Treatment Plant Hydraulics for Civil Engineers

- ✓ **Know the fundamental principles of pressure pipe and open channel flow hydraulics**
- ✓ **Learn how to calculate head losses in pipes and open channels**
- ✓ **Learn how to integrate hydraulic design of treatment plants into overall plant layout and design**
- ✓ **Learn the hydraulic design basics of common unit processes of water and wastewater treatment**
- ✓ **Learn how to develop and plot a plant hydraulic grade line**
- ✓ **Learn how to select and use hydraulic control**
- ✓ **points in plant design**
- ✓ **Learn how to marry theoretical hydraulics with practical plant layout and operations**

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Purpose and Background:

This seminar presents the basics of pressure pipe and open channel flow hydraulics as applied in the design and operation of water and wastewater treatment plants. Calculators will be used in design examples.

Topics covered include: basics of pipe and open channel flow, hydraulic head losses, pipe and channel layout and design, flowmeter selection, flow control and flow distribution, design of hydraulic elements, and design of water and wastewater treatment plant unit processes. Topics not included are pumps and pump station design (offered separately by ASCE).

This seminar will provide engineers with the hydraulic engineering design tools needed to successfully layout and design the flow elements of both water and wastewater treatment plants. Numerous design examples are incorporated in the seminar material- both theoretical examples and practical design solutions from existing treatment plants.

Who Should Attend?

–Civil engineers and design engineers

–Consulting engineers and project managers

–Plant superintendents and operators

–Utility and Authority managers and planners

–Approval agency plan reviewers

–Design/Build contractors and construction managers

–Plant and process oriented contractors

–Site development engineers

–Engineers preparing to take the PE exam

- To register your group of 12 or more, call John Wyrick at 703.295.6184

Learning Outcomes

–Apply open channel flow methods
–Apply pressure flow methods
–Know how to balance plant flows
–Calculate friction headlosses
–Know methods to control plant flows
–Understand use of critical flow concepts
–Know how to design weirs
–Know how to prepare and interpret a hydraulic grade line
–Know process calculations for unit processes

Assessment Procedures

Students' achievement of the learning outcomes will be assessed through a series of interpretation, class exercises, class discussion, and calculations.

Seminar Instructor:

DAVID HANNA, P.E.,M.ASCE, i*s a graduate of the United States Merchant Marine Academy with a B.S. degree in Marine Engineering and Rensselaer Polytechnic Institute with an M.S. degree in Environmental Engineering.* Mr. Hanna is an Associate Professor at Ferris State University with faculty responsibilities in both the construction management and surveying engineering programs. Mr. Hanna has worked for several consulting engineering and construction management firms before joining the faculty at Ferris State in 1991. Mr. Hanna is a licensed professional engineer in Ohio and the recipient of university and national teaching awards. He has designed both water and wastewater treatment plants and numerous plant processes and facilities ranging in size from 0.2 to 120 million gallons per day. His experience includes planning, conceptual and preliminary design, final design, production of plans and specifications, construction administration, construction installation and quality control, plant startup and troubleshooting, and evaluation of facilities for hydraulic expansion and process upgrade. Mr. Hanna has served as an Instructor on hydraulics, pumping systems, and treatment processes to the New York State Department of Environmental Conservation and the New York State Department of Health with operator training and certification programs. He has also presented in-house training to a number of consulting engineering firms and County/Regional Agencies and Authorities. Mr. Hanna is a member of ASCE, the American Society of Plumbing Engineers (ASPE), and the American Society of Mechanical Engineers (ASME).

Summary Outline:

Hydraulic Design Criteria
Importance of hydraulic design
Plant layout
Process diagrams
Hydraulic grade lines
Plant piping
Yard piping
Plant Hydraulic Design
Design philosophy
Hydraulic design
Basis of design
Plant siting
Plant layout
Flow diagrams
Hydraulic profiles
Open Channel Hydraulics
Types of open channel flows
Geometry factors
Energy factors
Specific energy
Froude and Reynolds numbers
Critical flow
Uniform flow
Non-Uniform flow
Rapidly varying flow
Hydraulic jumps
Closed Conduit Flow
Hydraulic principles
Friction head loss
Bernoulli and General Energy equations
Laminar and turbulent flow
Pipe friction losses
Minor losses
Series piping headlosses
Parallel piping headlosses
Flow Control and Distribution
Gates
Valves
Weirs
Distribution Boxes
Hydraulic Control Points
Parshall flumes
Manifolds
Weirs
Fundamental hydraulics
Sharp crested weirs
Broad crested weirs
Triangular section weirs
Trapezoidal section weirs
Selection and use of weirs
Orifices,Gates and Tubes
Orifices
Discharge of falling head
Gates
Tubes
Nozzles
Flow Measurement
Hydraulic principles
Basics of flow measurement
Accuracy of flow measurement
Selection of primary elements
Selection of secondary elements
Application of flumes
Field measurements
Wastewater Treatment Plant Process Hydraulics
Screening
Grit removal
Sedimentation
Aeration
Contact tanks
Cascade aerators
Outfalls
Water Treatment Plant Process Hydraulics
Mixing
Flocculation
Sedimentation
Filtration
Wastewater Treatment Plant Design Example

Water Treatment Plant Design Example

References and texts

All of ASCE's seminars are available for on-site presentation. Bringing a program in house for groups of 12 or more people can reduce your per person costs by more than 25%.

For details regarding on-site training and/or needs-based training opportunities only, please contact:

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Pumping Systems Design for Civil Engineers

- ✓ Determine which engineering relationships apply to specific pumping situations
- ✓ Know the impact of pump machine construction on hydraulic performance
- ✓ Learn how to marry theoretical hydraulics with practical pump station and system design
- ✓ Learn the latest approaches in wet well design including the new Hydraulic Institute/ANSI Design Standards
- ✓ Learn how to design correctly for viscous sludges without using inaccurate “rules of thumb”
- ✓ Share positive experiences with other designers and engineers

Purpose and Background:

This seminar presents the basics of pumping systems design and specifications for civil engineers. An emphasis is placed on the application of pumping systems in municipal water and wastewater systems.

Topics covered include: pump and system hydraulics; centrifugal pump selection; interpretation of manufacturer’s pump head-capacity curves; types of pumping stations; series and parallel operation; variable speed systems; friction losses in sludge pumping; wet well design; specifying of pumps; shop drawing review considerations; and some common pump operating problems.

This seminar will provide the hydraulic engineering design needed for successful pump station projects and for providing pumping systems with the necessary hydraulic flexibility required on water and wastewater treatment plants.

Who Should Attend?

- – Civil engineers and design engineers
- – Consulting engineers and project managers
- – Specification writers
- – Construction and mechanical contractors
- – Plant superintendents and operators
- – Approval agency plan reviewers

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Learning Outcomes

- Learn how to design and specify successful pumping systems
- Know the major classifications of pumps and how that classification affects hydraulic operating conditions and design issues
- Review the basics of hydraulics and pressure factors as related to pump system design
- Understand flow regimes and which engineering relationships do and do not apply in each regime
- Understand and calculate actual net positive suction head on a pump
- Understand and calculate all system head losses in a pumping system
- Develop a hydraulic grade line
- Understand pump impellers and how different types are hydraulically applied
- Understand and interpret manufacturer's pump head-capacity curves
- Understand and apply the pump affinity laws
- Review the comparative features of different types of pump stations
- Review and discuss suggested approaches to specifying pumps
- Review and discuss design review items during shop drawing review
- Learn why traditional hydraulic design methods do not work with non-newtonian fluids and sludges
- Review associated station design elements
- Discuss design blunders and how to avoid future errors

Assessment of Learning Outcomes

Throughout the seminar, class exercises, group discussion, calculation and interpretation of materials taught will help assess students' achievement.

Seminar Instructor:

DAVID J. HANNA, P.E.,M.ASCE *is a graduate of Rensselaer Polytechnic Institute with a M.S.degree in environmental engineering, and a B.S. degree in marine engineering/ mechanical from the United States Merchant Marine Academy.* Mr. Hanna is an Associate Professor at Ferris State University with faculty responsibilities in the construction management and surveying engineering programs. Mr. Hanna worked for several consulting engineering and construction management firms for eighteen years before joining the faculty at Ferris State University in 1991.Mr.Hanna is a licensed professional engineer in Michigan and Ohio. He has designed numerous pumping stations and pumping systems associated with water and wastewater projects. Sizes of the facilities range from 80 gallons per minute to 30 million gallons per day. His experience includes design, construction administration, construction installation and quality control, and startup of new facilities as well as evaluation and troubleshooting of existing pumping and treatment facilities. Mr. Hanna has served as an Instructor on hydraulics, pumping systems and treatment processes to the New York State Department of Environmental Conservation and the New York State Department of Health with operator training and certification programs. He is a technical reviewer of pumping standards for the Hydraulic Institute and a member of ASCE.

Summary Outline:

Pump Types and Classification
- Classification of Pumps
- Types of Centrifugal Pumps
- Types of Rotary Pumps
- Types of Positive Displacement Pumps

Basic Hydraulics
- Liquid Characteristics
- Fluid Properties
- Pressure Relationships
- Fluid Statics
- Pumping Terms
- Energy Losses in Pumping Systems (Design Example # 1)

System Hydraulics
- Flow Regimes
- Pipeline Friction Losses (Design Example # 2)
- Minor Losses
- System Head Curves (Design Example # 3)
- Fluid Rheology

Pump Selection
- Impeller Classification
- Specific Speed
- Centrifugal Pump Performance
- Pump Operating Conditions & Duty Points (Design Example # 4)
- Manufacturers Pump Curves

Systems Operations
- Affinity Laws of Centrifugal Pumps
- Pumping Application Considerations
- Sump Design Issues
- Net Positive Suction Head (Design Example # 5)
- Variable Speed Pumping

Types of Stations
- Wastewater Pumping Stations
- Water Pumping Stations

Shop Drawing Review
- Pump Performance
- Materials
- Contract Coordination

Wastewater Pumps
- Types of Wastewater Pumps
- Selection & Comparison of Wastewater Pumps

Water Pumps
- Types of Water Pumps
- Selection & Comparison of Water Pumps

Sludge Pumping
- Sludge Design Characteristics
- Friction Headlosses (Design Example # 6)
- Sludge Design Concepts
- Design Guidelines
- Comparison of Sludge Pumps

Station Design
- Design for Expansion
- Increasing Existing Station Capacity
- Designing for Operations
- Designing for Safety
- Design Problems
- Mechanical and Maintenance Design

Avoiding Design Blunders
- General
- Site
- Environmental
- Hydraulics
- Pumps
- Valves
- Mechanical
- Electrical
- Structural/Architectural
- Specifications
- Economics

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