

# Charles H. Dowding

## *Biographical Data*

### **EDUCATION**

- Ph.D. University of Illinois at Urbana 1971
- M.S. University of Illinois at Urbana 1968
- B.S. University of Colorado at Boulder 1967

### **ACADEMIC CAREER**

- Northwestern University
  - Professor of Civil Engineering 1986-
  - Associate Professor of Civil Engineering 1976-1986
- Massachusetts Institute of Technology
  - Assistant Professor of Civil Engineering 1972-1976
- Norwegian Geotechnical Institute
  - Royal Norwegian Post-Doctoral Fellow 1971-1972

### **PROFESSIONAL REGISTRATION**

Registered Professional Engineer, State of Colorado (14015)

### **MEMBERSHIP IN PROFESSIONAL SOCIETIES**

- American Society of Civil Engineers
- International Society for Soil Mechanics and Foundation Engineering
- International Society of Rock Mechanics
- International Society of Explosive Engineers

### **HONORARY SOCIETIES**

- Sigma Xi
- Tau Beta Pi
- Chi Epsilon

## HONORS AND AWARDS

- Distinguished Member of the American Society of Civil Engineers (2017)
- Civil Engineer of the Year (2014), Illinois Section, American Society of Civil Engineers,
- Kersten Lecturer (2013), Minnesota Geotechnical Society
- Bengt Broms Lecturer (2012), Scandinavian Geotechnical Societies
- Distinguished Service Award – International Society of Explosive Engineers (2011)
- Diplomat of Geotechnical Engineering (2009)
- Fellow, American Rock Mechanics Association (2008)
- Distinguished Alumnus, University of Illinois Department of Civil & Environmental Engineering (2006)
- Distinguished Lecturer, Sigma Xi (2003-2005)
- Distinguished Engineering Education Alumnus, University of Colorado (2003)
- CIC (Big Ten + 2) Academic Leadership Fellow (1992)
- Maxbamm Award – Hungarian Committee for Industrial Explosives Technique (1991)
- Visiting Exchange Scholar - P.R. China, National Research Council (1989)
- Outstanding Applied Research Award in Rock Mechanics from U.S. National Committee for Rock Mechanics (1981)
- Royal Norwegian Post-Doctoral Fellowship (1971-1972)
- NASA Trainee Fellow (1967-1970)
- Outstanding Civil Engineering Graduate, University of Colorado (1967)

## PRINCIPAL FIELDS OF RESEARCH INTEREST

Rock Mechanics	<i>(Blasting, Dynamic Response, Jointed Media)</i>
Soil Mechanics	<i>(Exploration Decisions, Foundation Engineering)</i>
Construction	<i>(Vibrations, Digital Data Acquisition &amp; Analysis)</i>

## PROFESSIONAL COMMITTEES AND ACTIVITIES

### INTERNATIONAL

- International Society for Rock Mechanics-Chairman, Committee on Ground Vibration Monitoring
- Editorial Board of Rock Mechanics and Rock Engineering, 1997-

### NATIONAL

- American Rock Mechanics Association
  - Board of Direction 1999 – 2005
- American Society of Civil Engineers
  - Geotechnical Institute
    - Technical Coordination Committee 1999-2004
    - Publications Committee 1986-90
    - Rock Mechanics Committee
      - Chairman 1984-91
      - Control Group Member 1981-1999

- International Society of Explosive Engineers
  - Board of Directors 2002-2008
- National Research Council
  - U.S. National Rock Mechanics Committee 1983-1988
  - Chairman, 25th U.S. Rock Mechanics Symposium 1982-84
  - Committee for Rock Mechanics Research Requirements
  - Co-chairman, Fracture Pattern Mapping, 1978-1981
- National Science Foundation
  - Proposal Reviewer & Visitation Committee
- Society of Mining Engineers
  - Reviewer for Journal

## **CHICAGO**

- American Society of Civil Engineers, Illinois Section
  - Director, Illinois Section, 1979-1980
  - Chairman, Geotechnical Division, 1979-1980
  - Executive Committee, Geotechnical Division, 1976-1982
- Village of Winnetka
  - Planning Commission 2011-2014
  - Environmental and Forestry Commission (2009-  
Chair: 2013-

## **MAJOR CONSULTING PROJECTS**

- Fortis BC Energy 2015-2016 (Blasting near Buried Natural Gas Pipelines)
- BNSF RR 2014 (Railroad induced building response)
- MWH 2012 (Rock Mechanics: Cleveland CSO Rock Tunnel)
- Panama Canal Authority 2011-12 (Mitigation of Blasting Effects)
- Metro North Railroad NY City 2008-14 (Blasting within Grand Central Station)
- Pipeline Research Council Inc. 2008 (Blast Strain Response of Welded Steel Pipelines)
- CH2MHill 2006-2010
  - Newcastle, CA (Pipeline Construction through Tunnel)
  - Southern Nevada Water Authority (Shaft Excavation adjacent to Pump Station)
- Vulcan Materials Co. 1999-00 (Blast Response of Rock Slope)
- Argonne Nat. Lab, IL, 1997-99 (Blast Response of High Energy Physics Instruments)
- IBM, White-Plains, NY 1998-99 (Impact of Micro-vibrations on Research Instruments)
- Fina Oil Co. 1996-98 (Vibrois Ground Motion)
- PBQ, Newark NJ 1996-97 (Blasting Considerations for Urban Rail Tunnel)
- Birmingham Water Board, 1996-97 (Change of Geologic Conditions)
- CIGNA Insurance Co., 1994 (Blast Damage of Adjacent Rock)
- Shell Pipeline Co., 1993 (Blast Vibration Response of Pipelines)
- Morton Thiokol, 1991-92 (Solid Propellant Explosion)
- Leviton Constr. Co., Dayton, OH, 1989-90 (Pile Driving Vibrations)
- Turner Constr. Co., New York City, 1988-89 (Urban Blast Vibration Monitoring)

- Northern Ill. Gas Co., 1987 (Pile Driving Near Gas Transmission Pipelines)
- Sargent and Lundy, Chicago, 1985-88 (Dynamic Slope Stability)
- U.S. Army Corps of Engineers, 1985 (Lock and Dam Safety)
- Petromine, NORWAY, 1985 (Undersea Oil Transmission Tunnel)
- U.S. Dept. of Energy, 1984-1990 (Nuclear Waste Isolation)
- Minnesota DOT, 1983-1989 (Blasting Response of Historic Buildings)
- Peabody Coal Co.
  - Kentucky, 1981-86 (Blast Induced Subsidence)
  - Indiana, 1986-89 (Strain Monitoring)
- Bechtel, San Francisco, 1981-82 (Earthquake Response of Rock Caverns)
- National Park Service, 1980 (Pinnacle Response to Blasting Vibrations)
- Gas Research Institute, 1979 (Subsidence Modeling)
- Illinois Institute of Environmental Quality, 1978 (Blast Vibration)
- Colorado Attorney General, 1978 (Expansive Clay Shale)
- Morrison Knudson Construction Co., Boise, ID, 1978 (Tunnel Geology)
- GARD Inc., Niles, IL, 1978 (Point Load Strength: Jaw Crusher Design)
- EXXON Research and Engineering Co., NJ, 1977 (Coal Silo Response)
- Alyeska Pipeline Service Co., 1975 (VSM Support for Alaskan Pipeline)
- Stone and Webster, Boston, MA, 1974-76 (Rock Foundations for Nuclear Power Plants)
- Woodward Clyde Consultants, Houston, TX, 1974 (Cooling Pond Design)

## **BOARDS OF DIRECTION**

- Digital Vibration Inc., Northbrook, Illinois (1982-1988)
  - Co-founder of Company; sold in 1988 to STS

## **EXTERNAL RESEARCH SUPPORT**

### **National Science Foundation**

- Excitation and Response for Close-In Urban Blasting Producing High Excitation Frequencies 2014-2015 \$24,000
- NeTs NOSS: Small Languages for Digital/Analog Sensor Networks w/ Adaptive Compression 2007-2009 \$450,000 (with R Dick, P. Dinda, and L. Henschen)
- Microbial Age-Dating of Cracks, 2005-2006, \$55,000 (with L. Sullivan)
- Rock Engineering Issues in Underground Urban Infrastructure Construction: Workshop on Research Needs (w/ P. Smeallie) 2000-2001, ~\$25,000.
- Time Domain Reflectometry (TDR) Cable and Grout System to Telemetrically Monitor Soil Slope Stability, 1995-2001, \$140,000 (with R.J. Finno).
- Massively Parallel Computation for Stability of Openings in Jointed Rock, 1993-1996, \$165,000 (with T.B. Belytschko).
- Infrastructure Research for Undergraduates (REU Site), 1987-1999, \$306,000, P.I.
- Laboratory Approach to Evaluate Thermo-mechanical Properties of Rock Joints, 1987, \$14,000, Subcontract with Terra Tek, Inc.
- Cyclic Shearing of Rock Joints, 1985-1988, \$127,000, P.I. (with T.B. Belytschko).

- Field Verification of Millisecond Delay Blast Densification of Sand, 1985-1987, \$41,000, P.I.
- Seismic Enhancement of Joint Hydraulic Conductivity near Caverns, 1984-1987, \$78,000, P.I. (with T.B. Belytschko).
- Fracture Process Zone: Effect of Grain Size, Strain Rate and Moisture, 1984-1987, \$132,000, P.I. (with S.P. Shah).
- Dynamic Analysis of Earthquake Shaking Deformations for Large Caverns in Jointed Rock, 1979-1983, \$175,900, P.I. (with T.B. Belytschko).
- Characterization of Rock and Soil Deposits for Analysis, 1977-1980, \$24,000, P.I.
- Behavior of Rock Discontinuities, 1975-1977, \$70,000 (with H.H. Einstein, MIT).
- Calculation of Degrees of Belief in Geotechnical Models from Case Studies, 1973-1974, \$17,000, P.I.

### **Department of the Interior**

- Telecommunication of TDR Data, U.S. Bureau of Mines, 1990-96, \$250,000, P.I.
- Application of Time Domain Reflectometry to Subsidence Monitoring, Office of Surface Mining/Illinois State Geological Survey, 1985-1988, \$64,000, P.I.
- Technological Investigation of the Economic, Legal and Social Consequences of Blasting, U.S. Bureau of Mines, 1978-1980, \$249,000, Consulting Investigator
- Calculation of Structural Response from Blast Generated Ground Vibration and Air Pressure, U.S. Bureau of Mines, 1976-1981, \$95,000, P.I.

### **Department of Health, Education, and Welfare**

- Program on Infrastructure Enhancement, Department of Education, 1988-1991, \$300,000 in Fellowships (with S.P. Shah).
- Mineral Resource Engineering and Management, HEW & Industry, 1977-1981, \$171,000, Industry, \$65,000, Director and Co-founder.

### **Department of Transportation**

- High Frequency Urban Blasting Induced Strain, NU Infrastructure Technology Institute, 2011-2013, \$30,000, P.I.
- MEMS Wireless Crack Sensors, NU Infrastructure Technology Institute, 2004- , >\$250,000, P.I.
- Autonomous Crack Measurement (ACM), NU Infrastructure Technology Institute, 1999- , >\$500,000, P.I.
- Time Domain Reflectometry (TDR) Measurement of Bridge Pier Scour and Movement, NU, Infrastructure Technology Institute, 1993-2003, \$268,000, P.I.
- Determination of the Feasibility of Using Horizontal Penetration Techniques for Pre-excavation Subsurface Investigation in Soft Ground Transportation Tunnels, 1974-1975, \$99,400, P.I.

## **U.S. Army Corps of Engineers**

- Tribology of Rock Joint Fill, 1993-95, \$118,000, P.I.
- Expansive Cement Induced Fracture and Activity Detection, 1987, \$78,000, P.I.
- Lock and Dam Safety Research Project, 1985, \$4,500, Advisor.

## **Private Industry**

- Amoco, Computer Graphics, 1989, \$5,000.
- Bendix, Training for Egyptian Geological Survey, 1986, \$15,000, P.I.
- EXXON, Civil Engineering Aspects of Mining, 1980-1985, \$10,000 equipment grant, P.I.
- Petrodyne, Inc., Water Jet Cutting of Rock, 1978, \$8,000 equipment grant, P.I.
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## **MAJOR PUBLICATIONS**

## **PATENTS**

- Soil Shear Measurement with Time Domain Reflectometry (Applied for 1994).
- Water Pressure Measurement with Time Domain Reflectometry (Applied for 1993).

## **BOOKS**

- Micrometer Crack Response to Vibration and Weather, C. H. Dowding, International Society of Explosives Engineers, Cleveland, OH, Feb Dec 2008, 409 pgs
- Proceedings of Second International Symposium and Workshop on Time Domain Reflectometry for Innovative Geotechnical Applications, C.H. Dowding, Editor, Infrastructure Technology Institute, Evanston, IL, September 2001, ISBN 0-9712631-0-8, 543pp and CD.
- Geotechnical Materials: Measurement and Analysis: R.J. Krizek Commemorative Symposium, C.H. Dowding, Editor, Infrastructure Technology Institute, Evanston, IL, August, 2002, ISBN 0-9712631-1-6, 268pp and CD.
- GeoMeasurement by Pulsing TDR Cables and Probes, K.M. O'Connor & C.H. Dowding, CRC Press, Boca Raton, FL, 1999, 402pp.
- Construction Vibrations, C.H. Dowding, Prentice Hall Inc., Englewood Cliffs, NJ, 1996, 620pp.
- Time Domain Reflectometry in Environmental, Infrastructure, and Mining Applications, K.M. O'Connor, C.H. Dowding, & C.C. Jones, Editors, Special Publication SP 19-94, U.S. Bureau of Mines, Washington, D.C., 1994, 600pp.
- Blast Vibration Monitoring and Control, C.H. Dowding, Prentice Hall, Inc., Englewood Cliffs, NJ, 1985, 297 pp. Translated into Chinese by the Safety and Environmental Protection Institute, Wuhan, PRC. Translated into Japanese by Sankaido Book Pub. Co., Tokyo, JAPAN.
- The Practice of Foundation Engineering, R.J. Krizek, C.H. Dowding and F. Somogyi, Editors, Dept. of Civil Eng., Northwestern University, 1985, 435pp.

- Rock Masses, C.H. Dowding, Editor, American Society of Civil Engineers, 1985, 189 pp.
- Rock Mechanics in Productivity and Protection, C.H. Dowding and M.M. Singh, Editors, Society of Mining Engineers, Littleton, CO, 1984, 1222pp.
- Site Characterization and Exploration, C.H. Dowding, Editor, American Society of Civil Engineers, 1979, 295pp. First printing 1500 copies; second printing 1500 copies.

## JOURNAL ARTICLES

### *Journal of Geotechnical and Geoenvironmental Engineering; ASCE*

- "Nodal Failure Index Approach to Groundwater Remediation Design," (w/ J.J. Lee and H.W. Reeves) Volume 134, No. 10, Oct 2008, pp. 1554-1557.
- "Comparison of Crack Response to Long-Term Weather and Blast Vibration Effects", (with L.M. McKenna), Volume 131, No. 9, Sept 2005, pp. 1151-1161.
- "Finite Element Analysis of TDR Cable-Grout-Soil Mass Interaction During Localized Shearing", (with J.T. Blackburn), Volume 130, No. 3, March 2004, pp. 231-239.
- "Directing Exploration with 3-D FEM Sensitivity and Data Uncertainty," (with A. Graettinger), Volume 125, No. 11, November 1999, pp. 959-967.
- "Early Detection of Rock Movement with Time Domain Reflectometry," (with F.C. Huang), Volume 120, No. 8, Paper No. GEO-5680, August 1994, pp. 1413-1427.
- "Pipe Response to Pile Driving and Adjacent Excavation," (with P.W. Linehan and A. Longinow), Volume 118, GT2, Proceedings Paper 26554, February 1992, pp. 300- 316.
- "Dynamic Stability of Rock Slopes and High Frequency Traveling Waves," (with C. Gilbert), Volume 114, GT10, Proceedings Paper 22808, October 1988, pp. 1069-1088.
- "A Laboratory Study of Blast Densification of Saturated Sand," (with R.D. Hryciw), Volume 112, GT2, Proceedings Paper 20372, February 1986, pp. 187-199.
- "One and Two Support Models for Blast Response," (with H. Todo), Volume 110, GT6, Proceedings Paper 18935, June 1984, pp. 675-683.
- "Dynamic Computational Analyses of Openings in Jointed Rock," (with T.B. Belytschko and H. J. Yen), Volume 109, GT12, Proc. Paper 18436, December 1983, pp. 1551-1566.
- "Fracturing of Rock with Expansive Cement," (with J.F. Labuz), Volume 108, GT10, Proceedings Paper 17404, October 1982, pp. 1288-1299.
- "Damage to Rock Tunnels from Earthquake Shaking," (with Arnon Rozen), Volume 104, GT2, Proceedings Paper 13533, February 1978, pp. 175-191.
- "Embankment Instrumentation Tunnel Performance," (with T. W. Lambe and L. A Wolfskill), Volume 100, GT5, May 1974, pp. 567-70.

### *Journal of the Construction Division, ASCE*

- "Ground Motions and Air-Blast Effects of Explosive Demolition of Structures," Vol. 120, No. 4, Paper No. CO-5985, December 1994, pp. 838-856.
- "Vibration Criteria for Historic Buildings," Discussion of paper by W. Konon and J. P. Schuring, Volume 113, C04, September 1987, pp. 533-536.
- "Cracking and Construction Blasting," (with P. G. Corser), Volume 107, C01, March 1981, pp. 89-106.

*Journal of Structural Engineering, ASCE*

- "Autonomous Monitoring of Dynamic Response of In-Service Structures for Decision Support" (w/ D. Kosnik) July 2014
- "Simultaneous Airblast and Ground Motion Response," (with C. Fulthorpe), Volume 108, ST11, Proceedings Paper 17459, November 1982, pp. 2363-2378.
- "Dynamic Properties of Residential Structures Subjected to Blasting Vibrations," (with P. D. Murray and D. K. Atmatzidis), Volume 107, ST7, July 1981, pp. 1233-1249.

*Journal of the Mechanics Division, ASCE*

- "Measurement and Description of Rock Fracture," (with J. F. Labuz and S. P. Shah), Volume 115, No. 9, September 1989, pp. 1935-1949.

*Journal of the Performance of Constructed Facilities, ASCE*

- "Field Qualification of Inexpensive Wireless System to Monitor Micro-Meter Crack Response for Structural Health Monitoring" (w/ M Kotowski & T. Koegel), July 2014

*Practice Periodical on Structural Design & Construction, ASCE*

- "Blast and Construction Vibration Monitoring and Control: Thirty-Five-Year Perspective", Volume 11, No. 1, February 2006, pp. 8-12.

*Cement and Concrete Research*

- "Accelerated protocol for measurement of carbonation through a crack surface", (with L. Sullivan-Green, and Hime, W.) Elsevier, Vol 37, 2007, pp. 916-923

*International Journal of Rock Mechanics and Mining Sciences*

- "Suggested Method for Blast Vibration Monitoring," Volume 29, Number 2, March 1992, pp. 143-156.
- "Joint Asperity Degradation During Cyclic Shear," (with R. W. Hutson), Volume 27, Number 1, February 1990, pp. 109-119.
- "Measurement of Rock Mass Deformation Through Electromagnetic Wave Analysis of Grouted Coaxial Cable," (with M. B. Su and K. O'Connor), Volume 25, Number 5, October 1988, pp. 287-297.
- "The Fracture Process Zone in Granite: Evidence and Effect," (with J. F. Labuz and S.P. Shah), Volume 24, Number 4, August 1987, pp. 235-246.
- "Experimental Analysis of Crack Propagation in Granite," (with J. F. Labuz and S. P. Shah), Volume 22, Number 2, April 1985, pp. 85-99.
- "Water Jet Cutting of Experimental Rock Discontinuities," (with R. M. Dickinson), Volume 18, Number 3, June 1981, pp. 235-243.

*International Journal for Numerical and Analytical Methods in Geomechanics*

- "Determination of Asperity Damage Parameters for Constitutive Models of Rock Discontinuities," (w/ M. E. Plesha and R. W. Hutson), Volume 15, 1991, pp. 289-94.
- "A Computer Method for Stability Analysis of Caverns in Jointed Rock," (with T. B. Belytschko and M. Plesha), Volume 8, 1984, pp. 473-492.



- "A Coupled Finite Element - Rigid Block Method for Transient Analysis of Caverns," (with T. B. Belytschko and H. J. Yen), Volume 7, 1983, pp. 117-127.

#### *Computers and Geotechnics*

- "Parallel Processing for a Discrete Element Program," (with TB Belytschko and O. Dmytryshyn), Vol. 25, No. 4, 1999, pp. 281-285.
- "Explicit Modeling of Dilation, Asperity Degradation and Cyclic Seating of Rock Joints," (w/ A. Zubelewicz, K. O'Connor and T. B. Belytschko), Volume 11, 1991, pp. 209-227.

#### *Rock Mechanics and Rock Engineering*

- Strains Induced in Urban Structures by Ultra-High Frequency Blasting Rock Motions: A Case Study. *Rock Mechanics and Rock Engineering*, (w/ Hamdi, E., & Aimone-Martin, C. T. (2016). 1-18. DOI: 10.1007/s00603-016-0921-4
- "Dynamic Response of Million Block Cavern Models with Parallel Processing" (w /T.B. Belytschko and O. Dmytryshyn), Volume 33, 2000, pp. 207-214
- "Distinct Element Modeling and Analysis of Mining Induced Subsidence," (with K. M. O'Connor), Volume 25, 1992, pp. 1-24.
- "Measurement of Rock Mass Deformation with Grouted Coaxial Antenna Cables," (with M. B. Su and K. O'Connor), Volume 22, 1989, pp. 1-23.
- "Parametric Study of Acoustic Emission Location Using Only Four Sensors," (with J.F. Labuz, H.S. Chang, and S.P. Shah), Volume 21, 1988, pp. 139-148.
- "Computer Controlled Sawing of Multiple Rock Joints for Laboratory Testing," (with R. W. Hutson), Volume 20, 1987, pp. 39-55.
- "Multiple Blast Hole Stresses and Measured Fragmentation," (with C. T. Aimone), Volume 18, 1985, pp. 17-36.

#### *ASTM Geotechnical Testing Journal*

- "Electromagnetic Wave Propagation Model for Differentiation of Geotechnical Disturbances along Buried Cables," (with J.A. Summers, A. Taflove, WL Kath), December 2002, pp 449-458.
- "Remote Piezometric Water Pressure Measurement with Time Domain Reflectometry," (with F.C. Huang and P.S. McComb), March 1996, pp. 58-64.
- "Cone Penetration of Partially Saturated Sands," (with R. D. Hryciw), Volume 10, Number 3, September 1987, pp. 135-141.
- "Geotextile Filters for a Large Liquifaction Tank," (with R. D. Hryciw and J.M. Conet), Volume 8, Number 3, September 1985, pp. 140-143.
- "Blast Vibration Implications of Cyclic Shear Behavior of Model Plaster Panels," (with K. R. Beck and D. K. Atmatzidis), Volume 3, Number 2, June 1980, pp. 81-90.

#### *Advances in Tunneling Technology & Subsurface Use*

- "Estimating Earthquake Damage from Explosion Testing of Full-Scale Tunnels," Volume 4, Number 3, 1984, pp. 113-119.
- "Earthquake Stability of Tunnels," June 1979, pp. 15-20.

*Environmental and Engineering Geosciences*

- "Response of Test House to Vibroseis Vibrations and Environmental Forces," (w/ D.L. Teasdale, J.L. Kiker, L.L. Oriard, and S.J. Morrison). Vol. XII, No. 1, February 2006, pp. 25-37.
- "Response of Rock Pinnacles to Blasting Vibrations and Airblasts," (with F. S. Kendorski), Volume XX, Number 3, 1983, pp. 271-281.

*Engineering Geology*

- "Potential for Rock Burst and Slabbing in Deep Caverns," (with C. A. Anderson), Volume 22, 1986, pp. 265-279.

*Journal of Mathematical Geology*

- "Quantifying Exploration Sufficiency while Accommodating Judgment" (with A. Graettinger & H.W. Reeves), Volume 33, Number 2, 2001, pp. 133-153.

*Powder Technology, an International Journal*

- "Point-Load-Deformation Relationships and Design of Jaw Crusher Plates," (with G. R. Lytwynshyn), Number 31, April 1982, pp. 277-286.

*Journal of the Acoustical Society of America*

- "Explosive Source Location by Relative Arrival Times of Atmospherically and Seismically Propagating Disturbances," (with R. D. Hryciw and J. M. Garetta), Volume 82, Number 6, December 1987, pp. 2034-2041.

*Experimental Techniques (Society of Experimental Mechanics)*

- "Using Seismic Techniques to Characterize Fractures in Rocks," (with J. F. Labuz and S. P. Shah), March 1987, pp. 30-32.

*Transportation Research Record*

- "Real Time Monitoring of Subsidence along I-70 in Washington, PA", (w/ K.M. O'Connor, RJ Clark and DJ Whitlach), Transportation Research Record-Journal of Transportation Research Board 1772, 2001, pp32-39.
- "Remote, Continuous Monitoring of Subsidence and Slope Movement using Time Domain Reflectometry,"(with K. M. O'Connor), Jan 1996.
- "Ground Vibration Monitoring Instrumentation and Computerized Surveillance," (with D. C. Jessen), TRR 1169, Geotechnical Instrumentation, 1988, pp. 24-32.

*International Journal of Applied Science and Technology*

- Sparse colonization and cultivation of bacteria on construction surfaces under zero-shear conditions (with L. Sullivan-Green, M Hausner and B Price), Vol.2, No. 1, Jan 2012, pp 95-110

## OTHER REFEREED PUBLICATIONS

- NUMOD and NUTSA: Software for Interactive Acquisition and Analysis of Time Domain Reflectometry Measurements, (with F.C. Huang, K.M. O'Connor, D.M. Yurchak), U.S. Bureau of Mines, Information Circular, IC 9346, 1993, 42p.
- "3-D Small Displacement Rigid Block Model," (with C.M. Gilbert), Seventh International Rock Mechanics Congress, 1991, pp. 729-732.
- "Rock Mass Modification in Civil Works," Rock Mass Modification, Annual Review of U.S. Progress in Rock Mechanics, National Academy Press, 1990, pp. 13-20.
- A Method for Evaluating the Effectiveness of Site Characterization Measurement (with Ditmars, J. D., Baecher, G. B., and Edgar, D. E.), Argonne National Laboratory, Report ANL/EES-TM-342, 1988, 92 pp.
- Effects of Repeated Blasting on a Wood Frame House (with Stagg, M. S., Siskind, D. E., and Stevens, M. G.), United States Bureau of Mines, Report of Investigations, 8896, 1984, 82 pp.
- "Response of Caverns in Jointed Rock to High Frequency Earthquake Motions," Proceedings of the 8th World Conference on Earthquake Engineering, Prentice Hall, Inc., NJ, Volume VII, 1984, pp. 47-54.
- Structure Response and Damage Produced by Ground Vibration from Blasting (with Siskind, D. E., Stagg, M. S., and Kopp., J. W.), United States Bureau of Mines, Report of Investigations, 8507, 1980, 74 pp.
- "Ground and Structural Response Due to Blasting," (with A. J. Hendron), Third International Rock Mechanics Congress, Volume IIB, 1974, pp. 1359-1364.

## BOOK CHAPTERS

- "Blast Vibration Monitoring" Mining Engineering Handbook, Society of Mining Engineers, Littleton, CO, 2010
- "Assessment of Current Vibration Regulations with Micro-meter Crack Response" Vibrations from Blasting, AT Spathis and MJ Noy, Eds., CRC Press-Balkema, Boca Raton, FL, pp 105-114, Sept 2009
- "Integrating Site Characterization with Aquifer and Soil Remediation Design," (w/ J.J. Lee, H.W. Reeves), Fate and Transport of Chemicals in the Environmenting: Impacts, Monitoring, and Remediation, Lipnick et. Al. eds., American Chemical Society, Washington, D.C., 2001.
- "Blast Vibration Monitoring for Rock Engineering," Comprehensive Rock Engineering, Pergamon Press, 1993, 25 p."Monitoring and Control of Blast Effects," SME Mining Engineering Handbook, H.L. Hartmon, Ed. Society of Mining Engineers, 1992, pp. 746-760.
- "Blast Vibrations," (with D. Sproft and J. Franklin), Mine Monitoring Manual (Chapter 4.3), J. Franklin Ed., Special Vol. 42, Canadian Institute of Mining and Metallurgy, 1990, pp. 96-104.
- "Comparison of Environmental and Blast Induced Effects through Computerized Surveillance," The Art and Science of Geotechnical Engineering at the Dawn of the 21st Century, R.B. Peck Honorary Volume, W. J. Hall, Ed., Prentice Hall, Inc., 1989, pp. 143-160.

- "Fractures and Fracture Patterns," Encyclopedia of Field and General Geology, Von Nostrand Reinhold Company, New York, in press.
- "Shearing Resistance and Deformability of Rock Joints," (with H. H. Einstein), Chapter 7 in Physical Properties of Rocks and Minerals, Y. S. Touloukian, W. R. Judd, and R. F. Roy, Eds., McGraw-Hill CINDAS, 1980, pp. 177-220.
- "Seismic Stability of Underground Openings", Storage in Excavated Rock Caverns, M. Bergman, Ed., Pergamon Press, 1978, Volume II, pp. 231-238.

## PROCEEDINGS PAPERS

- "Measured and Modeled Response of a Multi-Story, Urban Structure to High Frequency Blasting Excitation" ( w/ C. Aimone-Martin & P. Abeel), 11th International Symposium on Rock Fragmentation by Blasting, Sydney Australia, August 2015
- "Instrumental Detection of a Climatologically-Induced Cosmetic Crack in Wall Covering" (With J Lueker and P. Abeel), Proceedings of 41st Conference on Explosives and Blasting Technique, International Society of Explosives Engineers, Cleveland, OH, February 2015.
- "Autonomous Crack Measurement for Comparison of Vibratory Compaction Excitation and Climatological Effects" ( w/ C. Aimone-Martin & P. Abeel) European Workshop on Structural Health Monitoring, Nantes, France, June 2014.
- "Long Term Field Measurement of Micro Inch Crack Response to Climatological and Blast Vibration Induced Effects (w/ Pierre, Abeel), ASCE Geo Institute GSP, Atlanta, Feb 2014
- "Importance of Ground Strain in Predicting Blast-induced Strain and Stress in Pipelines" (w/ U Akayya), Proceedings: RocDyn1 EFPL Lausanne, June 2013
- "Vibratory and Climatologically Induced Crack Response: Effects of Un-cracked Weaknesses, Low Frequency Excitation, & Period of Vulnerability: (w/ J. Meissner) Kirsten Lecture, Proceedings, University of Minnesota 61st Annual Geotechnical Engineering Conference : Feb, 2013.
- "Interpretation of Microseismic Effects from Response to Large Coal Mine Blasts " 8th International Conference on Earthquake Resistant Engineering Structures, Wessex Institute of Technology, Southampton, UK, September, 2011
- "Interpretation of Microseismic Effects of Petroleum Production through Observed Response to Coal Mine Blasts" the 45th US Rock Mechanics Symposium, San Francisco, CA, June, 2011.
- "Response of Un-cracked Drywall Joints and Sheets to Blast Vibrations and Weather" (w/ J Meissner) Proceedings of 37th Conference on Explosives and Blasting Technique, International Society of Explosives Engineers, Cleveland, OH, February 2011.
- "Comparison of Micro-inch In-Plane and Out-of-Plane Response of Cracks to Blast Vibration and Weather" (w/ J Meissner) Proceedings of 36th Conference on Explosives and Blasting Technique, International Society of Explosives Engineers, Cleveland, OH, February 2010.
- "Real-Time Monitoring of Subsidence Along I-70 in Washington, Pennsylvania," (w/ K.M. O'Connor, R.J. Clark, & D.J. Whitlatch) Geo-Strata, pp 39-42, Feb 2009.
- "Crack Response to Blast Vibrations and Moisture Induced Volumetric Changes in Foundation Soils" ( with Aimone-Martin, C.; Rosenheim, V. and Meissner, J)

Proceedings of 35th Conference on Explosives and Blasting Technique, International Society of Explosives Engineers, Cleveland, OH, February 2009.

- “Evaluation of Close-In Blasting Effects on Welded Steel Pipelines,” (w/ Nyman, D.J. and Oriard, L.L.) Proceedings of IPC 2008, 7<sup>th</sup> International Pipeline Conference, Calgary, Alberta, Canada, 2008.
- "Multi-Hop Wireless Crack Measurement For Control Of Construction Vibrations," (with Kotowsky, M. and Ozer, H.) Proceedings, 7th International Symposium on Field Measurements in Geomechanics (FMGM), American Society of Civil Engineers, Reston, VA, September 2007
- "Response of Historic Structure to Long-term Environmental and Construction Vibration Effects," (with Marron, D & Baillot, R ) Proceedings, 7th International Symposium on Field Measurements in Geomechanics (FMGM), American Society of Civil Engineers, Reston, VA, September 2007.
- "Case Studies in Integrated Autonomous Remote Monitoring," ( with Finno, R. Kosnik, D & Kotowsky, M) Proceedings, 7th International Symposium on Field Measurements in Geomechanics (FMGM), American Society of Civil Engineers, Reston, VA, September 2007.
- "Blast Induced Micrometer Response of Cracks in Concrete Block Structures," Proceedings, 4th World Conference on Explosives and Blasting, European Federation of Explosive Engineers, UK, September 2007
- “Lucid Dreaming: Reliable Analog Event Detection for Energy Constrained Applications” (with Jevtic, S., Kotowsky, M., Dick, & R.P., Dinda, P.A.) International Conference on Information Processing in Sensor Networks IPSN’07, [IPSN/SPOTS Proceedings](#), Cambridge, MA, USA. April, 2007.
- Dowding, C.H. & (2007) "Micro-meter Crack Response to Rock Blast Vibrations, Wind Gusts & Weather Effects" (with Aimone-Martin, C) Proceedings of the GeoDenver Congress of the Geo-Institute of the American Society of Civil Engineers, Reston, VA, February, 2007.
- "Ground Motions from and House Response to Underground Aggregate Mining", (with Revey, G.F. & Waldron, M.), Proceedings of the 33rd Conference on Explosives and Blasting Technique, International Society of Explosive Engineers, Cleveland, OH, January, 2007.
- “Potentiometers for Measuring Micro-Meter Crack Displacements with Wireless Systems” (w/ H. Ozer & D. Marron), Proceedings of the 8<sup>th</sup> International Symposium on Rock Fragmentation, ISEE, Santiago, Chile, 2006.
- “Wireless Crack Measurement for Control of Construction Vibrations” (M. Kotowsky and H. Ozer), Proceedings of GeoInstitute GeoCongress, ASCE, , Atlanta, 2006.
- “Structure Response to Trench and Road Blasting” (w/ Aimone-Martin, C. and V. Rosenhaim) Proceedings of the 3<sup>rd</sup> World Conference on Explosives and Blasting, European Federation of Explosives Engineers, Brighton, England, 2005.
- “Response of Test House to Vibroseis Vibrations and Environmental Forces” (w/ D.L. Teasdale, J.L. Kiker, L.L. Oriard, & S.J. Morrison), ASCE GSP 134, Soil Dynamics Symposium in Honor of Professor Richard J. Woods, 2005.
- “Blast Induced Structural and Crack Response of a Brick Residential Structure Near an Aggregate Quarry” (w/ C.A. Aimone-Martin) Proceedings, 31<sup>st</sup> Conference on Explosives and Blasting, ISEE, 2005.

- “Response of Cracks to Construction Vibrations and Environmental Effects,” (w/ M.L. Snider), Geotechnical Engg. For Transportation Projects, M.K. Yegian, E. Kavazanjian Eds., special Geotech. Publication No. 126, ASCE, pgs 1767-1776, 2004.
- “New Developments in TDR Cable Surveillance of Potential Instability,” C.H. Dowding (w/ M.L. Dussud and K.M. O’Connor), Field Measurements in Geomechanics, Proc. 6<sup>th</sup> International Symposium, F. Myrvoll, Ed. AA Balkema, ISBN 9058096025, pgs 459-468, 2003.
- “Effect of Blast Design on Crack Response,” C.H. Dowding (w/ C. Aimone-Martin, and M.L. Snider), Explosives and Blasting Technique, Proc. 2<sup>nd</sup> World Conf. Of European Federation of Explosive Engineers, Holmber, R. Ed., AA Balkema, ISBN 9055809605X, pgs 573-582, 2003.
- “New Approach to Control Vibrations Generated by Construction in Rock and Soil,” (w/ M.L. Snider), Soil and Rock America, Proc. 12<sup>th</sup> Pan Am. Conf. and 39<sup>th</sup> U.S. Rock Mech. Symp. Culligan, P.J. et al Eds., VGE Essen Gr., ISBN 3773959850, pgs 2683-2690, 2003.
- “Monitoring Deformation in Rock and Soil with TDR Sensor Cables,” C.H. Dowding (w/ M.L. Dussud, W.F. Kane, and K.M. O’Connor), Geotechnical News, BiTech Pub. Ltd., Richmond, BC, Canada, Vol. 21, No. 2, pp 51-59.
- “Micro-Meter Measurement of Cracks to Compare Blast and Environmental Effects”, (w/ M. Lewis), Proceedings, 29<sup>th</sup> Conference on Explosives and Blasting Technique International Society of Explosives Engineers, Cleveland, OH, Vol. II, pp 245-269, 2003.
- “Control of Construction Vibrations with an Autonomous Crack Comparometer,” (w/ D. Siebert), Explosives and Blasting Technique, R Holmberg, Ed. A.A. Balkema, pp 103-110, 2001.
- “Time Domain Reflectometry for Landslide Surveillance”, Landslides: Causes, Impacts and Countermeasures, H.H. Einstein et. al. Eds. United Engineering Foundation, NY, NY, pp 249-260, 2001.
- “Measure the Crack Instead of Construction Vibrations”, Geo-Strata, pp 20-23, July 2001.
- “A Radical New Approach to Addressing Blasting Complaints”, Aggregates Manager, pp 36-42, January, 2001.
- "Effects of Ground Motions from High Speed Trains on Structures, Instruments and Humans," Wave 2000, A. Balkema, December 2000, pp. 269-288.
- "Comparison of TDR and Inclinometers for Slope Monitoring" (with K.M. O'Connor), ASCE Geotechnical Special Technical Publication #, Field Instrumentation, Denver, CO, 2000.
- "Inclusion of the Performance Model to Direct and Control Site Characterization" (with H.W. Reeves, A. Graettinger, and J.J. Lee), ASCE Geotechnical Special Technical Publication #97, Innovations and Applications in Geotechnical Site Characterization, Denver, CO, 2000.
- "Real Time Monitoring of Transportation Infrastructure with TDR Technology" (with K.M. O'Connor), Proceedings of Structural Materials Technology IV: An NDT Conference, Technomic Publishing Co., Lancaster, PA, 2000.

- "Vibration Control by Direct Measurement of Crack Response" Proceedings of the 25th Annual Conference on Explosives & Blasting Technique, International Society of Explosives Engineers, Cleveland, OH, 1999 pp. 349-357.
- "Blast Vibration Monitoring and Control; a Thirty Year Perspective," Proceedings of the 37th U.S. Rock Mechanics Symposium, Balkema, Rotterdam, Netherlands, 1999 pp. 45-49.
- "Interdisciplinary Team Research with Undergraduates," (with K. Wang & J.J. Biernacki), Proceedings, ASCE IL/IN Sectional Conference, March 1999.
- "Blasting Near Segmented Pipelines: Damage Potential Assessment," (with M. Rucker), Geotechnical Earthquake Engineering and Soil Dynamics III, ASCE Special Technical Publication No. 75 pp. 1518-1529, June 1998.
- "Interdisciplinary Team Research with Undergraduates," (with J. Biernacki), Proceedings of the American Society of Engineering Education, Milwaukee, WI, June 1997.
- "Quantitative Site Explanation Directed by Interface Location Uncertainty," (with Andrew Graettinger), Site Characterization for Geotechnical and Geoenvironmental Problems, Proceedings, 5th Great Lakes Geotechnical/Geoenvironmental Conference, R.D. Hryciw, Ed., Dept. of Civil Engineering, Univ. of Michigan, Ann Arbor, MI, May 1997.
- "NUVIB, Computer Programs for Construction Vibration Analysis," Proceedings, Society of Explosive Engineers, Las Vegas, NV, 1997.
- "Time Domain Reflectometry (TDR) to Monitor Groundwater Levels," (with G. Nicholson, C. Pierce & A. Agoston), Proceedings of the 2nd North American Rock Mechanics Symposium, Montreal, Balkema, Netherlands, June 1996.
- "Time Domain Reflectometry Monitoring of Bridge Integrity and Performance," (with C. Pierce), Proceedings of the Structural Materials Technology Conference, California Department of Transportation and FHWA, January 1996, pp. 85-91.
- "Geostatistical Guidance of Exploration in Roof Control B How Many Drill Holes are Enough," (C.T. Ledvina), Proceedings of Fifth Conference on Ground Control for Midwestern Coal Mines, Department of Mining Engineering, Southern Illinois University, 1995.
- "Vibration Induced Settlement From Blast Densification and Pile Driving," Vertical and Horizontal Deformations of Foundations and Embankments, ASCE Geotechnical Special Publication No. 40, 1994, pp. 1672-1688.
- "Telecommunication Enhancement of Time Domain Reflectometry," (with F.C. Huang), Proceedings, 1st Congress on Computers in Civil Engineering, ASCE, 1994, 8 pp.
- "Permanent Displacement and Pile Driving Vibrations," Proceedings of 16th Conference of the Deep Foundations Institute, J.F. Parola, Ed., Sparta, NJ, Oct. 1992.
- "Frequency Based Control of Urban Blasting," Excavation and Support for the Urban Infrastructure, T.D. O'Rourke, and A.G. Hobelman, Eds., ASCE Geotechnical Special Publication 33, 1992, pp. 181-211.
- "Remote Monitoring of Rock Mass Deformation Using Time Domain Reflectometry," (with K.M. O'Connor). Proceeding 3rd International Symposium on Field Measurements in Geomechanics, Norwegian Geotechnical Institute, Oslo, Norway, 1991, pp. 295-306.

- "AE Instrumentation and Deconvolution Techniques," (with R. L. Claxton and S. P. Shah), Proceedings of the Conference on Non Destructive Testing of Construction Materials, ASCE, 1990, 8 pp.
- "Monitoring & Simulation of Mining Induced Subsidence," (w/ K. M. O'Connor), Proc. of the International Conference on Mechanics of Jointed and Faulted Rock, MJFR, Vienna, 1990, 7 pp.
- "Monitoring Rock Mass Deformation Using Time Domain Reflectometry," (with K. M. O'Connor and M. B. Su), Proceedings of the Conference on Surface Crown Pillar Extraction Evaluation for Active and Abandoned Metal Mines, CANMET, 1989.
- "CPT and DMT Evaluation of Blast-Densification of Sand," (with R. D. Hryciw), Proceedings of the First International Symposium on Penetration Testing, 1988, Orlando, pp. 521-526.
- "Quantification of Rock Mass Deformation Using Time Domain Reflectometry," (with K. O'Connor and M. B. Su), Post Conference Volume, Proceedings of the 6th International Congress of the International Society for Rock Mechanics, Montreal, Canada.
- "A New Method for Producing Joints in Real Rock of all Hardness," (with R. W. Hutson), Post Conference Volume, Proceedings of the 6th International Congress of the International Society for Rock Mechanics, Montreal, Canada.
- "Quantification of Rock Caving within Sinkholes by Time Domain Reflectometry," (with K. O'Connor and M. B. Su), Proceedings of the 2nd International Sinkhole Conference, University of Central Florida, B. Beck, Ed. 1987.
- "A Constitutive Model for the Cyclic Behavior of Dilatant Rock Joints," (with A. Zubelewicz, K. O'Connor, T. B. Belytschko and M. Plesha), Proceedings of Second International Conference on Constitutive Laws for Engineering Materials, C. Desai, Ed., University of Arizona, Tucson, January 1987, 8 pp.
- "Real Time Control of Joint Shearing with a Micro Computer," (with R. W. Hutson), Proceedings of the 28th U.S. Symposium on Rock Mechanics, Arizona University, June 1987.
- "Attenuation of Acoustic Emissions and Definition of the Fracture Process Zone," (with C. Mueller), Proceedings of the 28th U.S. Symposium on Rock Mechanics, Arizona University, June 1987.
- "Dynamic Pore Pressure and Ground Motion Instrumentation during Blast Densification of Sand," (with R. D. Hryciw), Proceedings of the First International Symposium on Environmental Geotechnology, 1986, pp. 620-629.
- "Identical Joints Artificially Produced in Real Rock," (with R. W. Hutson), Proceedings of the 27th U.S. Symposium on Rock Mechanics, University of Alabama, June 1986, pp. 213-218.
- "Cavern Response to Earthquake Shaking with and without Dilation," (with K. O'Connor, A. Zubelewicz, T. Belytschko and M. Plesha), Proceedings of the 27th U.S. Symposium on Rock Mechanics, University of Alabama, June 1986, pp. 891-896.
- "Location of Acoustic Emissions During Fracture of Slightly Anisotropic Granite," (with J. F. Labuz and S. P. Shah), Proceedings of the 26th U.S. Symposium on Rock Mechanics, South Dakota School of Mines and Technology, June 1985, pp. 731-738.
- "Earthquake Response of Caverns: Empirical Correlations and Numerical Modeling," Proceedings of the Rapid Excavation and Tunneling Conference, June 1985.



- "Noise and Air Blast from Construction Blasting," Noise and Vibration Measurement, W. A. Redl, Editor, American Society of Civil Engineers, May 1985, pp. 17-32.
- "Inexpensive Micro-Computer Digitizer and Response Spectrum Analyzer," Proceedings of The 10th Conference of the Society of Explosive Engineers, 1984, Montville, Ohio, pp. 28-38.
- "Fracture Analysis of Subsize Charcoal Granite Specimens," (with J. F. Labuz and S. P. Shah), Proceedings of the 25th U.S. Symposium on Rock Mechanics, Northwestern University, June 1984, pp. 77-86.
- "Application of Time Domain Reflectometry to Mining," (with K. M. O'Connor), Proceedings of the 25th U.S. Symposium on Rock Mechanics, Northwestern University, June 1984, pp. 737-746.
- "Field Study of the Blasting Vibration Stability of Large Natural Rock Pinnacles," (with F.S. Kendorski), Proceedings of the 8th Conference of the Society of Explosives Engineers, 1982, Montville, Ohio, pp. 1-34.
- "Post Peak Tensile Load-Displacement Response and the Fracture Process Zone in Rock," (with J. F. Labuz and S. P. Shah), Proceedings of the 24th U.S. Symposium on Rock Mechanics, Texas A&M, June 1982, pp. 421-428.
- "Earthquake Response of Caverns in Jointed Rock: Effects of Frequency and Jointing," (with C. Ho), Seismic Design of Embankments and Caverns, ASCE Special Publication, May 1982, pp. 142-156.
- "Prediction of Subsidence from Full Extraction Coal Mining," (with B. M. Hall), Proceedings of 22nd U.S. Symposium on Rock Mechanics, Massachusetts Institute of Technology, June 1981, pp. 305-312.
- "Response of Rock Tunnels to Earthquake Shaking," Soil Dynamics, Proceedings of the ASCE Geotechnical Specialty Conference, June 1978, Pasadena, California, pp. 1349-1351.
- "Pre-Blast Surveys and the Importance of Photographic Technique," (with J. Ballard), Proceedings of the 5th Conference of the Society of Explosive Engineers, Montville, Ohio, pp. 221-232.
- "Ground-Structure Response to Blasting Vibrations," Proceedings of the 15th Annual Meeting, Society of Engineering Science, Lehigh University, November 1977, pp. 1085-1089.
- "Lifeline Viability of Rock Tunnels: Empirical Correlations and Future Research Needs," The Current State of Knowledge of Lifeline Earthquake Engineering, Proceedings of the ASCE Specialty Conference, August 1977, Los Angeles, pp. 10-37.
- "Bureau of Mines Research on Response of Residences to Ground Vibrations from Blasting," (with D. E. Fogelson), Proceedings of the 18th U.S. Symposium on Rock Mechanics, Colorado School of Mines Press, June 1977, Keystone, Colorado, 3C1-6.
- "Comparison of Predicted and Encountered Geology for Seven Colorado Tunnels," Proceedings of the Rapid Excavation and Tunneling Conference, AIME, 1976, pp. 19-38.

## GOVERNMENT REPORTS (Printed for Distribution to Public)

- Comparative Study of Structure Response to Coal Mine Blasting, (w/ C.T. Aimone-Martin, M.A. Martell, and L.M. McKenna), United States Office of Surface Mining Reclamation and Enforcement, Pittsburgh, PA, USA, 2002.
- Snow and Ice Accumulation on Solar Collector Installations in the Chicago Metropolitan Area (with R. B. Corotis and E. C. Rossow), National Bureau of Standards Report Number NBS GCR 79-181, 1979, 103 pp.
- Statistical Analysis of Blast Emission Records from Quarrying Mining and Construction Operations in the State of Illinois, (with Spencer Lucole), Illinois Institute of Natural Resources, Document Number 79/02, 1979, 200 pp.
- Feasibility of Horizontal Boring for Site Investigation in Soil, Final Report DOT Contract DOT-FH-11 8526, 1976, 395 pp.

## GRADUATE STUDENT SUPERVISION

### Ph.D.

- "A Web-Enabled Data Management System for Structural Health Monitoring of Civil Infrastructure", David E. Kosnik, December, 2012. Dr Kosnik is a Senior Research Engineer at Construction Technology Laboratory, Skokie, IL
- "Quantification of Biomass Accumulation on Building Surfaces through Simulation of Natural Modes of Deposition, " Laura Sullivan-Green, June 2008. Dr Sullivan-Green is an Assistant Professor in the Department of Civil and Environmental Engineering at San Jose State University, San Jose, CA.
- "Reliability-Based Exploration: A Quantitative Method for Evaluating and Directing Subsurface Exploration," Graettinger, Andrew, December 1998. Dr. Graettinger is an Associate Professor in the Department of Civil Engineering at the University of Alabama, Tuscaloosa.
- "Time Domain Reflectometry Measurements of Localized Soil Deformation," Pierce, Charles, December 1998. Dr. Pierce is an Assistant Professor in the Department of Civil Engineering at the University of South Carolina.
- "Telecommunication Enhancement of Time Domain Reflectometry Measurements," Fei Chiu Huang, 1994. Dr Huang is a senior engineer with American Geotechnical Services, Anaheim, CA.
- "Visualization Systems for Groundwater Flow and Contaminant Transport," Gustavious P. Williams, 1994. Dr Williams is an Associate Professor at Brigham Young University, UT.
- "Geostatistical Inference and Exploration of Coal Mine Roof Strata," Christopher T. Ledvina, 1991. Dr. Ledvina began his career as an Assistant Professor in the Department of Geology, Northeastern Illinois University, Chicago, IL.

- "Source Identification of Acoustic Emissions from Rock Fracture," Richard Claxton, 1990. Dr. Claxton began his career as an Assistant Professor at Marquette University, Milwaukee, WI.
- "Three-Dimensional Distinct Element Modeling of Rock Masses with Dilation," Christian Gilbert, 1989 (advising shared with T. B. Belytschko). Dr. Gilbert began his career as a Senior Analyst with Soletanche and Professor at Ecole Nationale des Ponts et Chaussees, Paris, France.
- "Refinements of Acoustic Emission Measurement to Deduce Three Dimensional Rock Fracture Source Mechanisms," Gyo-Won Kim, 1989, Dr Kim is Professor of Geological Engineering, Department of Geology, Kyoing-Pook National University, Korea.
- "Distinct Element Modeling and Analysis of Mining-Induced Subsidence," Kevin M. O'Connor, 1988. Dr. O'Connor is President of Geo TDR Inc., Columbus, OH.
- "Quantification of Cable Deformation with Time Domain Reflectometry Techniques," Mia Bin Su, 1987. Dr. Su is a Professor in the Department of Civil Engineering, National Chung-Hsing University, Taichung, Taiwan, R.O.C.
- "Preparation of Duplicate Rock Joints and Their Changing Dilatancy under Cyclic Shear," Robert W. Hutson, 1987. Dr. Hutson is an attorney in Northbrook, IL.
- "Deep Blast-Densification of Sand with Millisecond Delays," Roman Hryciw, 1986. Dr. Hryciw is a Professor in the Department of Civil Engineering, University of Michigan, Ann Arbor.
- "A Study of the Fracture Process Zone in Rock," Joseph F. Labuz, 1985 (advising shared with S. P. Shah). Dr. Labuz is Professor and Chairman of the Department of Civil and Mineral Engineering, University of Minnesota, St. Paul.
- "Numerical Methods for Jointed Media and Structures," Michael E. Plesha, 1983 (advising shared with T. B. Belytschko). Dr. Plesha is an Associate Professor in the Department of Theoretical and Applied Mechanics, University of Wisconsin-Madison.
- "A Coupled Rigid Block-Finite Element Model for Prediction of Shaking Induced Rock Mass Deformation," H. J. Yen, 1982 (advising shared with T. B. Belytschko). Dr. Yen is a senior civil engineer with OSHA, Chicago, IL.
- "A Three-Dimensional Wave Propagation Model for Prediction of Blast Induced Rock Fragmentation," Catherine Aimone, 1982. Dr. Aimone (now retired) was Professor and Chair of the Department of Mining and Geological Engineering, New Mexico Institute of Mining and Technology.

## **VISITING SCHOLARS**

- Essaieb Hamdi (2014-2015), Fulbright Fellow, Professor of Civil Engineering University of Tunis El Manar, Tunis, Tunisia. During his stay he condensed information and wrote a report and two articles on Measured Response of Urban Structures to Ultra-High Frequency Excitation from Close-in Blasting
- Anan Sarma (2002-2003), Graduate student, Nanyang University, and engineer at Singapore Defense Science and Technology Army. During he wrote part of a thesis on attenuation of model explosive stresses and a paper "Scaled Distances on Peak Stresses Near Field Explosion Tests."

- Zhimin Tian (2003), Professor Luoyang Technical Institute of Hydraulic Engineering. During his stay he wrote a paper on “Investigation of New Laced Reinforcement Foam Core Sandwich Panel” for explosion protection.
- Orest Dmytryshyn, Former Professor of Computational Mechanics, University of Kiev. During his stay he developed the parallel computation version of RBM, which can now employ one million rigid blocks.
- Alexander Zubelewicz, Post Doctoral Fellow during the 1985-1986 academic year. During his stay he was collaborating on the continued development of NURBM discrete element model for discontinuous rock masses.
- Ting-Jie Li, Assistant Professor of Civil Engineering, Institute of Rock and Soil Mechanics, Wuhan, People's Republic of China, Visiting Scholar during the 1985-1986 academic year. During his stay he wrote a report on joint dilation modeling.
- Zhen Zhang, Associate Professor of Civil Engineering, Southwestern Jiaotong University, People's Republic of China, Visiting Scholar during the 1984-1985 academic year. During his stay he wrote a report on "Calculation of Linear Stresses Induced by Earthquake Shocking."
- Robert Langan, Ph.D. Geophysics, M.S. Civil Engineering, Post Doctoral Fellow during the 1980- 1981 academic year. During his stay he participated in the NSF research project on the analysis of shaking deformation of large caverns in jointed rock.
- Adrian Dorenfeld, Associate Professor of Mining Engineering at the University of Minnesota, Visiting Professor during 1979-1980 academic year. During his stay he 1) studied high sulfur content coal, 2) taught a course - Origin and Distribution of Ores and Fuels, and 3) conducted a 12 week seminar - Frontiers of Mineral Resource Development.

#### **M.S. (each student wrote an extensive thesis)**

- Building and Crack Response to Blasting, Construction Vibrations and Weather Effects, Pierre Abeel, 2012
- “Wireless Sensor Networks for Monitoring Cracks in Structures” Mathew Kotowsky, 2010
- “Acoustic Emission Monitoring for Large Civil Structures” David Kosnik, 2009
- “Qualification of Autonomous Crack Monitoring Systems,” Brandon Hughes, 2006
- "Residential Crack Response to Vibrations from Underground Mining," Michael Waldron, 2006
- “Wireless Sensor Networks for Crack Displacement Measurement,” Hasan Ozer, 2005
- “Effect of Crack Width on Carbonation: Implications for Crack Dating” Laura Sullivan-Green, 2005
- “Crack Response of a Historic Structure to Weather Effects and Construction Vibrations,” Remi Baillot, 2004.
- “Standardization of Automated Crack Monitoring Apparatus for Long-Term Commercial Applications.” Markian B. Petrina, 2004.

- “Crack Response to Weather Effects, Blasting, and Construction Vibrations,” Mickey L. Snider, 2003.
- “TDR Monitoring of Soil Deformation: Case Histories and Field Techniques,” Mattieu L. Dussud, 2002.
- “Finite Element Analysis of TDR Cable-Grout-Soil Mass Interaction During Localized Shearing,” James T. Blackburn, 2002.
- “Comparison of Measured Crack Response in Diverse Structures to Dynamic Events and Weather Phenomena,” Laureen M. McKeena, 2002.
- “Field Authentication of Autonomous Crack Comparometer,” Michael Louis, 2001.
- “Compliant TDR Cable/Grout Composites to Measure Localized Deformation,” Richard Cole, 2000.
- “Autonomous Crack Comparometer,” Damian Siebert, 2000.
- “Numerical Simulation of Measured Time Domain Reflectometry Signatures,” Stephane Bordas, 1998.
- “Cement Bentonite Grouts Compatible with Compliant TDR Cables,” David M. Will, 1997.
- “Numerical Simulation of Measured Time Domain Reflectometry Signatures,” Christopher Kroll, 1997.
- “Low Strength Grouts for Embedding TDR Cables in Soils,” Nicolas Aymard, 1996.
- “Effects of Multiple Crimps and Cable Length on Reflection Signatures from Long Cables,” Christophe Bilaine, 1994.
- “Specifications for Control of Vibrations During Blasting and Pile Driving,” Pierre Santoni, 1993.
- “NUVIB Program Summary,” (Report), Jin-Young Park, 1993.
- “Frequency and Energy Considerations for Construction Vibrations,” Franck Blais 1993.
- “Piesometric Water Pressure Measurement by Time Domaine Reflectometry,” Paul S. McComb, 1993.
- “Micro-Vibration Excitation of Sensitive Equipment,” Herve M. Gatineau, 1991.
- “Finite Pulse Excitation Models for Blast Excitation,” Sizwe Mncwango, 1990.
- “Quantification of Rock Mass Movement with Grouted Coaxial Cable,” Myung-Hok Kim, 1989.
- “Effects of Shaking on Joint Hydraulic Conductivity,” Chris Patoux, 1988.
- “Seismic Enhancement of Joint Hydraulic Conductivity,” Marc Gosse, 1988.
- “Environmental Effects of Explosive Demolition of Structures,” Yoram Sofrin, 1988.
- “Effect of Loading Configuration and Crystal Size on the Relative Magnitude of Acoustic Emissions in Granite,” Christopher G. Mueller, 1987.
- “A Laboratory Investigation of the Use of Geotextile to Mitigate Frost Heave and a Case Study of Potential Causes of Frost Heave,” Karen S. Henry, 1987.
- “Effects of Wave Propagation on Stability of Rock Slopes,” Christian Gilbert, 1986.
- “Blast to Recorder Distance from Time Delay Between Ground Motion and Air Blast,” Jean-Michel Garreta, 1986.
- “Detection and Analysis of Acoustic Emissions in Laboratory Granite Specimens,” Laurent Samama, 1985.
- “Determination of Acoustic Source Location by a Least-Squares Iterative Technique,” Hui Sing Chang, 1984 (report only).

- "Blast Densification of Sand with Millisecond Delays," Roman Hryciw, 1983.
- "Design Criteria for Walls in Earth Sheltered Construction," Arnold J. Radloff, 1983 (report only).
- "Techniques for Measurement of Blast Vibrations," Philippe Galet, 1982.
- "A Laboratory Study of Blast Densification of Sand," Jean M. Coronet, 1982.
- "Response of a Two-Support, Two-Degree of Freedom System to Blast Vibrations," Hiroko Todo, 1982.
- "Effect of Frequency on Shaking Response of Caverns in Rock," Chiti Ho, 1982.
- "A Microcomputer System for Digitizing and Processing Blast Vibration Transients," Herve Duplaine, 1981.
- "Use of the Single-Degree-of-Freedom-System as a Dynamic Model for Low Rise Residential Structures Subjected to Blast Vibration," Robert T. Langan, 1980.
- "Subsidence Prediction Methods and Instrumentation for Caved Long-wall Coal Mines," Britt M. Hall, 1980.
- "Application of Point-Load, Load-Deformation-Failure Relationships to the Design of Jaw Crusher Plates," George R. Lytwynshyn, 1980.
- "Potential of Rock Burst and Slabbing for Deep Caverns," Carl-Anders Andersson, 1979.
- "Wall Cracking in Residential Structures from Surface Mining and Hard Rock Construction Blasts," Patrick G. Corser, 1979.
- "Feasibility of Water Jet Cutting of Rock Discontinuities," R. Morgan Dickinson, 1979.
- "Computer Modeling of Structural Response to Combined Air Blasts and Ground Vibrations," Craig Fulthorpe, 1979.
- "Dynamic Properties of Residential Structures Subjected to Blasting Vibrations," Philip Murray, 1978.
- "Material Properties and Blast Induced Cracking in Residences," Patrick Accensi, 1978.
- "Fatigue Cracking of Drywall from Model Blast Loading," Kenneth Beck, 1978.
- "Response of Rock Tunnels to Earthquake Shaking," Arnon Rozen, 1976 (MIT).
- "Vibrations from Franki-Pile Driving," Philip J. Tatko, 1975 (MIT).
- "Horizontal Boring Systems - Excavation and Propulsion Subsystem Feasibility," Alan W. Katz, 1975 (MIT).
- "Geotechnical and Geophysical Exploration of Soft Ground from Horizontal Boreholes," Jan Hedberg, 1975 (MIT).
- "Controlled Horizontal Drilling for Pipeline Installation: A Case Study," Daniel Zulinski, 1975 (MIT).
- "A Comparison of Predicted and Encountered Geologies from Seven Tunnels in the Colorado Mineral Belt," John B. Miller, 1974 (MIT).
- "Deformation and Pore Pressures Measured Beneath a 2.4 Mile Embankment on Soft Clay," Kenneth L. Recker (with C. C. Ladd), 1973 (MIT).
- "A Probabilistic Approach to Hard Rock Tunneling," Steven G. Vick (with H. H. Einstein), 1973 (MIT).

#### **PUBLIC PRESENTATIONS (while at Northwestern)**

#### **INVITED LECTURES AND TALKS (unpublished)**

- Too many to list from 2004 and on - with Sigma Xi Distinguished Lectureships and various appearances in the media.
- Ruhr University, Bochum, Germany, "Effects of Ground Motions from High Speed Trains on Structures, Instruments and Humans," 2000.
- Vail Colorado, American Rock Mechanics Association, "Blast Vibration Monitoring and Control: A Thirty Year Perspective" 37th Rock Mechanics Symposium Invited Retrospective Case History, June 1999.
- North Carolina State University, "Urban Adjacent Blasting and New Method of Monitoring Vibration Effects," March. 1998.
- National Public Radio, Chicago WBEZ "848" program "Implosion Technology and Demolition Of CHA Buildings" repeated Saturday as part "Best of 848" series, 1998.
- Utah State University, ASCE Geo-Institute, "Time Domain Reflectometry in Geoenvironmental Applications," 1997.
- U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, "Time Domain Reflectometry to Monitor Ground Water Levels," 1996.
- University of Wisconsin -- Madison, Uncertainty 96, ASCE Geo-Institute, "Differences between Rock and Soil," 1996.
- Chicago, IL, WGN Roy Leonard Show, Radio interview concerning details of truck bomb attack on Murrah Federal Building in Oklahoma City, 1995.
- Chicago, IL, ASCE Geotechnical Section Dinner Meeting, "Rock Slope Stability & Blast Vibration Monitoring on Broadway in New York City," 1994.
- Texas A&M, ASCE Geotechnical Division Congress, "Vibration Induced Settlement from Blast Densification and Pile Driving," 1994.
- U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, "Time Domain Reflectometry," 1993.
- National Public Radio, Washington DC, "The Great Chicago Flood," Weekend Edition, 1992.
- Channel 11, WTTW, Chicago, IL, "Flood in the Loop," Chicago Tonight, 1992.
- University of Minnesota, Minneapolis-St. Paul, MN "Vibration Effects of Pile Driving," 39th Annual Minnesota Geotechnical Engineering Conf., 1991.
- Beijing Institute of Mechanics, Beijing, P.R. China, "Rock Fracture and Acoustic Emissions," 1989.
- Japan Society of Civil Engineers, Tokyo, Japan, "Blast Vibration Monitoring," 1989.
- Colorado State University, Ft. Collins, CO, "Comparison of Environmental and Blast Vibration Effects," 1988.
- University of Illinois, Urbana, IL, "Close In Blasting," 1988.
- University of Michigan, Ann Arbor, MI, "Close In Blasting," 1987.
- University of Wisconsin at Milwaukee, "Blast Vibration Damage Criteria," 1984, 1985, 1986, 1987.
- U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, "Probability and Site Characterization," 1985.
- Johns Hopkins University, Baltimore, MD, "Sand Densification from Pile Driving and Blasting," 1983.

- Georgia Institute of Technology, Atlanta, GA, "Response Considerations in the Design of Construction Blasts," 1981.
- University of Colorado, Boulder, CO, "Water Jet Cutting of Rock Discontinuities," 1980.
- University of Kansas, Lawrence, KS, "Blast Vibration Cracking; Structural and Geotechnical Considerations," 1979.
- Washington University, St. Louis, Missouri, "Analysis and Prediction of Structural Response to Blasting," 1979.
- University of Wisconsin at Milwaukee, Tunneling Institute, "Blasting in an Urban Environment," 1978.
- Massachusetts Institute of Technology, Cambridge, MA, Short Course, Recent Advances in Rock Mechanics, "Shaking Stability of Underground Openings," and "Blasting Vibrations," 1978.
- Purdue University, Lafayette, IN, Geotechnical Engineering Seminar, "Ground-Structure Response to Blasting Vibrations," 1977.
- Uppsala University, Sweden, Institute of Technology, "Damage from Blasting," 1977.

## **PAPERS PRESENTED IN PERSON AT PROFESSIONAL MEETINGS**

- Too many to list in the last several years. See "Proceedings Papers for at least the list of presentations associated with conferences and their proceedings.
- ASCE Geo-Institute Conference, "Comparison of TDR and Inclinometers for Slope-Monitoring," Denver, Co, August 2000.
- "Rock Mechanics for Underground Construction" Development Chair for 1 day short course during Conference of the Geo-Institute, ASCE, Urbana, IL, June 1999.
- Organize and lecture in short course on Rock Mechanics for Practicing Engineers, Geo Institute Conference, Seattle, WA, August 1998.
- North American Rock Mechanics Symposium, Montreal, Canada, "Time Domain Reflectometry (TDR) to Monitor Groundwater Levels," 1996.
- SPIE Conference on Nondestructive Evaluation of Aging Infrastructure, Oakland, CA, "Measurement of Water Pressure and Deformation with Time Domain Reflectometry Cables," 1995.
- ASCE Geotechnical Convention, College Station, TX, "Vibration Induced Settlement from Blast Densification and Pile Driving," 1994.
- ASCE National Convention, New York, NY, "Frequency Based Control of Urban Blasting," 1992.
- Transportation Research Board Annual Meeting, Washington, DC, "Ground Vibration Monitoring Instrumentation and Computerized Surveillance," 1987.
- Abandoned Mine Lands Association Annual Meeting, Charleston, WV, "Use of Time Domain Reflectometry for Monitoring Subsidence," 1985.
- Rapid Excavation and Tunneling Conference, New York, NY, "Earthquake Response of Caverns: Empirical Relations and Numerical Modeling," 1985.
- ASCE National Meeting, Denver, CO, "Noise and Air Blast from Construction Blasting," 1985.



- International Tunneling Association, Caracas, Venezuela, "Estimating Earthquake Damage from Explosive Testing of Full-Scale Tunnels," 1984.
- ASCE National Meeting, Philadelphia, PA, "Effect of Frequency on Shaking Response of Caverns in Rock," 1983.
- 22nd U.S. Symposium on Rock Mechanics, Massachusetts Institute of Technology, Cambridge, MA, "Prediction of Subsidence from Full Extraction Coal Mining," 1981.
- Association of Engineering Geologists, Annual Meeting of North Central Section, Merrillville, IN, "Extrapolation of Natural and Artificial Fracture Patterns," 1981.
- ASCE National Meeting, Portland, OR, "Construction Blasting: Importance of Frequency and Free Response," 1980.
- 20th U.S. Symposium on Rock Mechanics, University of Texas at Austin, Austin, TX, "Blast Vibration Response of Residential Structures Near Surface Coal Mining," 1979.
- NSF Workshop on Site Characterization, Northwestern University, Evanston, IL, "Perspectives and Challenges in Site Characterization," 1978.
- ASCE Geotechnical Division Specialty Conference, Pasadena, CA, "Response Spectra Analysis of Blasting Vibrations," 1978.
- First International Conference on Storage in Excavated Rock Caverns, Stockholm, Sweden, "Seismic Stability of Underground Openings," 1977.
- Specialty Conference-Technical Committee on Lifeline Earthquake Engineering, Los Angeles, "Lifeline Viability of Rock Tunnels: Empirical Correlations and Future Research Needs," 1977.
- 15th Annual Meeting, Society of Engineering Science, Lehigh University, Bethlehem, PA, "Ground Structure Response to Blasting Vibrations," 1977.
- 18th U.S. Symposium on Rock Mechanics, Keystone, CO, "Bureau of Mines Research on Response of Residences to Ground Vibrations from Blasting," 1977.

## **NORTHWESTERN UNIVERSITY COMMITTEES AND ACTIVITIES**

### **UNIVERSITY**

- Chair: University Committee for Information Technology, 2005-2008
- Chair: Presidential Advisory Committee on University Space Planning, 2002-2004
- Program Review Committee: Preparation for Third Cycle Review, 2000
- Program Review Chair, Development of Alumni Relations, 1999
- Program Review Chair, Division of Continuing Education, 1998
- Program Review Chair, University, Law and Medical Libraries, 1997
- Search Committee for VP for Facility Planning, 1997
- Program Review Council, 1996-1999
- Presidential Inauguration Committee, 1995
- Program Review Panel, Geology, 1994
- Ad Hoc Committee on Computers in the Undergraduate Student Environment, 1992-93.
- General Faculty Committee, 1989-92
- Chairman, Educational Affairs
- Chairman, Committee on Committees
- University Library Committee, 1987-89

- Mineral Resource Engineering and Management Interdisciplinary Program, Director, 1976-1989.

## **McCORMICK SCHOOL OF ENGINEERING AND APPLIED SCIENCE**

- Space Planning Committee, 2000-2003
- Promotion and Tenure Committee, 1997-1999
- CoOp Committee, 1992-93
- Computer Committee, 1987-1988 & 1989-1997
- Chairman, 1984-1986
- Development Committee, 1982-1986
- Industrial Liaison Committee, 1979-1982
- Tech Open House Committee, 1977-1978

## **CIVIL ENGINEERING DEPARTMENT**

- Associate Chair: Civil & Environmental Engineering, 2011-
- Chair, ABET study committee, 2005-
- Space Committee Chair, 1999-2003
- Executive Committee 1992-1994, Chair, 1994
- Computer Committee Chair, 1991-1997
- Reconstruction Committee Chair, 1989-1992
- Geotechnical Area Coordinator, 1987-
- Undergraduate Laboratory Committee, 1982-1986
- Research Committee, 1978-1982
- Undergraduate Advisor, 1977-
- Committee on Relations with Ind. Students and Alumni, 1977-1982
- Secretary, Faculty Meetings, 1976-1978

## **NEW COURSE DEVELOPMENT**

- Principles of Ground Water 720-355 (revived a dormant course) 2007
- Geographical Information Systems, 720-C95
- Analytical Computer Graphics, 753-A20
- Rock Dynamics, 720-D99 1980
- Underground Construction, 720-D99
- Geotechnology, 720-C53

## **COMMUNITY ACTIVITIES**

### **WINNETKA**

- Park District Lakeshore Masterplan Advisory Committee (2014-
- Member: Winnetka Planning Commission 2012-2014
- Commissioner : Winnetka Village Environment and Forestry Commission 2009-
- Chair 2013-

- Board of Direction : Harkness Outreach Center 2008-2010
- Winnetka Park District-Village Service Center Study Committee 2007-2009
- Winnetka Public School Foundation 1998-2000
- Winnetka Man of the Year, 1997
- Financial Committee to Reconstruct Elementary School Facilities, 1996
- Co-chair, Committee to Construct 5 Million Dollar addition to WCC, 1995-97
- Chairman, Caucus Questionnaire Committee, 1995-96
- Village Solid Waste Study Committee, 1993-94
- Trustee, WCC, 1992
- Chairman, Space Resources Planning Committee, WCC, 1990
- Curriculum Review Committee, Winnetka Public Schools, 1985-1987
- Council, Winnetka Cong. Church, 1985-1989
- Chairman, Adult Education Committee, Winnetka Cong. Church (WCC), 1979-1981
- Chairman, Nominating Committee, Winnetka Caucus, 1980  
(Caucus nominates nonpartisan candidates to serve on village boards (School, Village, Park and Library))
- Chairman, Village Affairs Committee, Winnetka Caucus, 1979

#### **NEW TRIER TOWNSHIP**

- Nominating Caucus for New Trier High School Board

#### **METROPOLITAN CHICAGO**

- Chairman, Winnetka Cong. Church Committee to build a playground for Children's Day Care Center in Rogers Park area, Chicago, 1984-1985