

**EERI STUDENT CHAPTER
AT THE UNIVERSITY OF NOTRE DAME**



**ANNUAL REPORT
2007-2008 ACADEMIC YEAR**

1.0 Mission Statement

In light of the many past, and more recent, natural 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@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@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, Indiana area.

2.0 Chapter Roster

Faculty Advisor: Dr. Yahya Kurama (2008-present)

Past Faculty Advisor: Dr. Richard Woods (2007-2008)

Current Chapter Contact: Kyle Butler (kbutler3@nd.edu)

Officers for 2007-2008 Year:

Kyle Butler, President

Kevin Walsh, Co-Vice President

Brian Smith, Co-Vice President

Rachael Bashor, Secretary

Audrey Bentz, Treasurer

Kevin Walsh, Webmaster

Officers for 2008-2009 Year:

Elections will be held in August 2008.

Chapter Members for 2007-2008 Year:

Rachel Bashor
Audrey Bentz
Kyle Butler
Jennifer Cycon
Adam Knaack
Ali Ozdagli
Brian Smith
Su Su
Kevin Walsh
Brad Weldon
Luling Yang

Faculty Chapter Members for 2007-2008 Year:

Tracy Kijewski-Correa
Ahsan Kareem
Yahya Kurama
Richard Woods

EERI Meeting Dates and Topics for 2006-2007 Year:

October 8th, 2007

- Beginning of the year lunch meeting.
- Officers were elected from the current and incoming graduate students.
- Preparations were made for visiting speakers.

November 12th, 2007

- Preparations were made for “High School Math Activity.”
- New members were introduced to the activity while also updating the presentation and handouts.

January 9th, 2008

- Preparations were made for “Science Alive.”
- Constructed models, refreshed hands on activities and reviewed presentations.

February 22nd, 2008

- Preparations were made for “Shakes & Quakes” activities.
- Upcoming outreach activities were discussed.
- Preparations were made for visiting speakers.

February 29th, 2008

- Initial preparations were made for event with Culver Academies.
- Major tasks included creating new presentation materials and activities.

May 9th, 2008

- End of the year meeting.
- Final preparations were made for Culver Academies visit
- Discussed future events for the organization.

3.0 Chapter Activities (August 2007 - June 2008)

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



Students preparing models and awaiting presentations

society. This past year we visited one school: Stanley Clark School (February 25 and March 11, 2008).

Continuing an annual tradition, EERI@UND members returned to area schools to challenge their 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, twenty to forty 5th and 6th grade students at each school participated in the program, forming their own construction companies made up of an architect, engineer, builder and owner.

On Shake Day, with proud parents looking on, the companies each gave a short presentation discussing the motivation for their design and some of the obstacles they encountered. The competition was fierce as each team demonstrated why their building was the best. 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 short skits 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 2 weeks, each week devoted to planning and building the LEGO and K’NEX structures. The last day of the second week is used for Shake 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. EERI@UND members remain available via e-mail for questions or concerns that any of the teams may encounter throughout this period. 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, EERI@UND officers and members 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.

They also spoke about earthquake risk, especially in regions of the U.S. that are not traditionally thought of as ‘active’ earthquake regions. Students learned of the New Madrid and Wabash faults in the Midwest and were shocked to learn about the many severe earthquakes that occurred in the 19th century in the New Madrid region, which is not too far from South Bend.



Students awaiting the “Shake Off”!

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 under a simulated earthquake ground motion.

Each of the classrooms formed groups of about four students in order to build an earthquake-proof building out of Lego blocks, to be tested on a small earthquake simulator. They had to use their imagination and ingenuity to come up with designs that could withstand severe earthquake loading.

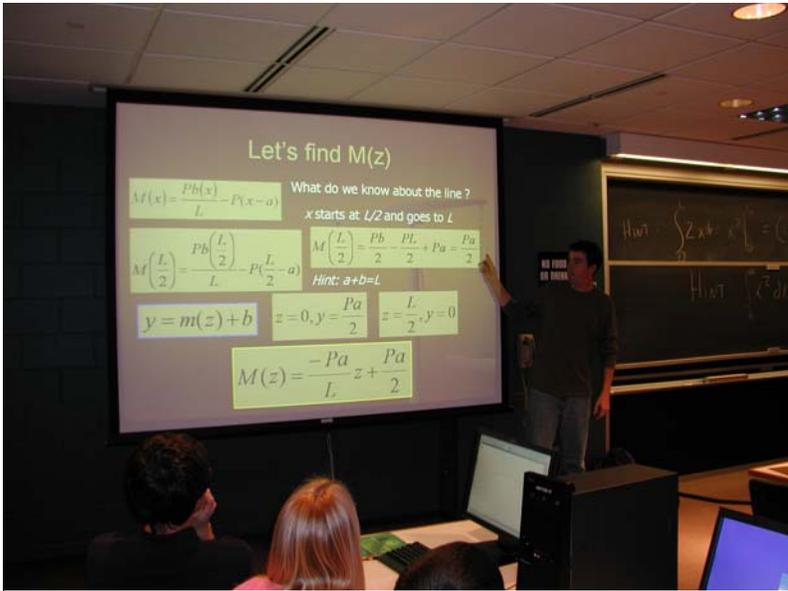
In each group, students had to choose their individual roles. The four roles were: owner of the building, the architect, the engineer, and the builder. They would have to learn to work together to fulfill their respective duties without compromising any of their teammates' goals.

They had to follow certain 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.

Shake Day was great fun not only for the students involved but also for the EERI@UND members. After the shake off, 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. Additional information, including photos, is 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, in conjunction with the American Society of Civil Engineers (ASCE) student chapter, continued the annual high school bridge activity. Each year, EERI@UND partners with a local high school calculus teacher to introduce his students to civil engineering and learning more about how engineers use integration and other calculus tools in their professions. At that time, EERI@UND developed an activity that allowed the students to use concepts of moment area methods to determine the deflections of a simple beam model approximating a simply supported arch bridge. In total, the activity explores the use of basic calculus and algebra in engineering calculations and overviews the different levels of modeling available to engineers in the design process. Though the activity was not explicitly concerned with seismic behavior, it serves 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.



EERI member discussing the procedure for integrating the equations

Students from a local high school (Clay High School) arrived on the campus of the University of Notre Dame on the afternoon of November 15, 2007 to begin the two-hour activity. In order to simulate a realistic engineering design office, the students were divided into groups of three or four 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 and an introduction to civil engineering by EERI@UND Co-President Kyle Butler and an overview of the tasks by various EERI@UND members, the students were allowed to work on their own through the different phases of the activity, with the participating EERI@UND and ASCE members on hand to assist them one-on-one with any problems arising with the calculations.

The integration in the first phase was most challenging for the students, as their basic integration skills were tested by more complex expressions. Guided by EERI@UND members through the integration procedure, the expression for the deflection of the simple beam approximation for the bridge was derived. The students were then able to evaluate the expression using the given properties and dimensions of the bridge. They compared their results 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, a structural analysis program, 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 scaled 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 the measurements. 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.

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 the 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



EERI member helping students with the bridge model

do not have. The students caught a glimpse of the big picture -- the application of mathematical principles for practical problem solving. The program continues to evolve as improvements are made on the activity each year, especially in deriving new ways to approach the calculus background to students for whom the topic does not come easily.

Science Alive

The EERI@UND student chapter participated in the 17th Annual Science Alive on February 2, 2008 at the St. Joseph County Public Library in South Bend. Science Alive is an event put on by the Library, and features exhibits about how science is used in everyday life, aimed at reaching K-8th grade children. The event lasted all day and over 5,000 children and adults were in attendance.

Along with members of the Notre Dame Student Chapter of ASCE, EERI@UND set up an exhibit at Science Alive. The display featured a poster board with information about the EERI@UND Student Chapter, background information on structural and earthquake engineering and how earthquakes affect structures. With a portable shake table and a K'NEX building on hand young students were able to see how a steel building responds in an earthquake. The building was constructed such that bracing elements could be easily removed, to illustrate what happens to a structure when it is damaged during an earthquake. As the building was undergoing a simulated ground motion, EERI@UND

members removed one of the bracing elements to introduce a torsional mode in the building. Visually seeing the building twisting, in addition to swaying back and forth, made the children appreciate the importance of symmetric structures in earthquake prone regions.

There were also geotechnical engineering demonstrations on display, including a “Bucket o’ Bolts”, paper reinforced sand piles and Oobleck. The “Bucket of Bolts” was created using a round pail in which six rock bolts were placed. The bucket was then filled with large rocks, and the bolts were tightened. To demonstrate the power of compressive forces, the bucket was turned upside down, and to the children’s amazement, the rocks did not fall out. This simple demonstration helped illustrate what is done in retaining walls and tunnels to keep the soil in place. The Oobleck mixture was created by mixing cornstarch and water. The children were then able to get hands on with this unique creation and view its interesting properties. Oobleck provides a good example of how clayey soils can dilate and liquefy during an earthquake. Also, the children thoroughly enjoyed playing with the mixture. Additionally, paper layers were placed in mounds of sand and weights were placed on reinforced and un-reinforced mounds to show how reinforcement helps with soil stability. The children were allowed to press on each pile with as much force as possible to get a feel for how well simple paper sheets can reinforce a sand pile. This was probably the most interesting event based on the responses of parents and children.

The event as a whole was quite a success, as the children (and adults) all enjoyed seeing the K’NEX building swaying when put under a simulated earthquake motion. Science Alive was not only a great experience for the children to learn about how science is used in the real world, but also a great opportunity for EERI@UND members to reach out to the community.

Culver Academies Activity

This year, EERI@UND was approached by Jan Weaver at the Culver Academies to do a demonstration about how engineers design for earthquakes to the senior geology class. The Culver Academies is a prestigious private school in Culver, IN, that was once a military academy. For this presentation, we brought a simple K’NEX building along with the portable shaking table to show how modifications of tall steel structure can drastically change its behavior to ground excitation. The initial presentation consisted of a background in earthquake mechanics and was followed by a background discussion into structural design. The second part of the presentation used the shake table and building to demonstrate the different building properties by ground excitation. The final part of the presentation was a question and answer session about engineering, as well as different ways buildings could be designed to mitigate many different excitation forces.

This was the first time EERI@UND has used the Shakes and Quakes type presentation on a High School level. We hope to continue this connection with the Culver Academies to build a multi-level project based course (like the Shakes and Quakes project) that

appeals to a much older age group, providing the necessary intellectual stimulation. This first presentation served as a stepping stone for future development of this course.



EERI members performing a demonstration of ground motion effects on a tall structure.

the Shakes and Quakes presentation, using LEGOs and K'NEX to demonstrate the behavior of masonry and steel buildings. The students were of elementary and middle school aged, so the discussion remained on the level of the current Shakes and Quakes model. This project served as another avenue for educating the Notre Dame community about engineering and earthquakes, while also demonstrating our repertoire of information to Notre Dame faculty in the science departments.

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 area and surrounding 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 EERI Friedman Family Visiting Professional Program

Unfortunately, due to time constraints, during the 2007-2008 school year EERI@UND was unable to host any speaker through the Friedman Family Visiting Professional Program. Due to a number of faculty recruit interviews and seminars along with the

Sensing Our World

This year, EERI@UND was contacted by the Notre Dame Summer Science Camp to do a brief presentation to its participants about engineering and the way structural engineers design for earthquakes. Their topic for the year was “Sensing Our World,” and we used this topic to discuss how engineers monitor bridges and buildings to assess their behavior. We did a brief presentation, similar to

significant amount of outreach activities, group member's time was very limited. EERI@UND hopes to once again be able to host speakers during the 2008-2009 school year.

5.0 EERI Seminars

Although, the chapter was unable to host any visiting professionals this year, there were a couple of guest speakers that made their way to Notre Dame, were they gave lectures to the student chapter and students. Typically, a lunch is provided for each guest with the EERI members in attendance as in informal way to communicate with other academics. As always, these lectures are greatly appreciated by both the student members and faculty. Attached are the flyers containing the abstracts for these lectures.

On November 13, 2007, EERI@UND was given a seminar by Dr. Jonathan Bray from the University of California, Berkley, and providing lunch for guests and active members. The lecture entitled "Mitigation of the Surface Fault Rupture Hazard" described some of the research areas in which Dr. Bray is currently working. This talk was attended not only by the EERI chapter members, but also members of the undergraduate class, giving Dr. Bray an opportunity to communicate some of his research concepts on a more basic level. We greatly appreciated Dr. Bray's visit, and hope to continue our relationship with him and provide him with future opportunities for EERI@UND lectures.

On December 7, 2007 EERI@UND was fortunate enough to have Dr. Jerome Lynch from the University of Michigan at Ann Arbor give a seminar entitled "Advance Sensor Technologies for Smart Structure Applications". EERI@UND had lunch with Dr. Lynch and discussed current and future trends within structural and geotechnical engineering regarding sensing technologies. It was a very informative day, with members asking many questions not only regarding his research but also his insight in to graduate level work. We enjoyed having Dr. Lynch and would certainly appreciate a future talk.

On April 11, 2008 EERI@UND was honored to have Dr. Jose Roesset from Texas A&M University, in which he gave a seminar entitled "Dynamics of Deepwater Offshore Platforms". EERI@UND had lunch with Dr. Roesset and discussed many different aspects of his past work and his experiences as a graduate student and working in the field. This talk was attended not only by EERI members, but by the entire structural engineering group. We certainly appreciated Dr. Roesset's visit to Notre Dame, and look forward to having him return for a future lecture.

On April 22, 2008 EERI@UND, along with the Notre Dame chapter of ASCE was given a seminar by Dr. William Marcuson, past National President of ASCE. The lecture entitled "The Civil Engineer in the 21st Century" gave a well rounded view of where the current state of the art is headed and what trends need to be addressed by current and future civil engineers. This talk was attended not only by the EERI chapter members, but also members of the greater South Bend, IN ASCE community and Notre Dame engineering students. We greatly appreciated helping with Dr. Marcuson's visit, and hope to continue our relationship with him and with ASCE for future EERI@UND lectures.



Department of Civil Engineering and Geological Sciences

Seminar

Title: *"Mitigation of the Surface Fault Rupture Hazard"*

Speaker: *Jonathan D. Bray, Ph.D., P.E.
University of California, Berkeley*

Date: *Tuesday, November 13, 2007*

Time: *1:00 p.m.*

Place: *217 Cushing Hall, Engineering Student Lounge*

Abstract

Recent earthquakes have reminded the profession of the devastating effects of earthquake surface fault rupture on engineered structures and facilities. Insights from these events are discussed with special emphasis on describing how ground movements associated with surface faulting affect structures. Similar to other forms of ground failure, such as mining subsidence, landslides, and lateral spreading, effective design strategies can be employed to address the hazards associated with surface faulting. These design measures include establishing non-arbitrary setbacks based on fault geometry, fault displacement, and the overlying soil; constructing earth fills, often reinforced with geosynthetics, to partially absorb underlying ground movements; using slip layers to decouple ground movements from foundation elements; and designing strong, ductile foundation elements that can accommodate some level of deformation without compromising the functionality of the structure.



Department of Civil Engineering and Geological Sciences

Seminar

- Title:** *"Advance Sensor Technologies for Smart Structure Applications"*
- Speaker:** *Dr. Jerome P. Lynch*
*Department of Civil and Environmental
Engineering*
University of Michigan
- Date:** *Friday, December 7, 2007*
- Time:** *3:30 p.m.*
- Place:** *117 DeBartolo Hall*

Abstract

A smart civil structure is defined by the embedment of sensing and/or actuation technologies that can be used to record system behaviors and to control undesired responses. The past thirty years have been characterized by a revolution in the field of smart structure technologies with sensors and actuators both reducing in size, power demand and unit cost. This presentation is chiefly focused upon the development of new sensor technologies optimally designed for structural health monitoring applications. Using state-of-the-art embedded systems and information technologies, a low-cost alternative to traditional wire-based sensing systems has been developed. Wireless communication eliminates the costs associated with installing extensive lengths of cables in a civil structure. However, the most exciting element of wireless sensors is the collocation of computing authority with the sensor. With computationally rich resources, wireless sensor networks can serve as autonomous computing agents capable of executing damage detection and system identification analyses in near real-time. As a means of system validation, various performance tests were performed including installation in many large-scale civil structures. Other emerging sensor technologies based upon multifunctional materials will also be presented. For example, carbon nanotube composites intentionally structured at the nano-scale represent a powerful material platform upon which strain and corrosion sensors can be developed. Specifically, our work is focused on utilizing such materials as a "sensing skin" that provides spatial resolution of structural behaviors.



Department of Civil Engineering and Geological Sciences

Seminar

Title: *"Dynamics of Deepwater Offshore Platforms"*

Speaker: *Dr. Jose Roesset
Texas A & M University*

Date: *Friday, April 11, 2008*

Time: *2:30 p.m.*

Place: *203 DeBartolo Hall*

In just 50 years the offshore industry has been able to extend the production of oil from some 6m of water to over 1000 m. with surface piercing structures and over 1500m with subsea completion systems. In this process, the industry has designed, fabricated and installed platforms which have defied the imagination of structural engineers and which have gained repeatedly the award for civil engineering accomplishment of the year. The purpose of the talk is to review briefly the historical evolution of offshore oil production, with special emphasis on the recent march towards very deep waters and to discuss some of the nonlinear dynamic effects in the response of these structures.

About the Speaker:

Prof. Roesset has undergraduate degrees from Spain and his doctor of engineering from MIT. He has taught at MIT, University of Texas-Austin, and is now associate chairman of Civil Engineering at Texas A & M University. Jose is past director of the Texas A & M Offshore Technology Program and is a worldwide recognized leading engineer in structural dynamics and soil-structure interaction.

A SPECIAL INVITATION TO SOME VERY SPECIAL EVENTS!

April 22, 2008

The North Central Branch of the Indiana Section of ASCE cordially invites you to attend some very special events welcoming our National Past President, William F. Marcuson III Ph.D., P.E., Hon. M.ASCE to the University of Notre Dame and the City of South Bend.

Dr. Marcuson is nationally and internationally renowned for his expertise in the geotechnical area. He is a consultant on lems and projects especially those involving seismic remediation, ground improvement and dam safety. He delivered ASCE's distinguished Karl Terzaghi Lecture in 1999. geotechnical prob

Dr. Marcuson will be presenting "The Civil Engineer in the 21st Century" in which he will discuss recent changes in the global economy and their implications for American civil engineers. Ideas for solutions will be offered including the need for changes in civil engineering education for American engineers to compete. The key question is what will make American civil engineers of the future so valuable as to be worthy of a salary that is an order of magnitude higher than foreign engineers with comparable skills. American civil engineers cannot compete on a technology/dollar basis. We must compete on a technology leadership/dollar basis. He will also describe what ASCE is doing to prepare American civil engineers for the future, i.e. BS + 30, "Body of Knowledge" and Summit for "The Civil Engineer of 2025". Additionally, he will discuss ASCE's action regarding infrastructure issues.

This is a presentation not to be missed...Dr. Marcuson is an amazing, entertaining and congenial presenter, able to draw on his experiences from all around the world, who will certainly challenge all of our thinking...

EVENT SCHEDULE

April 22, 2008

<u><i>Event</i></u>	<u><i>Time</i></u>	<u><i>Location</i></u>
Dr. Marcuson Seminar Presentation	3:30 p.m.	102 DeBartolo Hall (Notre Dame)*
Civil Engineering City Tour	4:30 p.m.	City of South Bend
Reception (hors d'oeuvres & beverage)	5:30-7:30 p.m.	Studebaker National Museum**
Dinner	7:45 p.m.	To be determined