- Inlet control
- Outlet control

Energy Dissipation

Controlling High Velocities at Culvert Outlets: A Must

Flexible Pipe Failures

Tying Down Inlets to Corrugated Steel Pipes (CSP) to Prevent Flotation Failures

5:00 Adjournment

Wednesday

8:00 Hydraulic Design (continued)

- Designing for different culvert placements
- Utilization of available upstream storage and example

Designing Tapered Inlets

Design Examples

- Tapered inlet design
- Adding a tapered inlet to an existing culvert
- Determining allowable headwater depth

Design Discharge

- Watershed delineation and example
- Subarea delineation and example
- Time of concentration
 - sheet flow
 - shallow concentrated flow
 - channel flow

Appendix Material

5:00 Final Adjournment

Please Note: Your course fee includes continental breakfast, midmorning and midafternoon breaks and lunch each day.

Four Easy Ways to Enroll

General Information

Fee Covers Notebook, course materials, break refreshments, lunches, and certificate.

Cancellation If you cannot attend, please notify us no later than 7 days prior to the start of the course, and we will refund your fee. Cancellations received after that date and no-shows are subject to a \$150 administrative fee. You may enroll a substitute at any time before the course starts.

Locations/Accommodations

Las Vegas Offering, March 12–14, 2007

The course will be held at the Riviera Hotel & Casino, 2901 Las Vegas Boulevard South. We have reserved a block of sleeping rooms (\$119/single, \$119/double plus energy surcharge not to exceed \$3.85 per night) for course participants at the Riviera Hotel & Casino, the course site. A deposit equal to the room rate for one night is charged at time of booking. This deposit is refundable if the reservation is canceled 48 hours prior to scheduled arrival. Room block rates are not available for Friday or Saturday night stays. To reserve a room, call 800-634-6753 or 702-794-9412 and indicate that you will be attending this course under group code UWMA-MA7. Room requests made later than February 23 will be subject to availability.

Madison Offering, March 26–28, 2007

The course will be held at The Pyle Center, 702 Langdon Street. We have reserved a block of sleeping rooms (\$79/single, \$89/double, including parking and continental breakfast) for course participants at the Lowell Center, 610 Langdon Street in Madison. To reserve a room, call 866-301-1753 or 608-256-2621 and indicate that you will be attending this course under group code H823. Room requests made later than February 28 will be subject to availability. We have reserved a second block of sleeping rooms (\$104/single, \$119/double, including parking and airport shuttle) for course participants at the Campus Inn, 601 Langdon Street in Madison. To reserve a room, call 800-589-6285 or 608-257-4391 and indicate that you will be attending this course under group code 53732. Room requests made later than March 4 will be subject to availability. Your enrollment confirmation will include other hotel/motel information.

Other Storm Water Courses

For details on our other storm water courses, check our Web site at <http://epd.engr.wisc.edu/catalogs/civil.lasso>

On-site Courses Save Time & Money

Engineering Professional Development can offer many of our courses:

- At a location of your choice in North America
- At your convenience
- At reduced per-person cost
- Tailored to your needs

To inquire about courses that we can bring to your site, including optimal group size and costs, call 800-462-0876 and ask for Corporate Education Director Carl Vieth (608-263-7424 direct). Or see <http://epd.engr.wisc.edu/onsite>

Contact Us

Call toll free **800-462-0876** and ask for

Program Director: Howard Rosen

Program Associate: Sandra Selvin-Semin

Or e-mail custserv@epd.engr.wisc.edu



Phone:
800-462-0876 or
608-262-1299 (TDD 265-2370)



Internet:
<http://epd.engr.wisc.edu/>

Mail to:

Engineering Registration, The Pyle Center
702 Langdon Street, Dept. 108
Madison, Wisconsin 53706



Fax:

800-442-4214 or 608-265-3448



Course Information

Please enroll me in **Designing Efficient Culverts and Open Channels**

- Course #H889** March 12–14, 2007 in Las Vegas, Nevada Fee: \$995
- Course #H823** March 26–28, 2007 in Madison, Wisconsin Fee: \$895
- I cannot attend at this time. Please send me brochures on future courses.

Personal Information (Please print clearly.)

Name _____

Title _____

Company _____

Address _____

City/State/Zip _____

Phone (____) _____ Fax (____) _____

E-mail _____

Additional Enrollees

Name _____

Title _____

E-mail _____

Name _____

Title _____

E-mail _____

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