Two practical courses in transmission line design for design engineers and technicians...

Computerized Transmission Line Design: PLS-CADD Hands-On Training

A specialized course focusing on computer-aided design

January 10–14, 2005
Las Vegas, Nevada

Design of Transmission Line Structures and Foundations

A comprehensive study of transmission design principles

January 24–28, 2005
Las Vegas, Nevada

Printed on recycled paper.

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

THE UNIVERSITY of WISCONSIN MADISON

COLLEGE OF ENGINEERING ■ DEPARTMENT OF ENGINEERING PROFESSIONAL DEVELOPMENT

Two complementary courses in transmission line design for design engineers and technicians

Computerized Transmission Line Design: PLS-CADD Hands-On Training

- **Learn how to use modern integrated software to expedite your design and upgrade projects**
- **Practice using transmission line design software at your own computer**

January 10–14, 2005 in Las Vegas, Nevada

Design of Transmission Line Structures and Foundations

- **Gain a solid understanding of transmission line design and behavior**
- **Learn how to design new transmission lines and upgrade existing ones**

January 24–28, 2005 in Las Vegas, Nevada

CONTINUING EDUCATION UNITS 3.4 CEU

Computerized Transmission Line Design: PLS-CADD Hands-On Training

A specialized course focusing on computer-aided design

January 10–14, 2005 in Las Vegas, Nevada

Design of Transmission Line Structures and Foundations

A comprehensive study of transmission design principles

January 24–28, 2005 in Las Vegas, Nevada

Two important courses for transmission line design engineers, structural engineers, consulting engineers, design and drafting technicians, and others needing a thorough understanding of the engineering principles of transmission line design and behavior

Course Summaries

Computerized Transmission Line Design: PLS-CADD Hands-On Training

The purpose of this course is to teach you how to use the PLS-CADD computer program. This computer lab course includes background theory and hands-on computer modeling. Lectures will present the basic concepts, and computer exercises will illustrate them. Numerous case studies will provide a range of real-life examples.

Course topics include:

- Software system overview and terrain modeling
- Conductor design and modeling
- Structures modeling by allowable spans
- Interactive line design and generation of construction documents
- Modeling existing lines, assessment, and refurbishment
- Steel latticed tower analysis and design

This course will provide you with the training you need to be more proficient with the computer software that will make you more effective on your job.

Design of Transmission Line Structures and Foundations

This in-depth course will provide you with the latest criteria and practical techniques used in the design of transmission line structures and foundations. Your instructors first will explain transmission design concepts and then illustrate them with design examples using traditional design methods and modern computer software. This course does not include training in how to use the PLS-CADD computer program.

Course topics include:

- Single and multiple pole structures
- Latticed steel towers
- Conductor design and behavior
- Line assessment and upgrading concepts
- Strength analysis for joint use
- Foundation design

This up-to-date course applies to the design of new transmission lines and the upgrade of existing ones.

Expert Instructors

The instructors for these courses are recognized experts in their fields. They are experienced design engineers with many years of practical experience in transmission line and foundation design.

Alain Peyrot
Principal Instructor

Dr. Alain Peyrot, professor emeritus of civil engineering at the University of Wisconsin–Madison, is a primary instructor and course coordinator for both of these courses. Dr. Peyrot is recognized throughout the industry as an expert in transmission line design and is the developer of the widely used transmission line design software program, PLS-CADD. You will benefit from Dr. Peyrot's expert teaching abilities and his lifelong experience in transmission line design.

Real-Life Examples

The concepts presented in these courses will be reinforced with case studies from the actual work history of your experienced instructors. These practical applications of engineering design techniques will assist your learning and show you how to apply the knowledge you gain in these courses to real-life problems you face on the job.

Enroll online today! epdweb.engr.wisc.edu/webG650

Computerized Transmission Line Design: PLS-CADD Hands-On Training

January 10–14, 2005 in Las Vegas, Nevada

Benefit from Modern Computer Technology

Advanced software aids transmission design process

Advanced computer programs are available to aid the transmission design engineer in the structural and geometric design of electric power lines. Computer software also makes it possible to more easily produce related construction documents such as plan-and-profile drawings and material lists.

Software not always used to full potential

While computer tools are available to greatly increase the design engineer's productivity and work quality, they are often not used to their full potential. One reason is a lack of training or understanding of modern survey techniques, proper design criteria, line behavior, structural analysis, and drafting. A second reason is an ineffective integration of these new design tools.

Learn how to use integrated software

At this course you will have hands-on training on how to use advanced transmission design software that has integrated the various surveying, engineering, drafting, and material management functions. Your training will help you become proficient at using this advanced software and help you be more productive when using it in your work.

Get the Training You Need To Be More Effective on Your Job

The purpose of this course is to teach design engineers and technicians how to use the PLS-CADD computer program. Case studies will provide real-life examples. This course will provide you with the training you need to more effectively use PLS-CADD software on your job.

Computer Exercises and How You Will Learn

This course includes a mix of background theory and hands-on computer modeling. Your instructor will first explain a basic transmission design concept and then demonstrate how to implement that design principle using the PLS-CADD software. Students will then execute the same design principles on their own computers. Numerous case studies will provide a range of real-life examples. The emphasis in this course is to teach students how to run the PLS-CADD software.

Special Features of This Course

- Background theory and computer exercises
- Review of basic line design concepts
- Modern integrated software
- Case studies

Hands-On Training...Limited Enrollment

Because this course features intensive hands-on computer training, we limit enrollment to 20 students. Enroll early to ensure your place in the class.

Who Should Attend

This course is intended for transmission engineers, technicians, and managers who are using or planning to use computerized line design tools. This includes:

- Transmission line design engineers
- Structural engineers
- Consulting engineers
- Design and drafting technicians
- CAD technicians
- Surveyors

Computer Software Used in This Course

The computerized design tool capabilities presented in this course will be illustrated through design examples using the programs PLS-CADD, PLS-POLE and TOWER, developed by Power Line Systems, Inc. These programs and classroom example files will be installed on each classroom computer for students to use during class.

Bring Your Own Laptop Computer

We ask that students bring their own laptop computer for this course. This allows current PLS-CADD users to immediately apply their learning to actual PLS-CADD projects they already have loaded on their computer. Contact Program Director John Raksany (raksany@epd.engr.wisc.edu; 800-462-0876) if you have questions or are not able to supply your own laptop computer.

Enroll online today! epdweb.engr.wisc.edu/webG650

Computer Hardware Requirements

If you are already a PLS-CADD user, please bring a laptop on which you have previously run the PLS-CADD software. Your laptop must have Microsoft Windows 95, 98, ME, NT4, 2000, or XP installed. It must also have an 800 MHz or faster processor, a minimum of 256 MB of RAM, 200 MB of available disk space, and an available parallel port for hardware key connection. A two-button mouse is also recommended.

Course Instructor

Otto J. Lynch PE, vice president of Power Line Systems, Inc., Madison, Wisconsin, is responsible for the technical sales and development of overhead line software. He is an expert in the PLS-CADD computer program and has conducted numerous seminars and training sessions in its use and applications. Prior to joining Power Line Systems in 2000, Mr. Lynch worked for more than 12 years with Black & Veatch, doing civil/structural design for substations and transmission lines. He has designed several families of lattice steel transmission towers and has worked worldwide on transmission projects ranging from 69kV to 500kV utilizing wood, tapered tubular steel, lattice steel, concrete, and laminated wood structures. A pioneer in integrating LiDAR aerial survey data into the PLS-CADD program for transmission line rerating and reconductoring projects, Mr. Lynch is an expert in the PLS-CADD, SAGSEC, PLS-POLE, and TOWER computer programs used throughout the course.

Course Outline

Monday

7:30 Registration
The Tropicana Hotel
3801 Las Vegas Boulevard South
Las Vegas, Nevada

8:00 Welcome
John A. Raksany PE
Program Director
University of Wisconsin–Madison

8:15 Instruction Begins
Otto J. Lynch PE

1. Overview and Terrain Modeling
- PLS-CADD system overview
- Presentation of projects
- How to organize project files
- View commands, opening of windows, viewing of phases and sags
- Needed terrain data and surveying techniques
- Prepare a terrain model
  - generate and edit feature codes data
  - import/generate and edit terrain files: XYZ or PFL models
  - digitize existing drawings

5:00 Adjournment

Tuesday

8:00 Instruction Continues

2. Conductor Design and Modeling
- Various conductor types
- Conductor properties: advantages and disadvantages
- Permanent deformation from overloading and creep
- Effects of high temperature on creep and strength reduction
- Conductor models in PLS-CADD
  - stress-strain charts
  - where to get conductor data
- Aeolian vibrations: how to limit
- Temperature vs. ampacity
- Line thermal rating

3. Design Criteria
- Weather data
- Wind and ice loads: gust response factors, etc.
- Conductor limits of use
- Conditions for automatic sagging
- Structure loads and safety factors
- Conditions for checking clearances
- PLS-CADD/LITE: simplified PLS-CADD module
  - quick sag/tension calculations
  - various sagging methods
  - create load files for TOWER and PLS-POLE

5:00 Adjournment

Wednesday

8:00 Instruction Continues

4. Structures Modeling by Allowable Spans
- Available structure models
  - allowable spans method
  - full analysis method
- Material lists, parts lists
- Create and edit allowable span structures

5. Interactive Line Design
- Spot structures interactively
- String and sag conductors: demonstrate four sagging methods
- Check clearances: vertical, between phases, galloping, etc.
- Check overall design efficiency

6. Generate Construction Documents
- Plan-and-profile sheets, staking lists, stringing charts, offset clipping, etc.

5:00 Adjournment

Thursday

8:00 Instruction Continues

7. Modeling of Poles and Frames by Analysis
- Overview of structure programs; PLS-POLE
- Create and edit wood, steel and concrete poles/frames
- Determining allowable spans of existing structure designs

8. Modeling Existing Lines, Assessment and Refurbishing
- Modeling existing lines and structures
- Assessment, reconductoring, refurbishing, etc.
- Joint use issues and modeling
- Links to SAPS and SAGSEC
  - limits of validity of ruling span concept
  - unbalanced ice, RSL after broken conductor, marker balls, structure deflection, etc.

5:00 Adjournment

Friday

8:00 Instruction Continues

9. Automatic Optimum Spotting
- Theory and examples

10. Steel Latticed Tower Analysis and Design
- Modeling towers in TOWER
- Joints, members, connections, tower wind load, conductor loads, etc.
- Checking and modifying older designs

3:00 Final Adjournment

Design of Transmission Line Structures and Foundations

January 24–28, 2005 in Las Vegas, Nevada

Learn How to Design New Transmission Facilities and Upgrade Existing Ones

A comprehensive design guide

At this technical course you will learn the latest criteria and practical techniques for the design of transmission line structures and their foundations. You will study various types of supporting structures, including wood, concrete, and tubular and latticed steel. You will also learn about conductor design and behavior under various operating temperatures and weather conditions. You will examine concepts for assessing and upgrading the capability of existing transmission lines. This course does not include training in how to use the PLS-CADD computer program.

Transmission capacity in short supply

Deregulation has changed the way the electric grid is being used. Power transfers have increased transmission flows and taxed the capacity of existing lines. In addition, loads have grown substantially over the last decade while few new transmission lines were built. These factors have produced a shortage of transmission capacity in many areas of the United States.

More capacity needed

New transmission lines will need to be built to meet the requirements of growing loads and operation under deregulation. Where right-of-way is at a premium and new lines cannot be built, existing lines will need to be upgraded to meet growing needs.

Learn transmission design principles

Construction of new lines and upgrading of existing ones will require comprehensive knowledge of transmission line conductors, structures, and foundations. This course will give you the knowledge you need to effectively design new lines and modify existing ones to meet the future needs of the electric transmission system.

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, or to request an on-site course, call 800-462-0876. Or check our Web site at http://epdweb.engr.wisc.edu/onsite

Key Course Topics

- Design criteria and loads
- Wind, ice, and broken conductor loads
- Basic sag and slack equations
- Survey data and clearance requirements
- Spotting transmission structures
- Conductor design and behavior
- Assessing existing capability
- Structural analysis for upgrading/reconductoring
- Strength analysis for joint use
- Foundations for single poles, frames, and towers

You'll Learn How To

- Analyze single and multiple pole structures
- Apply basic buckling equations to wood pole designs
- Model and analyze steel latticed towers
- Check structure strengths and line clearances
- Apply NESC overload factors

Benefit from Case Studies

Your instructors, experienced design engineers, will use case studies and design examples to illustrate (1) actual applications of the concepts discussed in this course and (2) the real-world design issues you may face in the field.

Who Should Attend

This course will benefit those people involved in the design and construction of transmission line structures and their foundations. This includes:

- Transmission line design engineers
- Structural engineers
- Consulting engineers
- Design and drafting technicians
- CAD technicians
- Surveyors

Experienced individuals and those recently assigned to transmission line projects will benefit from this course.

Computer Software Included with Course

The transmission design concepts presented in this course will be illustrated through design examples using the line design program PLS-CADD, developed by Power Line Systems, Inc. You will receive a CD and instructions for a free two-year license to use a subset of that program (PLS-CADD/LITE) that calculates sags, tensions, loading trees, and thermal rating of overhead conductors.

Course Instructors

Dr. Anthony M. DiGioia Jr. is president of DiGioia & Associates LLC and former president and chairman of GAI Consultants. Dr. DiGioia manages major projects in various areas of civil engineering, including soil mechanics, foundation engineering, and probabilistic analysis and design of transmission line structures and foundations. As an assistant professor of civil engineering at Carnegie Mellon University, he taught courses on various subjects, including soil mechanics, foundation engineering, and bridge foundation design. He is currently an adjunct professor in the Civil & Environmental Engineering Department of CMU and is a member of ASCE, SAME, ASTM, CIGRE and IEEE.

Dr. Alain H. Peyrot PE, president of Power Line Systems, Inc., Madison, Wisconsin, has a broad range of experience in structural engineering and design. As a professor of civil engineering at the University of Wisconsin–Madison, he has taught courses on the design of steel, reinforced concrete and wood structures, finite elements and probabilistic methods, structural dynamics and optimization, wind and earthquake engineering, and design of transmission lines. Dr. Peyrot has worked as a consultant on many engineering and research problems, specializing in transmission line design and behavior. He is the author of more than 100 technical papers.

Past Attendees Say...

"Excellent mixture of theory and practical engineering. The information received will be directly applicable to projects at work."

"Good course providing clarification on very important design issues as well as reinforcing current practices."

Upcoming Related Courses in Las Vegas, Nevada

Fundamentals of Substation Equipment and Control Systems
March 16–18, 2005
Course #G653

Principles of Substation Design and Construction
March 21–23, 2005
Course #G654

To learn more about these courses, please contact us.

Web:
http://epdweb.engr.wisc.edu/catalogs/electrical.lasso

E-mail:
custserv@epd.engr.wisc.edu

Phone: 800-462-0876

Course outline on next page...

Design of Transmission Line Structures and Foundations

January 24–28, 2005 in Las Vegas, Nevada

Course Outline

Monday

7:30 *Registration*
The Tropicana Hotel
3801 Las Vegas Boulevard South
Las Vegas, Nevada

8:00 *Welcome*
John A. Raksany PE
Program Director
Department of Engineering Professional Development
University of Wisconsin–Madison

8:15 *Instruction Begins*
Dr. Alain H. Peyrot

1. ***Design Criteria and Loads***
   - Design philosophies
   - Codes and standards
   - Wind and ice loads
   - Longitudinal loads
   - Concepts of wind and weight spans
2. ***Behavior of Suspended Cables***
   - Basic sag and slack equations
   - Ruling span concept
   - Offset clipping
   - Interaction between structures and cables
3. ***Loading Tree***

4:30 *Adjournment*

Tuesday

8:00 *Instruction Continues*
Dr. Alain H. Peyrot

4. ***Conductor Design and Behavior***
   - Conductor types
   - Creep and permanent elongation
   - Sag-tension calculations
   - High-temperature effects
   - Current vs. temperature relationships
   - Vibration and galloping
5. ***Line Design Process***
   - Survey data
   - Clearance requirements
   - Structure spotting
   - Drawings and construction documents
6. ***Computer Analysis and Design Tools***
   - 3-dimensional line modeling
   - Examples

4:30 *Adjournment*

7:00 *Optional Evening Session*

Advanced Computer Analysis and Design Tools
- Design examples that illustrate modern computer design capabilities through use of the PLS-CADD software tool

9:00 *Adjournment*

Wednesday

8:00 *Instruction Continues*
Dr. Alain H. Peyrot

7. ***Design of Wood Poles***
   - Unguyed and guyed
8. ***Design of Tubular Steel Poles***
9. ***Design of Concrete Poles***
10. ***Design of Wood H-Frames***
11. ***Line Assessment and Upgrading Concepts***
    - Assessing existing capability
    - Elevated temperature operation
    - Re-tensioning/re-sagging
    - Pole joint use issues
    - Structural analysis for upgrading/reconductoring
12. ***Case Studies: Transmission Line Capacity Assessment and Up-Rating***
    Installing larger conductor on a 138 kV, double circuit steel latticed tower line

4:30 *Adjournment*

Thursday

8:00 *Instruction Continues*
Dr. Alain H. Peyrot

13. ***Design of Steel Latticed Towers***
    - Tower configurations
    - Modeling for analysis
    - Detailed design criteria
    - Examples

1:00 *Instruction Continues*
Dr. Anthony M. DiGioia

14. ***Foundations***
    - How to specify, analyze, and use soil investigations
    - Types of foundations
15. ***Foundations for Single Poles***
    - Analysis and design methods
    - Examples

4:30 *Adjournment*

Friday

8:00 *Instruction Continues*
Dr. Anthony M. DiGioia

16. ***Foundations for Frames and Towers***
    - Factors influencing type of foundations
    - Analysis and design methods
    - Examples
17. ***Guy Anchors***

3:00 *Final Adjournment*

Daily Schedule

The daily schedule for both courses will include morning and afternoon refreshment breaks and lunch at noon. The courses will be conducted in a smoke-free environment.

"Excellent overall course. I learned a lot. UW–Madison was an excellent host."

Enroll online today! epdweb.engr.wisc.edu/webG650

Four Easy Ways to Enroll

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

Internet:
http://epdweb.engr.wisc.edu/webG650

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

Fax:
800-442-4214 or 608-265-3448

Need to Know More?

Call toll free 800-462-0876 and ask for

Program Director:
John A. Raksany PE
raksany@engr.wisc.edu

Program Assistant:
Sherry Daly
daly@engr.wisc.edu

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

General Information

Fees

January 10–14 Course: Fee of $2095 covers course materials, break refreshments, lunches, and certificate.

January 24–28 Course: Fee of $1895 covers course materials, break refreshments, lunches, and certificate.

Cancellation

January 10–14 Course:
*This limited enrollment course requires fee payment at time of enrollment. If you cannot attend, please notify us by January 3, and we will refund your fee. Cancellations received after January 3 and no-shows will be charged the full course fee. You may enroll a substitute at any time before the course starts.

January 24–28 Course:
If you cannot attend, please notify us by January 17, and we will refund your fee. Cancellations received after January 17 and no-shows are subject to a $150 administrative fee. You may enroll a substitute at any time before the course starts.

Location

The Tropicana Hotel, 3801 Las Vegas Boulevard South, Las Vegas, Nevada. If you must be contacted during the course, phone messages may be left for you at 702-739-2222.

Accommodations

January 10–14 Course:
We have reserved a block of rooms for course participants at The Tropicana Hotel, 3801 Las Vegas Boulevard South, Las Vegas, Nevada. To reserve a room ($55 sgl/dbl), call 800-634-4000 by December 9 and mention the University of Wisconsin–Madison and this course.

January 24–28 Course:
We have reserved a block of rooms for course participants at The Tropicana Hotel, 3801 Las Vegas Boulevard South, Las Vegas, Nevada. To reserve a room ($65 sgl/dbl), call 800-634-4000 by December 27 and mention the University of Wisconsin–Madison and this course.

Course 1 Information

Please enroll me in

Enroll Early. Save $100!

❑ **Computerized Transmission Line Design: PLS-CADD Hands-On Training Course #G677**
January 10–14, 2005 in Las Vegas, NV (Enrollment limited to 20: fee payment required at time of enrollment; *see cancellation policy for this course)
Fee (by December 13): $1995
Fee (after December 13): $2095 **Save $100! Enroll by December 13.**

❑ MasterCard ❑ VISA ❑ American Express ❑ P.O. or check enclosed (Payable in U.S. funds to UW–Madison)

Cardholder's Name _____

Card No. _____ Expires _____

Course 2 Information

❑ **Design of Transmission Line Structures and Foundations Course #G650**
January 24–28, 2005 in Las Vegas, NV
Fee (by December 27): $1795
Fee (after December 27): $1895 **Save $100! Enroll by December 27.**

Enroll Early. Save $100!

❑ Bill my company ❑ P.O. or check enclosed (Payable in U.S. funds to UW–Madison)
❑ MasterCard ❑ VISA ❑ American Express

Cardholder's Name _____

Card No. _____ Expires _____

Personal Information (Please print clearly.)

Name _____

Title _____

Company _____

Address _____

City/State/Zip _____

Phone (_____) _____ Fax (_____) _____

E-mail _____

Additional Enrollee

Name _____

Title _____

E-mail _____

UW# ❑ ❑ ❑ **Important–please enter the 3-digit UW# Code from the mailing label.**

❑ Please check the box if you are a person with a disability and desire special accommodations. A customer service representative will contact you. Requests will be kept confidential.

Earn Continuing Education Credit

By participating in one of these courses, you will earn 3.4 Continuing Education Units (CEU).