Instructor Guide
October 2004

Earthquake Hazard and Emergency Management

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Notes to Instructor:

Losses from natural hazards are rapidly growing and the projected trends are unsustainable. It is sobering to consider that the most expensive disaster in U.S. history was the 1994 Northridge Earthquake, a relatively minor earthquake on a poorly-studied fault located on the fringe of Los Angeles. Similarly, the 1995 Kobe Earthquake in Japan stands out as the world's most expensive natural disaster. The risk implication for many regions in the U.S. and throughout the world is alarming. There is growing recognition that much greater emphasis should be placed on mitigation of hazards, as opposed to the traditional approach that placed the most emphasis on response and recovery. Toward this end, recent legislation has been enacted and Congress has sponsored studies to develop specific cost-benefit data that demonstrate the importance of mitigation. This course is intended to help create a new generation of emergency managers who are better informed and better prepared to make decisions, obtain relevant information, and better understand how to make effective impacts on reduction of earthquake hazards.

The course consists of 15 sessions. The first half of the course addresses basic earthquake concepts that may not be familiar to those without a technical or engineering background. Issues and terminology such as earthquake magnitude, faults, and earthquake hazard/earthquake risk, are important concepts for hazard managers to understand from more than just a cursory standpoint. The concepts are essential for a complete understanding of earthquake hazards and for communication with the many individuals and entities that interface with emergency management programs. As explained in the course materials, depending on the comfort level of the instructor, it may be desirable to enlist the aid of faculty from an engineering or geology department to cover some of the technical issues. It should be remembered that **this is not an engineering course**, and only the basic concepts need be emphasized. Course includes time in syllabus for such guest lecturers.

With the exception of Session 9 (Mitigation), the latter half of the course is mostly non-technical, involving mostly policy and societal issues. Again, depending on the comfort level of the instructor, it may be desirable to enlist the aid of faculty from a department of sociology or similar group, preferably with experience in working with natural hazards.

The course is organized in sessions as follows:

1. **Introduction** (1.5 hrs.): This lecture reinforces the importance of earthquake hazard management and this course by briefly illustrating the magnitude of the earthquake threat and vulnerability in the United States. Issues associated with the details of earthquakes and their physical characteristics and effects will be covered only to the extent they are necessary for a clear understanding of the nature of this hazard.

Of particular importance are the two earthquake scenarios included at the end of this series of lecture notes. One scenario represents a worst case scenario for an earthquake occurring in an urban area of the U.S. (the heavy damages and severe

disruptions described for this scenario probably are not far from what would occur in many regions). The second scenario describes a much different set of outcomes where the damages and disruptions from the same event are minimal – in essence, this scenario represents what we can achieve with appropriate preparedness and mitigation behavior to reduce vulnerability. The instructor should use these two opposing scenarios to drive home the overall goal of this course.

2. **Causes of Earthquakes** (2 hrs.): The concepts presented in this session are designed to provide an in-depth understanding and appreciation of the fundamental causes of earthquakes. The highly erratic and unpredictable nature of the causative geological processes is of particular relevance. A better understanding of these processes provides an improved ability to anticipate and communicate the unique aspects of earthquake hazards. Also, the information in this session is important for improved communication with scientists, engineers, government official, and the public.

3. **Distribution of Earthquakes** (1.5 hrs.): In this session, the major plate boundary systems, and the locations of earthquakes worldwide will be introduced. The session will include specific regions of the U.S. where earthquakes are prone to occur. National seismic hazard maps, which reflect in scientific terms the information presented in the first part of the lecture, will be presented and will be explained in general terms.

4. **Earthquake Hazard and Risk in the U.S.** (2 hrs.): The main purpose of this session is to provide the students with a basic understanding of earthquake hazard and risk, show how the two concepts differ, and illustrate how these parameters vary across the U.S. Students should know the seismic hazards in the United States and refer back to the national seismic hazard maps discussed in the previous lecture, then progress to a discussion of the seismic risk in the United States, especially how the earthquake risk in the eastern U.S. compares to that of the western U.S.

5. **Characteristics of Earthquakes** (2 hrs.): This session introduces important characteristics of earthquakes, including earthquake sizes and how they are measured/determined, types of earthquake waves, and the significance of these characteristics in terms of the hazard posed. Terms such as “magnitude” and “intensity” commonly are used by the seismological community and popular media, and they should be understood by emergency managers.

6. **Earthquake Research and Information** (3 hrs.): This session introduces the student to key earthquake research organizations and information sources, and provides a perspective on the role of research information and recent initiatives. It also shows the student where to obtain specific types of research information, recognize the latest trends in earthquake research, identify who the key players are, learn about the major initiatives underway, appreciate the important role research information plays in hazard reduction, understand how research

information is used by decision makers, and appreciate the importance of building constituencies to promote funding of earthquake disaster research and other government–sponsored programs and activities.

7. **The Nature and Effects of Earthquake Hazards** (2 hrs.): This session will address the general nature of earthquake hazards, how earthquake hazards differ from other natural hazards, and the special challenges they pose in terms of damage and losses. It also covers the effects on people, the economy, and infrastructure.

8. **Disaster Phases and Earthquake Policies** (2 hrs.): This session includes a review of earthquake disaster phases, and history and current status of earthquake policy. Concepts such as the four disaster phases, the major agencies involved with disasters, and a brief history of U.S. disaster management programs, are designed to provide a basic understanding of disasters and their management.

9. **Mitigation** (4 hrs.): This section discusses the need to shift what has been an emphasis on emergency response and recovery to pre-event mitigation measures and the need for developing a more proactive stance toward mitigation. A number of basic concepts, lessons learned from case histories, and keys for successful mitigation strategies are discussed. The latter half of the session presents specific mitigation techniques that can be used for various cases.

10. **Earthquake Preparedness** (3 hrs.): The objective of this session is to introduce the student to the general principals associated with preparedness for earthquake disasters. It discusses where and how preparedness fits into the overall disaster management picture. It also provides information concerning the measures and activities typically involved with preparedness and how such measures affect earthquake disasters. The session gives extensive coverage to the factors that tend to encourage and/or impede preparedness efforts by various entities.

11. **Earthquake Disaster Response and Recovery** (3 hrs.):The objective of this session is to introduce the student to the general principals associated with earthquake response and recovery. It provides information concerning the measures and activities typically involved with earthquake response and recovery and how such measures affect the scale of earthquake disasters.

12. **Nature of Earthquake Disaster Vulnerability** (2 hrs.):. The objective of this session is to encourage the students to reflect on the many important lessons and concepts learned so far in the course and to understand growing vulnerability trends in the U.S. and abroad. This section examines this growing trend in more detail and discusses the relationship between earthquake hazards and earthquake disasters. The concepts presented in this session are important for emergency managers because they address fundamental issues associated specifically with earthquake vulnerability. This section also provides a more global perspective of the earthquake problem.

13. **Communication Strategies and Public Outreach** (3 hrs.):. This session introduces the student to the principal concepts involved in risk communication. It discusses the importance of risk communication, the unique nature of risk communication, problems that impede communications, tools for communication, and suggestions for communicating effectively to various audiences. It includes the basic tools and strategies needed to create or evaluate educational initiatives on earthquakes. A useful set of guidelines is included

14. **Earthquake Disaster Planning**. (3 hrs.): The objective of this session is to introduce the student to the general principles associated with earthquake disaster planning. It provides information concerning the measures and activities typically involved with disaster planning and how such measures affect earthquake disasters. Important keys for effective disaster planning are presented. The session discusses various tools that can be used for planning, as well as important considerations and issues associated with different entities such as agencies, households, and governments. Note that this session does not attempt to provide complete coverage of all aspects of planning associated with earthquakes. Issues such as land use planning and strategic planning for earthquake hazards are not covered in detail, but can be added at the instructor's discretion.

15. **Earthquake Issues and Roles – Classroom Skit** (2 hrs.): During this session, the instructor will lead the students in a classroom skit in which the students take on the roles of various parties (homeowners, rescue personnel, government officials, etc.) affected by a major earthquake in an urban area. This scenario is intended to be a "capstone" exercise for the students, drawing on the principles learned throughout the entire course. The concepts presented in this session are designed to provide students with a greater understanding and appreciation of the effects of earthquakes. Students should think in terms of emergency managers and about what actions and issues may or may not be associated with various entities. The information in this session should allow for improved understanding of and communication with various entities during actual earthquake disasters.

The breakdown of time spent is:

Total Lecture Hours:	33.5 hrs.
Classroom Skit:	2.0 hrs.

Outside Guest Speakers	2.0 hrs.
Discussion of Homework Assignments:	5.5 hrs.
Exam	2.0 hrs.
	Total 45 hrs.

A recommended breakdown in terms of grading in the course is shown below. The course grade will be based on:

- Class participation and presentations - 25%
- Homework - 25%
- Term Project - 25%
- Final Exam - 25%

Homework and class discussion assignments are included with most sessions. Where feasible, class discussion always is recommended, even if informal and unplanned. Although the course is organized into specific topic areas, there will be overlap between many of the key topics. Such overlap is intentional and purposeful as it reemphasizes the major concepts. Where possible, the instructor should strive to help the students make the link between topics and view the course as a continuum of closely related issues (i.e., planning involves mitigation, response, recovery, etc.).

The term project extends the coverage of the course beyond the lecture notes. This team assignment requires the students to research various topics on earthquake hazards, discuss and develop ideas, and present their results in class. The in-class presentation of these projects will allow all students to benefit from this exercise.

A final exam is included with the course, although the instructor may wish to modify this test depending upon the makeup of the class, university requirements, etc. The exam as written, is general in form and consists of short and long essay questions and is designed to be completed in-class, closed-book, within 2 hours.

The instructor is encouraged to experiment with various techniques to present this material (according to the background of the students, makeup of the class, class size, etc.). For instance, in some cases, the instructor may wish to post the lecture notes on the Internet and/or make handouts for the students prior to the lecture, and then use the following lecture period to discuss the major points of the session. A significant number of visuals have been included to enhance the course.

Finally, it is important to point out that the author views this set of notes as a work in progress, as they by no means address all of the important issues associated with earthquake hazards and their management. Rather, they should be viewed as a resource guide that should be revised, amended, and updated where necessary.