

**CE597M/EAS591G [Spring 2006]
GEOLOGIC & ENGINEERING SEISMOLOGY**

Class hours: T-Th 12:30-2:00 @ CIVL2118
Computer Lab hours: F 2:30-5:20 @ CIVL1252
<http://bridge.ecn.purdue.edu/~ce597m>

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DESCRIPTION

Observations and interpretations of ground deformation, ground shaking, and building response due to earthquakes. The course is designed around personal experiences of the instructors with several earthquakes supplemented by a literature study of a few other earthquakes. Theory will be presented to assist in interpretations.

OUTLINE

Course material will be introduced through a series of projects.

2003 Bingol, Turkey earthquake

- How are ground motions measured? How are building motions measured?
- How does one extract useful information from records of seismic ground motion?
- How does one interpret records of building motions caused by earthquakes?
- What can we learn from the most basic theory of building response to ground shaking about the differences in damage to different buildings in the Bingöl area?

1999 Kocaeli and Duzce, Turkey earthquakes

- Description of surveying techniques and terminology; total station; observations vs. deductions
- Faulting types and mechanics
- Faulting mechanisms: what happens as fault propagates to surface?
- Finite and different displacement, velocity, acceleration natures of footwall vs. hanging wall.
- Ground motion characteristics: pulse type motion near fault-rupture to noise type motion at far
- Response of buildings to pulse-type vs. generic noise-type ground motion. Modal analysis vs. wave-propagation approaches to study response of buildings to earthquake ground motions

1992 Landers earthquake

- Effect of propagation direction of rupture
- Broad rupture zones
- How to “read” ground fractures in landslides and earthquake deformation zones while strolling along in the field.
- Broad rupture zones along earthquake ruptures suggested by surface observations and trapped waves at depth

1971 San Fernando earthquake

- Liquefaction
- Ground strains determined by resurveying of streets
- Distribution of damage to buildings and infrastructure of the city.
- Using measurements of horizontal and vertical displacements of points in the San Fernando area and 3-D dislocation theory to estimate the dip and strike of the earthquake rupture.

1994 Northridge earthquake

- Ground deformation – multi-location ground failure
- Ground displacements and deformation associated with blind thrust faults
- Ground motion intensity; TriNet; Earthquake Engineering Intensity Scale
- Seismic hazard study fundamentals; uncertainty and certain emerging approaches

1999 Chi-chi, Taiwan earthquake

- MODES analysis of ground rupture of 3-D GPS data.
- The form of the leading edge (“toe”) of the thrust fault. Comparison with leading edges in large landslides.
- Faulting due to 1999 earthquake and some earlier earthquakes exposed in large trenches dug across the leading edge of the thrust.
- The ground-deformation zone

As we go through these earthquakes, and with excursions to elsewhere, we will try to answer a series of questions including the following:

- How are ground deformation and ground shaking generated by slip on a fault?
- How is propagation of seismic waves modeled in elastic whole space?
-in layered media?
- How does the motion of buildings relate to seismic waves?
- How are fault propagation, fault slip, ground accelerations, ground velocities dependent and independent. How do motions of buildings relate to each of these phenomena.
- What are the characteristics of damaging earthquakes?
- How are the damage and deformations different for *strike-slip* (e.g., 1906 San Andreas earthquake; 1989 Loma Prieta (“World Series”) earthquake; 1999 Turkey earthquakes; *reverse-slip* (e.g., 1999 Chi Chi earthquake; 1971 San Fernando earthquake); and *normal-slip* earthquakes (1950s Dixie Valley, California and 1970’s Yellowstone earthquakes).
- What is the evidence that damage to structures has been caused by large ground deformations associated with “silent” earthquakes on coactive faults in the vicinity of the fault(s) that produced the main shock?
- What is “ground lurching,” and what is the evidence that it can cause serious damage to structures?
- What is the evidence for deformation zones or belts that occur in association with the main earthquake rupture that reaches or even approaches the ground surface?
- How does the ground surface and structures on the ground surface deform when a fault slips only at depth, in the absence of ground shaking.
- ... as a fault propagates to the ground surface.
- The patterns of deformation zones are different for strike-slip and dip-slip earthquake ruptures. How can we begin to understand this?
- How does one recognize and differentiate damage due to ground shaking, ground lurching, ground rupturing and straining and collapse of foundation soils.
- How are hazards of earthquakes estimated.

GRADING

Grading is based entirely on homeworks. Students are required to solve every homework correctly to pass the course. Re-submittal of homework as many times as it takes to get it correct is allowed. Whoever passes all homework problems is awarded an A. The others are awarded an F.

Name Surname: _____

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30-9:20					
9:30-10:20					
10:30-11:20					
11:30-12:20					
12:30-1:20					
1:30-2:20					
2:30-3:20					
3:30-4:20					
4:30-5:20					

