

**NORTHWESTERN UNIVERSITY  
Infrastructure Technology Institute**

**Year 3 Annual Progress Report  
Part A – Corporate-Style Annual Report**

**Revision #1**

**January 30, 2003**

**1801 Maple  
Evanston, Illinois 60201  
(847) 491-8165  
Fax (847) 467-2056  
dschulz@northwestern.edu  
www.iti.northwestern.edu**

## Contents

<b>Introduction</b>	<b>Page 1</b>
<b>Center Theme</b>	<b>Page 1</b>
<b>Management Structure and Center Staff</b>	<b>Page 1</b>
<b>Program Activities</b>	
<b>Education</b>	<b>Page 3</b>
<b>Research</b>	<b>Page 4</b>
<b>Technology Transfer</b>	<b>Page 6</b>
<b>Vision</b>	<b>Page 7</b>
<b>Education</b>	
<b>Success Story: Public Infrastructure Management Course</b>	<b>Page 8</b>
<b>Success Story: Infrastructure Facilities &amp; Systems Course</b>	<b>Page 8</b>
<b>Success Story: Summer Infrastructure Institute</b>	<b>Page 9</b>
<b>Success Story: Freshmen Engineering Design Teams</b>	<b>Page 10</b>
<b>Success Story: Student of the Year</b>	<b>Page 10</b>
<b>Success Story: ASCE Steel Bridge Contest</b>	<b>Page 10</b>
<b>Success Story: Solar Powered Race Car</b>	<b>Page 11</b>
<b>Success Story: Infrastructure Management Students</b>	<b>Page 11</b>
<b>Research</b>	
<b>Success Story: Automated Crack Monitoring (ACM)     System Installed in Las Vegas</b>	<b>Page 12</b>
<b>Success Story: Institute-Developed Soil Movement Technology Applied     to Utilities Adjacent to Hospital Building Construction.</b>	<b>Page 13</b>
<b>Application of Institute-Developed Pile Testing Techniques     at California Naval Base</b>	<b>Page 14</b>
<b>Technology Transfer</b>	
<b>Success Story: Rebuilt Institute Web Site</b>	<b>Page 15</b>
<b>Success Story: Midwest Bridge Inspection and     Maintenance Consortium</b>	<b>Page 16</b>
<b>Success Story: Illinois Railway Museum Bridge Inspection Workshop</b>	<b>Page 16</b>
<b>Success Story: AEWG-45</b>	<b>Page 17</b>
<b>Policy and Management</b>	
<b>Success Story: Impacting the Regional and National     Infrastructure Debate</b>	<b>Page 17</b>
<b>Industry Partners</b>	
<b>Success Story: Miller Park Movable Roof Bearing Investigation</b>	<b>Page 18</b>
<b>Center of Excellence</b>	<b>Page 19</b>
<b>Research Projects</b>	<b>Page 20</b>

## **Corporate-Style Annual Report**

### **Introduction**

Founded in 1992, the Infrastructure Technology Institute of Northwestern University is an upper tier university transportation center funded under the Transportation Equity Act for the 21st Century (TEA-21). On November 10, 1999, the Research and Special Programs Administration (RSPA) of the US Department of Transportation approved the Institute's six-year strategic plan and awarded funding for the Northwestern fiscal year September 1, 1999-August 31, 2000. RSPA had previously granted the Institute an extension for closeout of its previous six-year funding under the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) to March 31, 2000.

Since the Institute continued to expend ISTEA funds well into the first quarter of calendar 2000, the Institute prepared and submitted in Spring 2001 a report documenting progress during calendar 2000 as its Year One funding progress report, and a similar report a year later on calendar 2001 as its Year Two progress report. This report documents progress from January 1, 2002 to December 31, 2002 as the Institute's Year Three funding progress report.

### **Center Theme**

The theme of the Infrastructure Technology Institute is improving the technology and expertise available to address the problems of the nation's transportation infrastructure.

### **Management Structure and Center Staff**

**Center Director** As the head of an interdepartmental center within Northwestern's McCormick School of Engineering and Applied Science, the Director of the Institute is appointed by and reports to the Dean of the McCormick School. The Director is responsible for the day-to-day management and administration of the activities of the Institute, including but not limited to developing, implementing and monitoring the Institute's annual budget; interacting with federal officials responsible for administering the Institute's grant funding; and carrying out all other aspects of the Institute's program. The Director is currently 100% funded by the Institute. The Center Business Manager assists the Director.

The Director is also responsible for overseeing the Institute's program of research and development projects, including but not limited to monitoring current research opportunities and needs, establishing and maintaining liaison with transportation infrastructure practitioners who are potential partners in research projects, helping to build research project teams to respond to those

needs and opportunities, managing the research project selection process, and administering research projects once they are awarded.

The Director also is responsible for managing the Institute's technology transfer process including overseeing the Institute's library services program and other technology transfer programs, monitoring commercialization activities of research projects and providing assistance as necessary, and establishing and maintaining liaison with transportation infrastructure practitioners who are targets of technology transfer.

The Director is also responsible for establishing and maintaining a public information program for the Institute, including but not limited to the preparation and dissemination of publications and the conduct of conferences and workshops. Finally, the Director is responsible for securing additional sources of support, including but not limited to research contracts, research partnerships, and grant support.

**Center Faculty and Staff** In addition to the Director, the Institute's only other direct full-time administrative employee is a Center Business Manager, Ms. Elizabeth Brasher. The Business Administrator is responsible for all aspects of the Institute's administration including budgeting, financial monitoring, purchasing, travel arrangements, computer system maintenance, interaction with other University departments, and other responsibilities as assigned by the Director.

In response to concerns raised by RSPA, Institute hired a new program assistant, Ms. Nancy Seeger, as an assistant to Ms. Brasher, with primary responsibilities the preparation of reports and other documents for federal reporting purposes, together with working with Institute staff on document development and preparation for research, education, technology transfer, and management and policy studies activities. Initially, this position will be part-time, allowing the Institute to gauge workload.

The Institute also employs a three-person bridge nondestructive testing research team, including Mr. David Prine, Chief Research Engineer, Mr. Dan Marron and Mr. Dan Hogan, Research Engineers. This team is totally supported by outside income and Institute research project support.

The Institute does not directly employ any faculty. Project-related research funding supports all faculty, research staff, and graduate students employed on Institute-supported research projects. The Institute also supports the full-time services on the payroll of the University Library of the Infrastructure Knowledge Manager, Ms. Ruth Allee and an assistant, for which a search is currently being conducted.

## **Program Activities**

**Education** The Institute's primary desired educational program outcome is to achieve a multi-disciplinary Transportation Infrastructure Management specialization in the Master's of Project Management (MPM) program in the Department of Civil Engineering. This program is evolving from and building upon the more generalized Infrastructure Management specialization currently offered in the MPM program.

An additional desired educational program outcome is to use the resources and activities devoted to the Master's program to enrich the available educational opportunities for undergraduate civil and environmental engineering students, and for graduate students at Northwestern in other engineering disciplines, the Transportation Center, the Kellogg Graduate School of Management, and the Medill School of Journalism and other programs. These resources and activities include the new courses to be developed and offered, seminars and symposia, field trips, and other activities associated with the program.

To achieve these objectives, the Institute is working to broaden its direct course offerings. The Institute Director devotes half his time and office resources directly to education activities. He developed and has taught for the last eight years the very popular – 23 students enrolled in Fall 2002 – undergraduate-graduate course, "Civil and Environmental Engineering 338, Public Infrastructure Management." In the spring of 2002, he developed and co-taught with Prof. Joseph Schofer a new course, "CEE 395, Infrastructure Facilities and Systems," which enrolled 24 students in its initial offering, and the intention currently is to make this an annual offering. The Institute Director is developing and will teach an additional undergraduate/graduate course in the Department of Civil and Environmental Engineering.

Possible additional course offerings – a final decision has not been made – include infrastructure planning and engineering, infrastructure organizations, public sector innovation, engineering communications, and development and implementation of large-scale transportation infrastructure projects. It is not currently anticipated that new faculty or staff will be hired and supported by this grant.

In the summer of 2002, the Institute developed and offered a weeklong course in infrastructure facilities and systems aimed at high school juniors and faculty. Post-course evaluations indicated it was very successful, and the Institute intends to offer it again in 2003. The Institute is also considering a variety of other K-12 transportation infrastructure education initiatives.

The Institute is working to integrate its education program with other disciplines in the University, and with its research, technology transfer and management and

policy activities. The Infrastructure Management specialization already provides broad interdisciplinary coverage, as depicted below:

**Typical Plan of Study and Alternate Course Selections  
Infrastructure Management Specialty  
Master's of Project Management**

**Typical Plan of Study**

Financial Issues for Engineers  
Total Quality Management  
Scheduling  
Human Resources Management  
Accounting Issues for Engineers  
Engineering Law  
Public Infrastructure Management  
Non-Profit Management Strategy  
Issues in Non-Profit Management  
Transportation Systems Planning  
and Management  
Evaluation and Decision Making  
for Infrastructure Systems  
Construction Contracts and  
Dispute Resolution  
Commercial Real Estate Development  
Decision-Making

**Alternate Course Selections**

Public Policy and Private Initiatives  
Development Finance  
Environmental Impact Evaluation  
Air Photo Interpretation  
Transportation Policy  
Geographic Information Systems  
Transportation Systems Operations  
Bargaining and Negotiation  
Hazardous Waste Management  
Uncertainty Analysis  
Transportation Economics  
Construction Estimating  
Construction Management  
Public Health Engineering  
Computers in Engineering Design,  
Management, and

The Institute chose an outstanding student of the year, Ms. Jill Roboski for 2002, awarded her \$1,000, and sponsored her trip to attend the award ceremony in Washington, DC, during the 2003 annual winter meeting of the Transportation Research Board.

**Research** The Institute seeks a research selection process which maintains at least the historic breadth and width of Institute-supported research. The objective is to at least maintain, if not expand, the number of technology areas actively being researched (breadth), while continuing to increase both the number of innovations and the amount of technical expertise in the technology areas being researched (depth).

The Institute currently solicits research proposals and accepts unsolicited proposals from Northwestern faculty. The Institute Director and a Research Advisory Panel comprised of three outside experts, including academics, researchers, and/or transportation infrastructure practitioners, review the proposals and make a recommendation regarding funding to the Institute Executive Committee for each proposal. This review is based on a careful

consideration of the research progress to date, with emphasis on the quality of the work, its applicability to meeting infrastructure needs, its degree of successful transfer to practice, and its ability to attract deployment partners.

Their recommendations are based on the salience of the unmet transportation infrastructure need proposed to be addressed by the research, the likelihood of achieving a commercializable end-product from the research and the likely market for it, the relationship to other ongoing research, the experience and qualifications of the researchers, the strength of the proposed technology commercialization and transfer plan, the sufficiency of the practitioner-involvement strategy, the proposed budget -- both annual and multi-year -- related to the Institute's overall research budget, and the success of prior related research in terms of end-products, technology commercialization and transfer, development of potentially-commercializable products, and budget and schedule adherence.

The Executive Committee is the Institute's governing body responsible for making policy and funding decisions. Membership currently includes the chairman of the Department of Civil and Environmental Engineering, the Associate Dean of the McCormick School of Engineering, and the heads of the Master's in Project Management program and the Center for Advanced Cement-Based Materials. The committee reviews the recommendations of the Research Advisory Panel and authorizes funding for projects the Committee deems worthy.

The Institute's desired research performance program outcome is to have each principal investigator publish at least one peer-reviewed research report and present one paper annually based on Institute-supported research.

The Institute's recent research efforts have emphasized nondestructive testing and evaluation of transportation infrastructure facilities -- principally bridges -- improved transportation infrastructure materials including weldable high-strength steel, better prediction methods for bridge deck concrete creep and shrinkage, and enhanced use of "paperless" procedures for highway contracting.

As detailed in the discussion of success stories below, Institute researchers have made a series of successful breakthrough deployments in continuous remote monitoring of transportation infrastructure facilities. The Institute is exploiting these advances in continuous remote monitoring while continuing selective work in transportation infrastructure materials research.

One of the key aspects of the Institute's success to date is its demonstrated ability to work closely with infrastructure agencies as true partners in the development and deployment of innovative technologies. To that end, Institute researchers work directly with the partner agencies, which provide support (and match) to the Institute's activities in three ways: (1) partner agencies provide on-site personnel and equipment to support Institute researchers undertaking field

trials and demonstrations; (2) partners provide in-kind support through engineering and other services conducted off site in direct support of the field work undertaken by the Institute researchers; and (3) partners on occasion contract directly with Institute researchers to provide technical assistance in the deployment of advanced technologies in the field.

Performance of Institute-supported research projects is monitored and evaluated in three ways. First, even though there can be implied long-term research support commitments to research topics, Institute funding is provided in annual increments. A careful peer-review evaluation of research performance is conducted annually as part of the Institute's research re-funding decision-making process.

Second, since 1993 the Institute has conducted monthly research luncheon meetings on the second Monday of every month. At these meetings the principal investigator of each active research project is required to make a presentation on recent progress and upcoming activities. Such presentations range in scope from brief reviews to lengthy and sometimes quite elaborate slide presentations, technical briefings, and even outside speakers dealing with the project in question. These presentations frequently generate discussion – often very lively -- among the other researchers present.

Third, the Institute Director is in continual contact with each of the principal investigators to informally monitor project progress, chart short and long-term plans for the work, and problem solve.

This three-part monitoring process provides continuing, thoughtful and productive review of the work and its results, without being overly burdensome in terms of paperwork and reporting requirements.

The Institute is also in contact with transportation infrastructure practitioners and researchers to develop additional research opportunities. Recently, the Institute began a dialogue with the University Transportation Center at the University of Wisconsin concerning possible joint research activities.

**Technology Transfer** The Institute's desired technology transfer program outcomes are to: (1) double the number of visitors to the Institute Website, (2) double the number of peer-reviewed papers on the Website, (3) conduct a summer transportation infrastructure institute for high school juniors and conduct other K-12 transportation infrastructure education initiatives, (4) conduct two meetings, one seminar, and one remote learning course annually, reaching 200 professionals, (5) provide frequently updated reports on Institute progress and news on the Institute Website, and (6) achieve an average of one successful research product deployment per funded project.

The Institute has successfully rebuilt its Website [www.iti.northwestern.edu](http://www.iti.northwestern.edu).

The Institute continues to build on the successful Midwest Bridge Maintenance and Inspection Technology Sharing Consortium by inviting additional state and local governments, universities, and private consultants to participate in the two meetings of the group each year, in addition to Web-based and other information exchanges. The States of Michigan, New York, West Virginia, and Tennessee joined the group of six states in 2001, bringing the total to ten.

The Institute Director continues to maintain an active speaking calendar on transportation infrastructure technology, policy, management, and related issues.

## **Vision**

In its strategic plan, the Institute established an ambitious vision for the six-year period:

- Develop a transportation infrastructure engineering **educational program** at the Master's level while enriching the undergraduate civil engineering curriculum at Northwestern and providing significant professional development opportunities to transportation infrastructure practitioners,
- Continue its successful transportation infrastructure **research programs** in nondestructive testing and evaluation of transportation infrastructure and materials,
- Build on its success in **moving the innovative transportation infrastructure technologies it develops into practice**,
- Contribute to advances in transportation infrastructure **policy and management**, particularly the vexing problem of the increasing paralysis of the transportation infrastructure industry in pursuing large complex projects,
- Grow the number of public and private sector transportation infrastructure **industry partners** with whom it works on technology issues, broaden existing partnerships, and develop new partnerships to include human resource and management and policy dimensions, and
- Generally enhance its position as a recognized **center of excellence** in transportation infrastructure technology.

The Institute is pleased and proud to report a number of important successes on these goals during 2002.

## Success Stories: Education

*... achieve a multi-disciplinary Transportation Infrastructure Management specialization in the Master's of Project Management (MPM) program in the Department of Civil Engineering [italicized inserts throughout this report are quoted from the Institute's University Transportation Center Strategic Plan: 1999-2005]*

**Success Story: Public Infrastructure Management Course.** The Institute once again offered its popular (23 students) Public Infrastructure Management course. Lecture notes were posted on Northwestern's "Blackboard" electronic teaching site, as were student responses to weekly e-mail assignments, items from the trade and popular media in the class's weekly "Infrastructure in the News" discussion, results of the full-day student charrette, and the final student term papers. The all-electronic format again proved to be extremely popular with students, as indicated in the results of the post course evaluation.

**Success Story: Infrastructure Facilities and Systems Course.** In spring quarter 2002, the Institute director developed and taught, with CEE Chair and Professor Joseph Schofer, a course in infrastructure facilities and systems. 24 students enrolled in the course, in which a weekly lecture was followed by a field trip to an infrastructure facility or project. Destinations included the Illinois Department of Transportation district office and communications center, the reconstruction of the century-old "Blue Line" of the Chicago Transit Authority "El," the new Calatrava-designed Milwaukee Art Museum addition and Miller Park movable roof baseball stadium in Milwaukee, the newly-rebuilt Midway Airport, a sewer construction project near the Evanston campus, the 6 Flags Great America theme park in Gurnee, Illinois, Chicago Union station for a briefing by officials from Amtrak and Metra, the Chicago area commuter rail system, the Chicago Skyway toll bridge currently under reconstruction, and a boat trip on the Chicago River to view bridges and architecture from the water. Students were offered the opportunity to do either individual term papers or team design projects, and three student teams developed outstanding team design projects:

1. The CTA's proposal for a new rapid transit "Super Loop":

[http://www.iti.northwestern.edu/education/ce395/presentations/super\\_loop.pdf](http://www.iti.northwestern.edu/education/ce395/presentations/super_loop.pdf)

2. Improved safety at railroad grade crossings:

[http://www.iti.northwestern.edu/education/ce395/presentations/railroad\\_crossing.pdf](http://www.iti.northwestern.edu/education/ce395/presentations/railroad_crossing.pdf)

3. Enhanced airport security:

[http://www.itn.northwestern.edu/education/ce395/presentations/airport\\_security.pdf](http://www.itn.northwestern.edu/education/ce395/presentations/airport_security.pdf)

Post-course evaluations indicated the course was very popular and the Institute intends to offer it again in 2003 and subsequent years.

*... use the resources and activities devoted to the Master's program to enrich the available educational opportunities for undergraduate civil and environmental engineering students, and for graduate students at Northwestern in other engineering disciplines, the Transportation Center, the Kellogg Graduate School of Management, and the Medill School of Journalism and other programs.*

**Success Story: Summer Infrastructure Institute.** In the summer of 2002, the Institute developed and offered a weeklong summer infrastructure institute on the Evanston campus. Educational and fun, each morning began with a lecture about elements of urban infrastructure presented by the Institute director. Each afternoon, the twenty high school students and teachers enrolled in the institute embarked on a supervised field trip to prominent facilities, including Midway Airport, a chartered the Chicago Transit Authority train, the Proviso Yard of the Union Pacific Railroad, the Illinois Department of Transportation expressway operations center, and a boat trip on the Chicago River. Participants returned to the Northwestern University campus at the end of each day.



**A happy participant (slightly underage) in the 2003 summer institute.**

The goal was to give students and teachers the opportunity to learn more about Chicago and urban infrastructure, while interacting with their peers and colleagues. While the Infrastructure Technology Institute hoped to pique the interest of at least a few of the participating students to pursue an education and career in civil engineering or a related infrastructure field, the main purpose was to give both teachers and students a richer and deeper understanding of how infrastructure works and the important role it plays in our society. Based on a post course evaluation, the summer institute will be offered again in 2003, with tentative dates June 25, 26, 27, and 30, and July 1.

**Success Story: Freshman EDC Teams.** The Institute sponsored two freshman engineering design teams in Winter Quarter of 2001. The teams developed design proposals for improving the esthetics of Chicago Transit Authority and Metra commuter rail bridges in downtown Evanston adjacent to a new downtown redevelopment project.

**Success Story: Student of the Year.** The Institute was proud to name Jill Roboski its 2002 UTC Student of the Year. Jill received her award at a ceremony sponsored by the Research and Special Programs Administration of US DOT at the annual meetings of the Transportation Research Board.

**Success Story: ASCE Steel Bridge Contest.**



**NU Steel Bridge Team at the Regionals**

The Institute again supported civil engineering students as they competed in this year's American Society of Civil Engineers/American Institute of Steel Construction student steel bridge competition. The team designed a fairly unique three-girder beam bridge. The bridge was fabricated entirely by students under the supervision of Institute research engineer, Dan

Hogan. This contest gives students an opportunity to try out their ideas and designs in a competition that includes thousands of their peers from several hundred different schools.

**Success Story: Solar Powered Race Car**



**Dan Hogan welding solar race car frame**

Institute Research Engineer Dan Hogan has over twenty-five years of experience as a prototype specialist and a welding researcher. Mr. Hogan provided consultations to the faculty and students who are designing the 2003 solar powered race car. Mr. Hogan was able to outline the steps needed to fabricate and weld this complex space frame and meet the requirement that total distortion be no more than one millimeter. Mr. Hogan supervised the students who fabricated the individual components and Mr. Hogan welded the space frame. The frame is made of aircraft quality Chrome-Molly tubing. Mr. Hogan assisted faculty members and other staff in portions of the analysis and design. The finished frame weights forty-five pounds and will be able to resist a 5-G side impact.

*...enroll and graduate twenty students each year in the Infrastructure Management specialization in the Master's of Project Management program.*

**Success Story: Infrastructure Management Students.** Seven students currently enrolled in the Master's in Project Management program are specializing in infrastructure management, the same as in the Year Two report.

*...have a student profile enrolled in its curriculum which meets or exceeds the University-wide proportions of minorities and women enrolled in graduate programs.*

The seven students currently enrolled include four white males, two minority males, and one minority female.

### **Success Stories: Research**

*...at least maintain, if not expand, the number of technology areas actively being researched (breadth), while continuing to increase both the number of innovations and the amount of technical expertise in the technology areas being researched (depth).*

*have each principal investigator publish at least one peer-reviewed research report and present one paper annually based on Institute-supported research.*

The Institute has prepared a report summarizing progress on all research projects funded under its TEA-21 funding during 2002. Rather than include that 48-page report either directly within this document, or as an appendix, it is posted on the Institute Web site:

[http://www.iti.northwestern.edu/institute/research\\_report/2002\\_annual.pdf](http://www.iti.northwestern.edu/institute/research_report/2002_annual.pdf)

**Success Story: Automated Crack Monitoring (ACM) System Installed in Las Vegas.** A ranch “test” house in Las Vegas provided the opportunity to test the Autonomous Crack Measurement (ACM) approach for monitoring and demonstrating the impact of typical highway construction activity on buildings where soil transmission distances were small during the summer fall and winter of 2002.



**Photographs of construction and external crack sensor, Top: Trackhoe excavation 12 m from the test house. Middle: Location of external crack sensors on south wall. Bottom: Close-up of external crack and sensors on south wall.**

**Success Story: Institute- Developed Soil Movement Technology Applied to Utilities Adjacent to Hospital Building Construction.**

Excavations in tight urban sites present challenges for preserving adjacent infrastructure from harm -- particularly roadways, subways, and utilities. Institute researchers have undertaken work in and around the excavation for the new Lurie Cancer Research Center on Northwestern's Chicago campus. An extensive series of sensors have been installed in the

excavation and on the streets surrounding the site, together with sensors directly attached to infrastructure such as gas mains, steam pipe tunnels, and other utilities. It is hoped that the results will allow further development and calibration of a model to predict the movements of adjacent utilities subjected to movements from adjacent construction based on excavation type, design, and construction methods, soil characteristics, and environmental and other factors. This would significantly improve the confidence of officials in granting permits for building, infrastructure and other construction.



**Lurie Cancer Research Center Excavation Site**

**Success Story: Application of Institute-Developed Pile Testing Techniques at California Naval Base.** The Institute's foundation nondestructive testing and evaluation research team has developed new methods to test piles in the field, termed longitudinal wave identification (LWI) and shear wave identification (SWI) tests, where intervening structure prevents use of impulse response techniques. This condition is quite common in bridge piers and wharf structures when the intervening structure between the top surface and the pile is too large. The research team has recently completed a project with the US Navy where the research team tested this new approach at their Port Hueneme facility.



**Conditions at Wharf 5 at Port Heuneme, California**

### **Success Stories: Technology Transfer**

*... (1) double the number of visitors to the Institute Web site, (2) double the number of peer-reviewed papers on the Web site, (3) conduct a transportation infrastructure essay contest for pre-college students, involving 100 student entrants and/or other K-12 transportation infrastructure education initiatives, (4) conduct two meetings, one seminar, and one remote learning course annually, reaching 200 professionals, (5) develop a monthly Web site-based Institute newsletter, and (6) achieve an average of one successful research product deployment per funded project.*

**Success Story: Rebuilt Institute Web Site.** The Institute's Knowledge Services implemented several significant changes to the Institute web site in 2002 to improve end users' experience in navigating the site to find content of interest; add new types of content such as streaming video synchronized with slide presentations (e.g., "Collapse of the World Trade Center Towers: Theory, Expectation and Reality") that provide a more effective learning platform for practitioners and researchers; and facilitate web site maintainability and future redesign. In addition to managing and maintaining the Institute web site, The Institute's Knowledge Services designed and developed 1) the electronic, multimedia proceedings of the August 3, 2002 "Geotechnical Materials: Measurement and Analysis"

symposium sponsored by the Institute and Northwestern University (distributed via CD-ROM, the Institute web site, and hard copy), and 2) a CD-ROM containing presentations, course materials, and field trip pictures for participants of the Institute's first Summer Infrastructure Institute for high school students and teachers. The site currently displays 5 articles from journals/books/newspapers, 11 conference papers, two sets of proceedings including the 2001 TDR proceedings (46 research papers), and the 2002 Geotechnical conference proceedings (15 research papers), and 10 director's meeting presentations given during 2002.

**Success Story: Midwest Bridge Inspection and Maintenance**

**Consortium.** An Institute-supported organization of state bridge inspection and maintenance engineers, the consortium continued to grow in 2002 with admission of new members Kansas, Minnesota, and Virginia to join current members Wisconsin, Illinois, Indiana, Kentucky, Ohio, Missouri, California, Michigan, Tennessee, New York, and West Virginia.

The consortium held two successful meetings during the period, a May meeting in Indianapolis with over 50 attendees, and a December meeting in Evanston with about the same number.

The consortium has evolved to offer themed agendas with topics such as bridge management systems, inspection methodologies, repair methods, emergency response, among others. The most valuable benefit of the semiannual meetings is the opportunity for bridge practitioners to interact with one another, both during the meeting sessions, and informally during breaks and after the meetings. In addition, the consortium, which is managed by the Kentucky Transportation Center -- a state-university cooperative research venture -- has its own technology-sharing Web site.

**Success Story: Illinois Railway Museum Bridge Inspection**

**Workshop.** The Institute held a one-day seminar on bridge inspection in June 2002 at the Illinois Railway Museum, Union, Illinois. The museum has in storage a salvaged plate girder bridge and support bents salvaged from the Chicago "El" system. This affords a unique opportunity for close access to the bridge and components. Mr. Phil Fish, retired chief bridge inspector from Wisconsin DOT, conducted a "walkaround" seminar explaining bridge inspection techniques for inspecting riveted steel plate girder bridges. Thirty-five people attended, including fifteen bridge inspectors from the Union Pacific Railroad, which has many bridges of this type. The entire seminar was video taped, and will be archived in streaming video format on the Institute web site.



**Bridge Inspection Consultant Phil Fish (black shirt) points out an aspect of a salvaged Chicago “EI” bent at the Illinois Railway Museum as volunteer Sam Polonetzky (left) and others look on.**

**Success Story: AEWG-45**

The Institute hosted the 45<sup>th</sup> meeting of the Acoustic Emission Working Group (AEWG). Thirty-three AE experts from seven countries attended the three-day meeting. The first day was devoted to a short course covering the fundamentals of AE. Twenty-two technical papers covering the latest developments in this technology were presented over the next two days.

**Success Stories: Policy and Management**

**Success Story: Impacting the Regional and National Infrastructure Debate.** The Institute Director maintained an active public speaking schedule on infrastructure issues during 2002:

- Spoke on consecutive days in January to the Nebraska and Kansas branches of the American Road and Transportation Builders Association in Omaha and Kansas City, respectively;
- Addressed the Kenosha Area Business Alliance on the topic of economic development;
- Gave a talk to the Kentucky branch of ARBTA in Lexington;
- Keynoted the annual meeting of the DuPage County Railroad Safety Council, a safety advocacy group;

- Lectured in the Contemporary Issues in Transportation series at the University of Wisconsin-Madison;
- Spoke to Northwestern alumnae as part of a course in contemporary transportation issues;
- Addressed the annual meeting of the Construction Writers Association in Chicago;
- Gave a talk at the annual scholarship luncheon of the Traffic Club of Chicago; and
- Helped organize and keynoted a half-day seminar on Chicago transportation sponsored by Lambda Alpha, the land development society.

### **Success Stories: Industry Partners**

#### **Success Story: Miller Park Movable Roof Bearing Investigation.**

Engineers from the Institute conducted acoustic emission (AE) tests on the pivot bearings for the moveable roof in Miller Park baseball stadium, Milwaukee, Wisconsin April and November of 2002. The purpose of the April test was to confirm that the source of the loud noises experienced during roof movement are emanating from the pivot bearings.



**Institute engineers installing AE sensors on thrust bearings in Miller Park, Milwaukee, Wisconsin**

AE monitoring clearly showed that the loud noises generated during roof openings and closings are produced by the pivot bearings. Based on

these tests and other consultants recommendations, the authority which owns the ballpark has contracted for the bearings to be replaced.

### **Conclusion: Center of Excellence**

In conclusion, the Institute continued to make substantial strides in 2002 towards its goal of becoming a nationally recognized center of excellence for infrastructure technology. A year of research successes was highlighted by direct involvement in a problem with a unique segmented movable roof for a new stadium. Institute researchers continued to successfully deploy their results in a growing number of locations across the country, and at the same time enhanced their stature as leaders in a number of important infrastructure technology areas. The Institute's rebuilt Web site was rapidly evolving to take advantage of streaming video, Internet-based televideoconferencing, and other innovations. The Institute-supported Midwest Bridge Maintenance and Inspection Technology Sharing Consortium grew in both number of member states (from 11 to 14) and meeting participation. And the Institute's management and policy studies efforts enjoyed great success as they examined and brought to public attention a number of important public policy issues including the interrelationship of sprawl and infrastructure problems, and the growing difficulty of building large infrastructure projects in the United States. Building on this success, the Institute looks forward to continued growth and achievement in 2003.

## **Part B – Research Projects**

### **New Projects**

**A450, Allowable Deformations of Gas Mains Adjacent to Deep Excavations,** Prof. Richard Finno, \$69,115<sup>1</sup>

**A455, The Infrastructure Construction and Condition Monitoring Laboratory as a Novel Teaching Tool to Improve Undergraduate Education in Civil Engineering,** Prof. Roberta Massabo, \$12,283<sup>1</sup>

**A456, Introducing Size Effect into Design Practice and Codes for Concrete Infrastructure,** Prof. Zdenek Bazant, \$60,388<sup>1</sup>

### **Continuing Projects**

**A448, Commercialization of Instrument for Micro-Inch Measurement of Crack Width in Support of Thrust in Remote Monitoring for Bridge Management,** Prof. Charles Dowding, \$70,916<sup>1</sup>

**A449, Commercialization of TDR Measurement of Soil Deformation in Support of Thrust in Remote Monitoring for Bridge Management,** Prof. Charles Dowding, \$51,965<sup>1</sup>

**A451, Improved Condition Monitoring of Bridges: Nondestructive Evaluation of Foundations,** Prof. Richard Finno, \$65,158<sup>1</sup>

**A452, Life Cycle Management of Steel Bridges Based on Nondestructive Testing and Failure Analysis,** Prof. Brian Moran and Prof. Jan Achenbach, \$61,535<sup>1</sup>

**A453, Improved Condition Monitoring for Bridge Management,** David Prine, \$178,418<sup>1</sup>

**A454, Further Commercialization of NUCu Steels,** Prof. Morris Fine and Dr. Semyon Vaynman, \$26,572<sup>1</sup>

**A441, Ultrasonic Technique for In-situ Monitoring of the Setting, Hardening, and Strength Gain of Concrete,** Prof. Surendra Shah, No Year 3 funding

## **Completed Projects**

**A428, Analysis of the Performance of the Rehabilitation of the Chicago-State Subway Station and Its Effects on Adjacent Structures, Prof. Richard Finno**

**A433, Evaluation of Capacity of Micropiles Embedded in Rock, Prof. Richard Finno**

### **Notes:**

1. Amounts shown for continuing projects are ITI Year 3 funding.