EERI STUDENT CHAPTER
AT THE UNIVERSITY OF NOTRE DAME

EERI
University of Notre Dame

ANNUAL REPORT
2001-2002 SCHOOL YEAR

1.0 Mission Statement

In light of the recent disasters that have claimed so many lives and destroyed so much property, it is essential that engineers become aware of the increasing threats of natural hazards and techniques to mitigate them. While research at the University of Notre Dame focuses in many of these areas, a vast majority of the undergraduate population is unaware of such efforts. Thus, EERI at UND was established to provide the next generation of practicing engineers with a venue to discuss the latest developments in the areas of Earthquake Engineering to better prepare them for the challenges which will await them in their careers.

Awareness, however, should not be limited solely to engineers as earthquakes affect every aspect of human life. Thus EERI at UND will also extend its mission to educate and increase awareness of natural disasters and techniques to mitigate against them across this campus and the wider community.

In particular, the EERI student chapter at Notre Dame prides itself in the outreach activities it sponsors, helping to make a difference in the lives of young people and spreading earthquake awareness in the greater South Bend area.

2.0 Chapter Roster

Faculty Advisor: Dr. Yahya Kurama (2000-present)

Current Chapter Contact: Brian Morgen (Brian.G.Morgen.1@nd.edu)

Officers for 2001-2002 School Year:

Tracy Kijewski-Correa, President
Brian Morgen, Vice President
Nelson Duran, Secretary
Ethan Kubatko, Treasurer
Michael May, Webmaster

Officers for 2002-2003 School Year (Elected in April 2002):

Brian Morgen, President
Brad Weldon, Vice President
Tiphaine Williams, Secretary
Devin Brown, Treasurer
Hua Jiang, Webmaster

Chapter Members for 2001-2002 School Year:

Devin Brown*
Tracy Kijewski-Correa*
Nelson Duran

Yong Gao
Hua Jiang*
Ethan Kubatko
Michael May
Brian Morgen*
Narutoshi Nakata
Manuel Ruiz-Sandoval
Qiang Shen*
Aaron Vorwerk
Lijuan Wang*
Brad Weldon*
Tiphaine Williams*
Limin Yuan*

A number of these members will be graduating and/or moving on to other programs. The remaining members that will form the core of our constituency next year are marked by asterisks.

3.0 Chapter Activities (August 2001-May 2002)

SHAKES & QUAKES: K-12 Outreach Program

'Shakes & Quakes' is an outreach program designed to stimulate young minds and allow them to better understand the way in which civil engineering structures respond to severe earthquakes. EERI@UND visits local area classrooms and demonstrates building responses to earthquakes through the use of a portable shaking table. Students are asked to build LEGO and K'NEX models and these student-designed buildings are tested on the shaking table to see how they respond under "real" earthquake ground motions.

For the EERI@UND members who participated, it was an excellent opportunity to share with students the advances being made in Earthquake Engineering for the betterment of society. This past year we were able to visit two schools in South Bend, Indiana: Stanley Clark School (February – March 2002) and Dickinson Middle School (April – May 2002).

Continuing an annual tradition, EERI members returned to Stanley Clark School to challenge its students in the design of LEGO "masonry" buildings and K'NEX "steel" buildings. As always, the students were incredibly enthusiastic and willing to accept the challenge. This year, 45 5th grade students participated in the program, forming 12 construction companies.

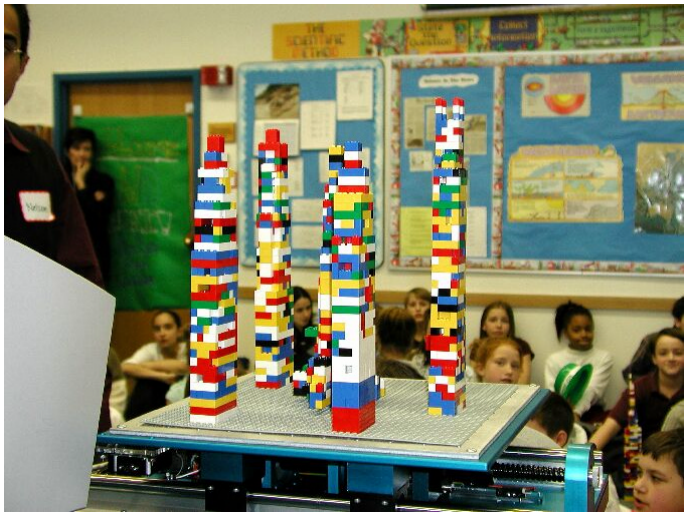
For the first time, EERI members visited Dickinson Middle School to challenge its students in the design of LEGO "masonry" buildings and K'NEX "steel" buildings. (25) 7th grade students participated in the program, forming 6 construction companies.

On Shake Day for both of the schools, the companies each prepared a small presentation discussing the motivation for their design and some of the obstacles they encountered. The competitive fire was obvious, as some teams made half-hearted accusations of copyright infringement and even sabotage! However, the presentations, all in good fun, demonstrated the concept of teamwork the students used in their design process. Some teams even prepared jingles and interactive presentations to promote their building.

'Shakes & Quakes' has been used as a supplement to the textbook during an Earth Science unit on earthquakes. The entire project lasts about 3 weeks, with 2 weeks devoted to planning and building the Lego structures and K'Nex. The third week is used for Quake Day, analyzing the results, researching building techniques, and writing the final reports. The first and last classes are led by EERI@UND members, while the teacher is responsible for conducting the discussions and group activities detailed in the second and third weeks. The coverage during the two visits is as follows:

Visit #1: Students receive a project handout, building supplies are given to the teacher, and a general overview of earthquakes and the project is given. In addition, Tracy Kijewski-Correa, the EERI@UND President, gave a presentation to show the importance of understanding how bridges and buildings respond to earthquakes and how damaging quakes can be to people and civil structures. She also spoke about earthquake risk especially in regions of the U.S. that are not traditionally thought of as 'active' earthquake regions. Students were shocked to learn about the many severe earthquakes that occurred in the 19th century in the New Madrid region which is located in the Midwest not too far from South Bend.

Visit #2: At the end of two weeks, the EERI@UND members visit the classroom for Quake Day, bringing a portable shaking table and a computer. The LEGO and K'nex buildings designed and constructed by the students are tested.



Each of the classrooms had to form groups of about four students in order to build an earthquake-proof building out of Lego blocks, which would be tested on a small earthquake simulator. They had to use their imagination and ingenuity to come up with designs that could beat the deadliest earthquakes known to man.

In each group, students had to choose their individual roles. One person was the owner of the building, one the architect, another an engineer, and the last person was the builder. They would

have to learn to work together to fulfill their respective duties without compromising any of their teammates' goals.

They had some rules for designing and constructing their building in order to make the exercise as realistic as possible (see www.nd.edu/~eeriund/shakes.html to view and download documentation and rules for the program). These regulations helped them to understand how important efficiency, cost, strength, appearance, and constructability are to any project.

More importantly, the students were also exposed to new life-saving technologies, emphasizing the concepts of energy dissipation and base isolation, a concept even few adults understand, made simple through the use of Legos on wheels. Some students even incorporated, albeit unknowingly, friction damping in their designs.

The day was great fun not only for the students involved but also for the EERI@UND members and raised overall awareness in the community through coverage on local television and in local newspapers. Additional information including photos is available on our chapter website: www.nd.edu/~eeriund.

Taking the Mystery out of Math and Science: Ms. Wizard Day 2002

EERI's Academic Fair display (top) which EERI member Tiphaine Williams used to explain the importance of structural engineering.

The EERI Notre Dame Student Chapter was one of the many student organizations that participated in Ms. Wizard Day on February 2, 2002 on the campus of the University of Notre Dame. The program, funded by a number of local businesses, brings elementary school girls from the South Bend area together for a day of math and science activities. The festivities began at 9 am in the form of an Academic Fair featuring professions heavily relying on math and science. EERI officers and members spent an hour with the girls explaining the important roles structural engineers play in society, particularly in earthquake-prone areas.

After a special seminar and a visit to campus dorms for lunch, the girls began three hours of lab activities, including a one-hour adaptation of the chapter's existing Quakes and Shakes outreach program. Coordinated by EERI's Vice President Brian Morgen, the activity encouraged teams of three to play the roles of architect, owner and engineer and construct a building of LEGO blocks. Following a presentation by EERI

President Tracy Kijewski-Correa, the teams were assisted by EERI members and began designing their buildings, faced with the competing objectives of aesthetics, rental profits and structural safety under earthquakes. The teams developed a number of impressive designs with towering spires, balconies and even a helipad!

Gao (above, left), Vice President Brian Morgen (right, top) and Nar assist teams in constructing their buildings.

The LEGO buildings were then tested in the Shake Off competition using a portable earthquake table mimicking a gradually intensifying earthquake. The surviving building was deemed the most earthquake-proof, earning that team honorary degrees in structural engineering. The team responsible for the most beautiful building similarly warranted an honorary architecture degree, and the design that maximized the available rental space for the most profits was presented with an owner's achievement award. The winners were able to share with their families elegant certificates marking these achievements.

At the end of the day, it became evident that the activity had made a lasting impact not only on the young students, who voted this particular lab activity one of the favorites in an exit survey, but also on the participating EERI members. The enthusiasm surrounding EERI's participation even attracted area newspapers and television crews, who featured the outreach activity on the evening news.

EERI members have remained personally committed to such programs targeted at increasing engineering enrollment amongst women by also participating in the Expanding Your Horizons Program (April 27, 2002) at the University of Notre Dame.

Distinguished Lecturers: Linbeck Series & Mete Sozen

The EERI student chapter at the University of Notre Dame assisted Dr. Billie Spencer and Dr. Yahya Kurama in coordinating aspects of the *Linbeck Distinguished Lecture Series in*

Earthquake Engineering: Challenges of the New Millennium (see appendix for lecture series poster) featuring 7 speakers:

- Thomas D. O'Rourke, the Thomas R. Briggs Professor of Engineering at the School of Civil and Environmental Engineering at Cornell University, spoke on September 21, 2001. Dr. O'Rourke's lecture was entitled "Geospatial Modeling for the Earthquake Response of Lifelines and Buildings".

- Helmut Krawinkler is the John A. Blume Professor in the Department of Civil and Environmental Engineering at Stanford University. On October 2, 2001, he delivered a talk entitled "Progress and Challenges in Performance-based Earthquake Engineering".

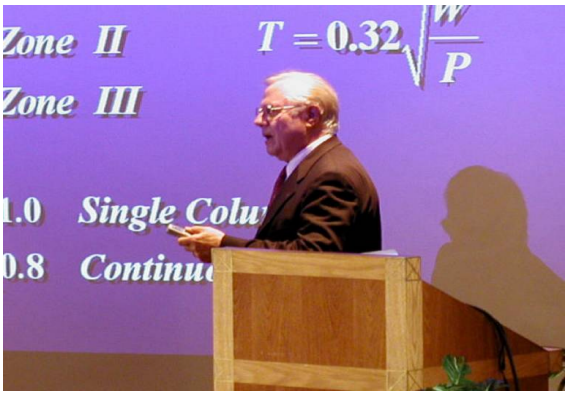
- Joseph Penzien, Senior Principal of International Civil Engineering Consultants, Inc. and Professor Emeritus of Structural Engineering at University of California, Berkeley, visited Notre Dame on October 19, 2001. His talk was entitled "Earthquake Engineering for Transportation Structures – Past, Present, and Future".

- Hiroo Kanamori, the John E. and Hazel S. Smits Professor of Geophysics at the California Institute of Technology visited Notre Dame on November 9, 2001. The title of his lecture was "Future Directions in Seismology for Earthquake Damage Mitigation".

- Notre Dame hosted Sharon L. Wood, Professor in the Department of Civil Engineering at University of Texas at Austin, on March 1, 2002. She spoke about "A Comparison of the Response of Precast Construction during the 1994 Northridge and 1999 Turkey Earthquakes".

- Eric Elsesser, the Founding Principal of Forrell/Elsesser Engineers, Inc., located in San Francisco, spoke at Notre Dame on March 22, 2002. His talk was entitled "The Search for the Perfect Seismic Protection System".

- On April 4, 2002, Notre Dame hosted, Daniel P. Abrams, the Hanson Engineers Professor of Civil and Environmental Engineering and Director of Mid-America Earthquake Center at the University of Illinois at Urbana-Champaign. "Consequence-based Engineering Approaches for Reducing Earthquake Losses in Mid-America" was the title of his lecture.



In particular, Dr. Penzien and Mr. Elsesser visits to Notre Dame were made possible by EERI's Friedman Family Visiting Professionals Program. Dr. Penzien, shown at the left, delivered his lecture to Notre Dame undergraduate and graduate students, post-docs, and faculty, summarizing the advances in earthquake engineering for transportation structures over the past fifty years. He focused on seismic loading criteria, dual strategy of design, modeling and analysis, design detailing,

and assessment of seismic performance. Dr. Penzien's lecture proved to be very informative, thorough and interesting.

Mr. Elsesser (shown at the right) delivered a lecture for a Notre Dame undergraduate structural analysis course, which was a great opportunity for the students and was very well received. Shortly after the undergraduate lecture, Mr. Elsesser delivered his main lecture on potential new directions for seismic protection systems that enhance energy dissipation and result in favorable building forms and configurations. Both students and faculty agreed that Mr. Elsesser's perspectives as a practicing structural engineer were especially refreshing.

During the visit of each Linbeck Lecturer, a special lunch was organized by the Notre Dame chapter of EERI. During these lunches, graduate students had the opportunity to discuss both professional and personal experiences from these distinguished visitors. At the same time, each speaker learned about the chapter's activities, such as the various outreach programs. In addition, during their visits the Linbeck Lecturers were able to meet and converse with members of the structural engineering faculty, tour department's facilities and tour Notre Dame's scenic campus.

Details about each visit, as well as photos and a complete video archive with each lecture in this series can be found at www.nd.edu/~linbeck and also linked on our chapter website www.nd.edu/~eeriund.

In addition to assisting with the Linbeck Lecture Series, the University of Notre Dame's EERI Student Chapter was fortunate to have Dr. Mete Sozen visit its campus as part of the EERI Distinguished Lecturer's Program (see appendix for lecture poster). Dr. Sozen is the Kettelhut Distinguished Professor of Structural Engineering at Purdue University in West Lafayette, Indiana.

Graduate students, post-docs and faculty enjoyed the opportunity to discuss with Dr. Sozen the many philosophies he had developed over his storied career over an informal breakfast reception. Dr. Sozen then delivered an informative and entertaining lecture that revealed how historical and personal context has shaped the unique theories and technical understanding of three great Civil Engineers. His talk, "A Way of Thinking", encouraged the audience to revisit the works of Westergaard, Cross and Newmark with new perspectives. Dr. Sozen's lecture proved to be refreshing and thought-provoking, stimulating much reflection amongst those present.

A summary of Dr. Mete Sozen's visit, more photos and a video file of his presentation are available on our chapter website www.nd.edu/~eeriund.

High School Math and Engineering Challenge

The EERI Student Chapter at the university of Notre Dame developed a new activity this year, branching out to involve members of the university's ASCE student chapter. EERI was contacted by a local high school calculus teacher whose students were interested in learning more about how engineers use integration and other math tools in their professions. EERI developed an activity that allowed the students to use concepts of moment area methods to determine the deflections of a simple beam model being used to approximate a simply supported arch bridge. In total the activity explored the use of basic calculus and algebra in engineering calculations and to overviewed the different levels of modeling available to engineers in the design process. Though the activity was not explicitly concerned with seismic behavior, it served as an important service program for the chapter and a way to promote science and specifically structural engineering among high school seniors heading off to college.

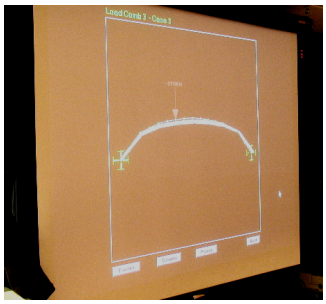
The students arrived on the campus of the University of Notre Dame on the afternoon of April 22, 2002 to begin the two hour activity. In order to simulate a realistic engineering design office, the students were divided into groups of three and presented with the following problem statement:

Determine the deflection of an arch bridge at its midspan due to a point load at three different locations using hand calculations based on simple beam assumptions and using more complicated structural analysis software model. Compare your results with measured data.

Following a brief welcome by EERI President Tracy Kijewski-Correa and an overview of the tasks involved by ASCE President Hugh Roberts, the students were allowed to work on their own through the various phases of the activity, with the participating EERI members on hand to assist them one-on-one with any problems they may have with the calculations.

The integration of this first phase was most challenging for the students as their basic integration skills would be tested by more complex expression in terms of a number of variables. After deriving the expression for the deflection of the simple beam approximation for the bridge, the students evaluated the expression using the given properties and dimensions of the bridge. They compared their result with those they calculated from a standard expression available in a number of structural analysis texts and found they matched identically, proving the accuracy

of the students' calculations.



The students then used RISA-3D structural analysis software to model the bridge, load it and record the deflections. This type of analysis allowed the students to readily visualize what was happening to the bridge as it was loaded and also gave them an opportunity to utilize realistic structural analysis software to illustrate the tools structural engineers have at their disposal to avoid having to do such complicated integration repeatedly in their analysis of large and complex structures.

As the final phase of the activity, each team of students had the opportunity to apply weights to a scale arch bridge model and measure its actual displacements. The students were then able to compare their findings from each of these three analyses and were pleased to find that their predictions via the computer programs and their hand calculations compared well with what they actually measured. More importantly, they got a feel for the types of predictive modeling tools engineers have at their disposal to allow them to predict the displacement of a structure they may be designing some day.

Though the activity only spanned two hours, the students were able to see an analysis from start to finish and experience some basic structural engineering first hand. For some, the concepts came naturally and today's activity served as a calling for a future profession. Even for those who did not feel this way, the activity at least provided perspective to the students that most beginning a career in mathematics and engineering do not have. The students caught a glimpse of the big picture -- the application of mathematical principles for practical problem solving.

EERI Website

More information about all of these activities can be found on our chapter website: www.nd.edu/~eeriund which serves as portal for current and prospective members, industry leaders, educators and other EERI student chapters to keep track of current EERI@UND events. As our activities continue to grow and gain more publicity in the South Bend community, our website has been expanded to house program information and archive press coverage in local newspapers and on local television news programs.

4.0 Appendix: Advertisements for Chapter Events

EARTHQUAKE ENGINEERING RESEARCH INSTITUTE

at the University of Notre Dame

Earthquake Engineering Research Institute and Department of Civil Engineering and Geological Sciences proudly present:

A Way of Thinking

A seminar by Dr. Mete Sozen

Kettelhut Distinguished Professor of Structural Engineering
Purdue University, West Lafayette, IN

Tuesday, February 19, 2002 at 9:30 am
133 Mendoza College of Business

ABSTRACT

Today, ready access to versatile and powerful software enables the engineer to do more and think less. It is not often questioned whether the exact analysis of the approximate model qualifies as an approximate analysis of the structure itself. To contemplate once again the role of analysis in design is not a waste of time.

A way of thinking about structural design was developed in a series of iterations in mid 20th century by three engineers. Their goals were not global. The whole was made up of specific solutions for specific problems. But when their contributions are viewed together, a complete way of thinking about structural design becomes discernible.

The thinking of Hardy Cross, Herald M. Westergaard and Nathan M. Newmark did not always intersect completely. But when it came to the relationship of structural mechanics to design, they were completely together. To them structural mechanics was perfect as long as it was not applied. When it was applied, it had to be applied with judicious care to maximize return in relation to investment. As long as one was going to be wrong anyway, one might as well be wrong the easy way.

The goal of this talk is to encourage engineers to review the works of Westergaard, Cross, and Newmark as a whole, not for the specific processes, but for the general principles of their art of thinking about structural design.