

# NONDESTRUCTIVE EVALUATION (NDE) USERS SEMINAR COURSE OUTLINE



Olson Instruments, Inc.

- › **Structural and Pavement NDE Methods for QA & Condition Assessment**
- › **Quality Assurance and Forensic NDE Methods for Foundations**
- › **Seismic Geophysics for Engineering Applications**

Questions/discussion sessions and hands-on demonstrations will be conducted for each NDE method by members of the class with an instructor's guidance. We offer PDH hours for the seminar classes to meet Professional Engineering registration continuing education requirements. Call 303.423.1212 with questions regarding any training we offer.

## Day 1 | Day 2

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### **Structural NDE Methods for Concrete, Masonry & Wood**

### **Pavement NDE for Asphalt and Concrete Condition Assessment & Quality Assurance**

- › Overview of ASCE 11/99 Guideline for Structural Condition Assessment of Existing Buildings
- › Overview of new draft International Concrete Repair Evaluation Committee Document On "Nondestructive Evaluation (NDE) Methods for Condition Assessment, Repair and Performance Monitoring of Concrete Structures" for methods and NDE investigation plans
- › Overview of ACI 228.1R-03 In-Place Methods of Determination of Strength of Concrete
- › Overview of ACI 228.2R – Nondestructive Evaluation Methods for Concrete
- › Ultrasonic/Sonic Pulse Velocity for Quality and Integrity on Concrete with 2-Sided Access
  - Test Procedures and Equipment
  - Pulse Velocity Physics and ASTM C597
  - Materials and Case Histories
  - Strength correlations
- › Impact Echo for Thickness and Integrity on Concrete with 1-Sided Access
  - Test Procedures and Equipment
  - Impact Echo Physics and ASTM C1338
  - Thickness Q/A
  - Materials and Case Histories for Void, Honeycomb, Cracking
  - Impact Echo Scanning
- › Spectral Analysis of Surface Waves for Concrete with 1-Sided Access
  - Test Procedures and Equipment
  - SASW Physics and ACI 228.2R
  - SASW for Concrete Quality/Strength Correlation
  - Damage Evaluation of Cracking, Fire, Frost, Alkali-Silica Reaction

**Day 1 | Day 2...continued**

**Structural NDE Methods for Concrete, Masonry & Wood**

**Pavement NDE for Asphalt and Concrete Condition Assessment & Quality Assurance**



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- » Slab Impulse Response
  - Test Procedures and Equipment
  - Slab Impulse Response Physics and ACI 228.2R
  - Void, Honeycomb, Delamination Detection
  
- » Ultrasonic Tomography
  - Tomography algorithms
  - 2-D and 3-D Analyses
  
- » Galvanostatic Pulse, Concrete Resistance and Half-Cell Potential for Rebar Corrosion
  - Test Procedures and Equipment
  - Corrosion Measurement Physics
  - Case Histories
  
- » Ground Penetrating Radar
  - Test Procedures and Equipment
  - Structural Embedment Location
  - 2D and 3D data analyses
  - Bridge Deck Surveys for Delaminations
  - Void/Wet Subgrade Detection for Pavments and Slabs
  
- » Impact Echo for Rigid Pavement Thickness Determinations
  - Test Procedures and Equipment
  - Thickness QA and ASTM C1338
  - CALTRANS Study of Impact Echo for Thickness Determination of Concrete Pavements and Core Thickness Correlations
  
- » Slab Impulse Response for Void Detection below Rigid Pavements
  - Test Procedures and Equipment
  - Physics and ACI 228.2R
  - Subgrade Void vs. Questionable vs. Sound Support
  - Correlations with Ground Penetrating Radar for Void Detection
  
- » Multiple Impact Surface Waves (MISW) for Flexible and Rigid Pavements
  - Test Procedures and Equipment
  - MISW Physics
  - MISW Case Histories for Asphalt and Concrete Pavement System Layer
  - Thickness and Young's Modulus Determination
  
- » Resonance Testing of Cylinders, Beams and Cores for Freeze-Thaw
  - Durability and Elastic Moduli Determination
  - Test Procedures and Equipment per ASTM C215-08 for elastic moduli
  - Young's Moduli
  - Shear Moduli
  - ASTM C666/666M-03 (2008) applications for Freeze-Thaw Durability



- » Stress Wave Basics for Foundations
  - Compression Waves
  - Bending (Flexural) Waves
  - Surface Waves
- » Crosshole Sonic Logging for QA of Drilled Shaft Foundations, Auger Cast Piles and Diaphragm Walls
  - Test Procedures and Equipment
  - Review of ASTM D6760-08 and European Standard
  - CSL Ultrasonic Signal Analysis and anomaly/debonding considerations
  - Log Generation and Report Considerations
  - Velocity vs. Strength
  - Angled and Singlehole Sonic Logs
  - Research and Case History Results
  - When does an anomaly become a defect?
  - Comparisons with Gamma-Gamma Nuclear Density Logging
  - Destructive Coring/Drilling Considerations
  - General Repair Approaches
- » Crosshole Tomography for 2-D and 3-D Imaging of CSL Anomalies
  - Review of Tomography Algorithms
  - Data Collection Procedures in CSL tests for velocity tomography
  - Data Analysis of angled CSL data
  - Velocity Tomography Analyses
  - 2-D vs. 3-D Velocity Tomograms in Research and Case Histories
- » Sonic Echo/Impulse Response for Shaft/Pile Integrity and Length in QA and Forensic Studies
  - Test Procedures and Equipment
  - Review of ASTM D5882-07 and ACI 228.2R-98
  - Sonic Echo Physics
  - Impulse Response Physics
  - Research and Case History Results for Concrete, Wood and Steel Piles
  - Testing through Pilecaps and on Pile Sides
- » Ultraseismic for Abutment/Pier/Shaft/Pile Unknown Foundation Depths
  - Test Procedures and Equipment
  - Compressional vs. Flexural Wave Impacts and Responses
  - Analysis of Data
  - Research and Case History Results for Concrete, Wood and Steel Foundations
- » Spectral Analysis of Surface Waves for Wall-Shaped Pier and Abutment Unknown Foundation Depths
  - Shallow and Deep Foundation Depth Determinations Test Procedures and Equipment
  - Review of ACI 228.2R-98
  - Surface Wave Physics
  - Research and Case History Results for Concrete and Masonry Foundations



- » Parallel Seismic for Shallow and Deep Foundation Unknown Depth Determinations and Buried Piles below Pilecaps
  - Test Procedures and Equipment
  - Review of ACI 228.2R-98
  - Parallel Seismic Physics
  - Research and Case History Results for Concrete, Wood, Steel Piles, Masonry Piers/Abutments and Steel H-Pile and Sheet Pile Considerations
  - Combined Parallel Seismic and Cone Penetrometer testing
  - Unknown Foundation Depth Determinations for Bridge Scour Safety Studies
  
- » Induction Field for Steel Pile and Reinforced Concrete Pile/Shaft Unknown Depths
  - Test Procedures and Equipment
  - Review of NCHRP 21-5 and 21-5(2) Research on Unknown Bridge Foundation Depths
  - Induction Field Physics
  - Research and Case History Results for Steel Piles
  
- » Borehole Radar and Ground Penetrating Radar for Unknown Foundation Depths/Pile Locations
  - Test Procedures and Equipment
  - Review of ACI 228.2R-98
  - Research and Case History Results
  
- » Impact Echo for Thickness and Integrity of Piers, Abutments and Pilecaps with 1-Sided Access
  - Test Procedures and Equipment
  - Impact Echo Physics and ASTM C1338
  - Unknown Thickness Determinations

**Day 5**

**Seismic Geophysics for Engineering Applications**



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- » Stress Wave Basics for Engineering Geophysics
  - Compression Waves
  - Shear Waves
  - Surface Waves
  - Elastic Moduli
  
- » Crosshole Seismic
  - Test Procedures and Equipment
  - Review of ASTM D4428/4428M-07
  - Data Analysis and Elastic Property Calculations
  - Case Histories
  
- » Downhole Seismic
  - Test Procedures and Equipment
  - Data Analysis and Elastic Property Calculations
  - Case Histories
  
- » Spectral Analysis of Surface Waves
  - Test Procedures and Equipment
  - Data Analysis and Elastic Property Calculations
  - Case Histories and comparisons with Crosshole Seismic Results
  
- » Multiple Impact Surface Waves or Multi-Channel Analysis of Surface Waves
  - Test Procedures and Equipment
  - Data Analysis and Elastic Property Calculations
  - Case Histories and comparisons with Crosshole Seismic Results
  
- » Seismic Refraction
  - Test Procedures and Equipment
  - Data Analysis for Bedrock Depth Determination
  - Case Histories