3. EDUCATION PROGRAM

3.1 Strategic Education Plan, Methodologies, Milestones, and Deliverables

The Education Program is designed to introduce, stimulate, cultivate and educate undergraduate and graduate students with the knowledge that will enable them to contribute to the earthquake-engineering profession from a variety of disciplines and perspectives. The program attracts students to earthquake engineering early in their academic career and aims to retain them through graduate study. While the principal audience of the Education Program is undergraduate and graduate students, K-12 students also benefit directly from the Education Program's activity. PEER's Education Committee, composed of representatives from all 18 core and affiliated universities, is charged with the planning and implement in the program.

Several specific programs have been instituted to provide undergraduate and graduate students with opportunities in the Education Program. Our overall objective is to build a culture within PEER, starting at K-12 and extending through graduate school, where students are excited about earthquake engineering learning and realize the need to contribute to the learning of others. Figure 3.1 illustrates the overall strategic plan with focus areas and milestones. Programs and deliverables cover the range from K-12, undergraduate students, and graduate students. Detailed descriptions of programs/projects are provided in subsequent sections of this chapter.

![Figure 3.1 – Education Program Strategic Plan](image-url)
3.2 Current Education Projects and Curriculum Innovations

3.2.1 Current Education Projects

During Year 6, the Education Program will sponsor eleven on-going projects. These are described briefly below:

3.2.1.1 Research Experience for Teachers (RET)

Middle school students from the inner city are often unaware of career opportunities in science and engineering. In an effort to improve math and science education at the middle-school level, PEER has begun working with teachers and their students through a Research Experience for Teachers (RET) supplemental grant. Our goal is to increase the knowledge and skill level of teachers from inner city schools, while at the same time having some direct impact on their students. This past year, nine teachers from eight inner-city schools spent several weekends on a PEER campus learning about earthquake engineering from faculty and graduate students, as well as receiving detailed instruction on operation of the university’s laboratory equipment. These teachers then worked with their own students to develop science fair projects with experiments carried out by the students and teachers at the PEER university campus. Two of these projects have made it to countywide science fair finals, taking second place. We believe that this program is making an impact on K-12 education in two ways: (1) by developing earthquake engineering knowledge and laboratory skills of the K-12 teachers that they can utilize in the classroom, and (2) by exposing K-12 students to the university environment so that they can begin to realize it is an achievable goal for them.

3.2.1.2 PEER Summer Internship Program

The PEER Summer Internship Program is intended to interest, attract, train and retain promising undergraduates who have expressed an interest in earthquake engineering research. Students work, over a period of ten weeks, under the direction of a PEER faculty mentor on a PEER-funded research project during the summer months and submit a report detailing their research experience during the fall term. We endeavor to restrict interns to working on projects that are current or recent-past PEER projects, although in exceptional cases we will accept students to work on PEER-related projects. During the past four years, PEER sponsored participating students to attend the EERI Annual Meetings in St. Louis, Monterey, Long Beach, and Portland. Prior to the Friday evening reception, students presented posters about their summer research experience in an informal setting, while interacting with renowned specialists in earthquake engineering. PEER's internship opportunities provide students with experience in hands-on, individualized laboratory and field research, and increase opportunities in academia and professional practice. The students who participated in the PEER Summer Internship Program during summer 2002 submitted their final research reports on November 1, 2002. The interns' papers are being compiled into a compendium document for

Figure 3.2 - Participants in the 2002 REU Symposium
distribution to PEER's community of faculty and students. The Education Program is currently recruiting fifteen students to participate in the PEER Summer Internship Program during summer 2003.

### 3.2.1.3 Research Experience for Undergraduates Summer Internship Program

In a program that parallels the PEER Summer Internship Program, the Research Experience for Undergraduates (REU) Summer Internship Program sponsors PEER students working at an institution other than their home campus, or students from campuses outside the PEER consortium, to work on PEER-funded research projects mentored by a PEER faculty member. In addition to the research experience, the REU Program (in an activity conducted jointly with SCEC) offers a one-day Communication Skills Workshop for the interns to assist them with oral and written reporting skills. The Workshop affords them the opportunity to discuss their ongoing research experience with other engineering and earth science students. The impact of the workshop is evident in the superior quality of the REU students' oral presentations and written reports submitted during the fall term following their internship.

The REU program also provides an opportunity to meet REU students from the other EERCs and thereby learn how earthquake engineering is perceived in other parts of the US. In August 2002, REU students from MAE, MCEER, and PEER met in Keystone, CO for a lively discussion of ethics in engineering, as well as an opportunity to hone their presentation skills in PowerPoint presentations relating their summer research experience to the group.

The PEER Education Program is currently recruiting seven students, focusing on those from groups historically underrepresented in the field, for the summer 2003 REU Program. The 2003 REU Symposium will be held August 7-10 in Bend, OR.

### 3.2.1.4 Earthquake Engineering Scholars Course

PEER's Undergraduate Earthquake Engineering Scholars Course (EESC) is a program implemented to showcase the graduate programs at PEER core institutions and introduce high-ranked undergraduate students to four topics in the field of earthquake engineering including seismology, geotechnical engineering, structural dynamics, and public policy. The Fall 2002 version of the EESC was a multi-campus program that provided instruction to 30 students from eleven PEER universities during four weekend retreats at PEER core-university campuses (UC Irvine – Seismology; UC Berkeley - Structural Dynamics; UC San Diego - Geotechnical Earthquake Engineering; and UC Los Angeles - Public Policy). These individual topics were the primary focus of each of the four weekends; however, the students commented on the faculty's success in developing a connection between the four topics which united the course overall and provided the students an opportunity to explore many facets of the earthquake engineering profession. As an addition to the 2002 program, the Education Committee invited at least one PEER Business and Industry Partner member to present during each of the retreats. For example, at UC Berkeley, several young BIP engineers gave the PEER Scholars tours of seismic retrofit projects on the Berkeley campus, described engineering drawings and engineering...
practices, and shared experiences going from school to professional practice. The schools also utilized the opportunity to conduct tours and "show off" their laboratories and facilities. An objective of the course is to recruit new talent to the field of earthquake engineering. Most students who participated in the EESC in 2000 and 2001 have gone on to pursue graduate study at a PEER institution.

The Education Committee has enthusiastically endorsed another Scholars' Course offering for Fall 2003. Retreats will be held at USC (Geotechnical Earthquake Engineering), Stanford (Seismology), University of Washington (Structural Dynamics), and UC Davis (Public Policy). As an addition to this year’s program, each host university will invite a faculty member from at least one other PEER core school so that all core schools are represented.

3.2.1.5 Tri-center Earthquake Field Study Program for Students

The Tri-center Earthquake Field Study Program for Students is a new effort focusing on earthquake reconnaissance experience for PEER students starting in May 2002. Each summer this project brings students from MAE, MCEER, and PEER together to conduct post-earthquake investigations during a weeklong summer camp at a non-US site. The “new blood and experience” that are gained not only broaden the students’ experiences but also train students future earthquake reconnaissance in programs such as the EERI Learning from Earthquakes Program. The participating students are drawn from a variety of institutions and disciplines. Each student is required to issue a formal reconnaissance report following the field investigation. The Education Directors have extended an invitation to EERI to fund four (non-EERC) students, plus a young faculty member, as part of its endowment program. In May 2002, three PEER students took part in the Taiwan Earthquake Field Study. In May 2003, three PEER students are scheduled to join their counterparts from MAE and MCEER for a field study in Italy. Students from the Southern California Earthquake Center (SCEC) will also participate. As this is a new program for PEER, the Education Program plans to conduct a critical evaluation of the program’s value after the students submit their final reports in 2003.

3.2.1.6 Graduate Fellowship Program

Graduate student participation in PEER's research program is a traditional mechanism to train and educate students. To augment this traditional approach, the Education Program initiated the Graduate Fellowship Program as a way to recruit and retain graduate Ph.D. students from groups that traditionally have been under-represented in the profession. The program aggressively recruited students from various ethnic groups, and subsequently provided funding for $20,000 per year for up to three Ph.D. students to study at a PEER institution, contingent on the student remaining in good standing. The Education Committee reviewed this program over the past two years and has determined that it neither an effective nor viable means of recruiting students from under-represented groups into the PEER circle. Currently there is one student remaining in the program, with two others graduated with their Ph.D.s in Year 6. After this final student graduates in Year 7, the PEER Education Committee will shift funding to programs that will impact more students.

3.2.1.7 Student Leadership Council

PEER aims to create an environment in which students learn leadership and management skills through independent student organizations. In PEER’s first years, we encouraged formation of EERI Student Chapters, with chapters now located at Caltech, Oregon State, San Jose State,
Stanford, UC Berkeley, UC Davis, UC Irvine, UC San Diego, and the University of Washington. Starting in Year 2, PEER formed its **Student Leadership Council** (SLC) and **PEER Student Association** (PSA). Both undergraduate and graduate student representatives on the SLC, from the core and affiliated campuses, provide an active and valuable voice for all PEER students. Over the past four years, PEER's SLC has been an influential contributor to the PEER Education Committee and PEER Administration concerning the needs of undergraduate and graduate students. The SLC president attends each of the Education Committee's quarterly meetings to provide feedback and input concerning the programs offered by PEER Education. The SLC conducts its own quarterly meetings, which are scheduled to coincide with other PEER Research and Education events to maximize opportunities for networking and discussion. PEER's fourth Student Day, held concurrently with the PEER Annual Meeting in March 2003, was an excellent forum for students to share their intellectual and personal experiences as participants in the PEER. The event includes meetings of the SLC and other students, formal poster sessions, and presentations by PEER students and Business and Industry Partners.

### 3.2.1.8 Tri-Center Ph.D. Candidate Exchange

The **Tri-Center Doctoral Candidate Exchange** is a new program in Year 6 that will send two PEER graduates students nearing completion of their doctorate to give lectures at MAE and MCEER, while PEER will welcome to two students for lectures from each of these centers as well. The first exchange to PEER from MAE is scheduled for 5 May 2003, when Leonardo Duenas-Osorio from Georgia Institute of Technology with present the results of his MAE-funded research to a group of graduate students at UC San Diego. The program provides valuable speaking opportunities for advanced students and exposes research among the three centers in ways that would not otherwise occur.

### 3.2.1.9 PEER Lecture Series

In Year 6 PEER will also institute a **PEER Lecture Series** by key PEER Researchers and Business and Industry Partners. The lectures will be web cast to all PEER Core and Affiliate School, providing further linkage among the schools and ensuring that key research results/topical areas are widely shared within PEER. The first lecture will be offered by PEER Director Jack Moehle in Spring 2003.

### 3.2.1.10 Learning with LEGO Program

The **Learning with LEGO Program** was inspired by a campus initiative at UC Irvine that brought over 800 K-12 students from socio-economically disadvantaged areas to the campus for an open house and shake-table demonstration in Spring 2000. One might think that seismic simulation is a topic only for advanced graduate students, but it has caught the attention of these younger students as well. The event pitted local elementary, middle and high schools against one another for the honor of having the best seismic designs. The LEGO structures were tested on one of PEER’s major earthquake simulators housed in the UCI Structural Engineering Test Hall. The event has been repeated each year, currently under the leadership of Tara Hutchinson, PEER Education Committee
member from UC Irvine. The Education Committee is considering expanding this effort to other PEER campuses.

3.2.1.11 PEER Professional Fellowship Program

The **PEER Professional Fellowship Program** is aimed at increasing contacts between our students and practicing professionals. Though started on an informal basis, our first formal PEER Professional Fellow was Maury Power of Geomatrix Consultants in 2002. Another of our Professional Fellows for Year 6 is William Holmes of Rutherford & Chekene, who on 14 May 2003 will give a lecture on “Staying Active in the Profession after Graduation.” In addition to the lecture, Mr. Holmes will have lunch with members of the EERI Student Chapter and meet with graduate students to discuss their research. As a leading practitioner who is very involved in PEER, EERC, and code committee development, Mr. Holmes will be a superb role model for our PEER students. The Education Committee has been tasked with continuing to develop this program so that more students can gain this valuable exposure.

3.2.2 Curriculum Innovations and Tools

PEER has encouraged and coordinated several curriculum development activities, including the following.

3.2.2.1 Teaching Modules for Graduate Students

Initiated as a Tri-Center activity, this project has created a series of graduate-level, self-contained, web-based, teaching modules. The modules include materials on various subjects and may be shared by a variety of academic institutions that do not have resident expertise in specialized subjects pertaining to earthquake engineering. The modules consist of written text, specifications for experiments, visual materials and supplementary web information. Modules have been commissioned for the following areas: Fluid Structure Interaction, Wave Propagation, Earthquake Engineering Design, Seismic Ground Motion and Hazard, Seismic Upgrading: A PBE Case Study, Seismic Behavior of Timber Structures, Earthquake Resistant Design, Liquefaction, Socioeconomic Aspects of Earthquakes, Putting a Face on Earthquakes: The Human Side of Earthquake Disasters, and Seismic Design of Diaphragms, Chords and Collectors. In the early phases of this program, each center was to produce at least one module per year on different aspects of earthquake engineering and hazard-related studies. An inter-center task force of faculty and professional earthquake engineers selects the module topics in consultation with the other two centers. SLC input has been solicited during the beta-testing of each module. Currently many of the modules are being evaluated and distributed for use. Further development in this area is pending evaluation of the existing modules.

3.2.2.2 Instructional Earthquake Simulators

In an effort to increase students’ knowledge of earthquake engineering through hands-on experiments, the three EERCs have organized a program for deployment of small earthquake simulators specifically designed for use in a classroom setting. Twenty-three institutions drawn from the three EERCs cooperated in the design of a bench-scale shake table. The initial acquisition was partially supported by an NSF grant and other private funding and has grown to a consortium of over 40 institutions know as **University Consortium for Instructional Shake Tables** UCIST. The equipment is used to integrate earthquake engineering into the undergraduate curriculum. Classroom demonstrations and "hands-on" experiments are conducted at all levels in order to have a significant impact on the curriculum. In addition, the shake tables
are displayed and demonstrated at public awareness events, including: state fairs, primary and secondary schools, and local community disaster preparedness programs. In Year 6 (and beyond), the SLCs from the three centers will develop plans for two nationwide competitions in earthquake resistant design, one for undergraduates and one for elementary school children. Also in Year 6, these mini-shake tables were used by middle-school students and teachers through PEER’s RET program for demonstrations and for carrying out experiments for science fair projects. See the Chapter 1 and Volume III for additional information.

3.2.2.3 Curriculum Changes from PEER Activities

PEER is seeking ways to incorporate its research activities into our earthquake engineering curricula. Some classes directly utilize the Graduate Course Modules developed in previous years, while many others are incorporating PEER research results into the lectures and assignments in a less formal way. Two examples of classes that have been significantly and positively impacted by PEER research are described below.

- **Earthquake Resistant Design of Structures (CE 227)** is a major component of the graduate curriculum at UC Berkeley attended by 40-60 graduate students and visiting scholars. The curriculum for his course has changed significantly in the past five years because of activities within PEER. An online course module was developed by PEER covering many aspects of the course, including the PEER PBEE methodology. In addition to containing course-related notes, the module contains a number of Java applets that allow students to rapidly assess the characteristics of ground motions they would expect at a site, and the effects of differing amounts and types of nonlinearity of structural response. In addition to facilitating the underlying complex computations, these applets allow students to do a lot more "what if" type comparisons so that they begin to develop a better intuitive understanding of the effects of ground motions on structures. In this regard, a computer program BISPEC, partially funded by PEER, has been extensively utilized in class. This program simulates the inelastic response of simple structural systems to up to two horizontal components of ground motion. With its rich graphical interface, students conduct a large number of nonlinear dynamic analyses to assess the effects of various factors such as strength, stiffness, viscous damping, shape of hysteretic loops, geometric nonlinearities, and so on, and develop design response spectra considering the methodologies being developed by PEER. The PEER ground motion database is used extensively in completing classroom assignments. Lastly, numerous examples of structural response of more complex systems are presented in the course based on results obtained using the PEER-developed OpenSees computational framework. In completing the final design project for the course, a number of students use OpenSees to carryout their analyses.

- **Case Studies in Seismic Design (Architecture 259X)** is a new course (Spring 2003) in the Department of Architecture at UC Berkeley. It takes advantage of the campus retrofit program and the PEER Center's studies of PBEE. The class has a mix of students from Architecture and Civil Engineering. The class introduces the students to performance design principles and requires that each student undertake a case study of the retrofit design of one of the UC campus buildings. The students are investigating the history of the campus program in terms of campus policy and design precedents. In addition, for each case study, they review the design goals, performance objectives, and methods of retrofitting a major building. Collectively, the student work will be the basis for a guide to the seismic retrofit program on the Berkeley campus, in anticipation of the 100-year...
anniversary of the 1906 earthquake.

3.3 Future Plans

Some of the most significant advances that the PEER Education Program has delivered from the center’s inception stem from two fundamental themes:

a) Development of an instructional and research environment within PEER that provides a natural growth for a student’s interest in all aspects of earthquake engineering through a variety of undergraduate and graduate student opportunities.

b) Cooperative efforts with the MAE and MCEER Education programs.

PEER has promoted a student-friendly environment. The development of a **PEER student culture** has been evident and has encouraged Summer Interns to become Earthquake Engineering Scholars who, in turn, have become active participants in the Student Leadership Council as well as graduate researchers and faculty members. The PEER Center Director has been a staunch supporter of these student programs, and has provided a direct and sincere communication link to the students through the Student Leadership Council and Student Association. Continued support of PEER’s student-friendly environment will be one of the primary goals in the future.

The intra-university and inter-university networking opportunities provided for students by PEER are leveraged with the cooperative programs established with MAE and MCEER, creating academic and social relationships across center boundaries. The cooperative efforts of the three EERCs have provided an environment enabling the students to jump-start their professional contacts – among themselves, EERC faculty, and industry representatives – sooner than those students who have not participated in the EERCs.

Accordingly, the PEER Education program intends to continue those programs that have served the students well, including **PEER Summer Intern Programs, Earthquake Engineering Scholars Course, REU Program** (including **Symposium for Young Researchers**, **Student Leadership Council**, and **Education Forums**). In addition, we will evaluate the effectiveness of our new programs, including the **Tri-Center Doctoral Student Exchange**, the **PEER Lecture Series**, and the **Tri-Center Earthquake Field Study**.

While we have implemented several new programs in the recent past, and are busy supporting those, we still are interested in pursuing additional new programs in the near future such as:

- **Undergraduate Shake Table Competition**: We are constantly looking for new ways to use our UCIST Shake Tables. We used them in Year 6 for testing Science Fair Projects through the RET program, and considered developing a K-12 LEGO competition, similar to that held at UC Irvine each year. While considering this competition, the PEER SLC, along with the SLC’s from MAE and MCEER, have started to pursue the idea of an undergraduate shake table competition. Conceptually, this will involve teams from several universities building earthquake-resistant structures within specified constraints. The competition would begin within each EERC, and culminate in a Tri-Center Competition. This is in the initial planning stages, and is planned for a trial run in Year 7.

- **Earthquake Education Series on UCTV**: PEER has begun work with UCTV on developing a Earthquake Education Series that would combine on-demand video and narrowcasting from the PEER Education Website, together with broadcasting on UCTV via satellite to reach a broader audience. The series would consist of up to six short documentaries on PEER Interns and Graduate Students working on Earthquake
Engineering research, as well as short video clips of PEER faculty explaining key issues and concepts in Earthquake Engineering. It is anticipated that funding for this effort would take the form of a NSF Informal Science Education Supplement. In order to demonstrate the feasibility of the series, a 15-minute pilot is currently being scripted by UCSD-TV. The focus of this pilot will the LEGO Structure Competition at UC Irvine on May 17, 2003.

- **Curriculum Changes from PEER Activities:** PEER aims to facilitate the incorporation of research results into our earthquake engineering curriculum. Some current curriculum developments have already been described. The Education Committee will be evaluating ways of accelerating this process.

- **Increased diversity in student programs** – PEER has aimed to increase the diversity of students involved in earthquake engineering, but has not succeeded to the degree that it would like. One modification that is planned for Year 6/7 is to modify the approach to selecting students for the Earthquake Engineering Scholars Course (EESC) and other similar programs. For example, in the past, each core campus was able to send up to three participants to the EESC, and the affiliates were represented by only five students. In Year 6, in an effort to reach more diverse group of undergraduates students, only half of the scholars will be coming from the core campuses. The rest will come from current affiliates and potentially from other universities with more diverse student populations.

- **Increased Undergraduate Involvement in Research:** One of the criticisms of PEER in Year 5 was the limited involvement of undergraduates in research. We are trying to address this in a number of ways. As a direct solution, PEER is offering supplements to active research awards of approximately $5000 specifically earmarked for undergraduate students, either during the academic year or in the summer. We are increasing undergraduate student involvement in PEER in other ways: adding undergraduate representatives to the SLC, having the PEER Professional Fellows visit undergraduate classes, and by starting the Undergraduate Shake Table Competition.