




UNIVERSITY OF KENTUCKY

APR 3 2003

TRANSMITTAL

**DATE:** March 31, 2003

**TO:** Angel Clark  
Senate Council

**FROM:** Lissa Holland   
Graduate Council

**The Graduate School**  
351 Patterson Office Tower  
Lexington, KY 40506-0027  
(859) 257-4613  
Fax: (859) 323-1928  
[www.rgs.uky.edu/gsl](http://www.rgs.uky.edu/gsl)

The Graduate Council met on March 27, 2003, and approved the following:

COLLEGE OF ENGINEERING

*Civil Engineering*

**NEW COURSE:**

**CE 585 – Civil Engineering Failures (3 credits)**

Fundamentals of failure investigation and forensic engineering; Failure types and mechanisms; Case studies and discussions on various constructed facilities.

***Prerequisites:*** CE 382 or consent of instructor.

1. Submitted by College of Engineering Date 2/7/02

Department/Division offering course Civil Engineering

2. Proposed designation and Bulletin description of this course

a. Prefix and Number CE585 b. Title\* Civil Engineering Failures

\*NOTE: If the title is longer than 24 characters (including spaces), write  
A sensible title (not exceeding 24 characters) for use on transcripts Civil Engr Failures

c. Lecture/Discussion hours per week 3 d. Laboratory hours per week

e. Studio hours per week \_\_\_\_\_ f. Credits 3

g. Course description

Fundamentals of failure investigation and forensic engineering; Failure types and mechanisms; Case studies and discussions on various constructed facilities.

h. Prerequisites (if any)

CE 382 or consent of instructor

i. May be repeated to a maximum of \_\_\_\_\_ (if applicable)

4. To be cross-listed as

\_\_\_\_\_  
Prefix and Number Signature, Chairman, cross-listing department

5. Effective Date Fall, 2002 (semester and year)

6. Course to be offered  Fall  Spring  Summer

7. Will the course be offered each year?  Yes  No  
(Explain if not annually)


8. Why is this course needed?

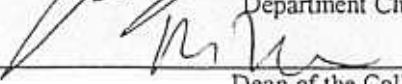
To understand the causes and factors affecting failures of constructed facilities and to avoid future failures based on the failure patterns and mechanisms.

9. a. By whom will the course be taught? Dr. Shien T. Wang

b. Are facilities for teaching the course now available?  Yes  No  
If not, what plans have been made for providing them?

Signatures of Approval:

  
 \_\_\_\_\_  
 Department Chair

  
 \_\_\_\_\_  
 Dean of the College

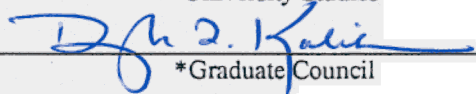
2/22/02  
 \_\_\_\_\_  
 Date

10/21/02  
 \_\_\_\_\_  
 Date

10/29/02  
 \_\_\_\_\_  
 Date of Notice to the Faculty

\_\_\_\_\_  
 \*Undergraduate Council

\_\_\_\_\_  
 Date

\*University Studies  
  
 \_\_\_\_\_  
 \*Graduate Council

\_\_\_\_\_  
 Date  
3/29/03  
 \_\_\_\_\_  
 Date

\_\_\_\_\_  
 \*Academic Council for the Medical Center

\_\_\_\_\_  
 Date

\_\_\_\_\_  
 \*Senate Council (Chair)

\_\_\_\_\_  
 Date of Notice to University Senate

\*If applicable, as provided by the Rules of the University Senate

\_\_\_\_\_  
 ACTION OTHER THAN APPROVAL

## **CE 585- Civil Engineering Failures**

### **Catalog Data**

Fundamentals of failure investigation and forensic engineering; Types of failures and patterns; Failure modes and mechanisms; Failures of constructed facilities and environmental failures; Causes of failure; Case studies and discussions on various constructed facilities; Criteria for better design to prevent failures.

### **Textbook**

Mathys Levy, and Mario Salvadori, "Why Building Fall Down: How Structures Fail," W.W. Norton & Co., Inc., New York, N. Y., 1992, (ASCE Press, 1994).

### **References**

J. Fortune, G. Peters, "Learning From Failure: The System Approach," John Wiley and Sons, Ltd., Chichester, England, 1995.

Dov Kaminetzky, "Design and Construction Failures: Lessons from Forensic Investigations," McGraw- Hill Inc., New York, N. Y., 1991

J. Feld, and J. Carper, " Construction Failures," John Wiley and Sons, New York, N. Y., 1997.

David H. Nicastro, " Failure Mechanism in Building Construction," ASCE Press, New York, N. Y., 1997.

### **Coordinator**

Professor Shien T. Wang

### **Prerequisites**

CE 382 or consent of instructor

### **Topics**

Introduction

Civil Engineering Achievements

Failures in Civil Engineering Constructed Facilities

Classification of Failures

## Environmental Failures

Causes and Modes of Failure  
Case Studies  
Discussions

## Criteria for Better Design of Constructed Facilities to Prevent Future Failure

### Goals

CE 585 is designed to teach students some basic concepts of failure theories of constructed facilities and the environmental impact of failures. Through failure case studies students will learn the causes and failure modes of various Civil Engineering facilities. The students will also learn the basic procedure on conducting a forensic engineering investigation. Ultimately, based on the knowledge gained they will be able to design better Civil Engineering facilities to reduce the possibility of failure.

### Specific Learning Outcomes

- Objective 1 Understand basic theory and failure patterns and modes of various constructed facilities.
- Objective 2. Understand procedures to conduct a forensic engineering investigation.
- Objective 3. Learn from past failure cases in the past.
- Objective 4. Set criteria to design better civil engineering facilities to reduce the possibility of failure.

### ABET Categories

Engineering science - 1 credits or 33%

Engineering design - 2 credits or 67%

### Design Content

67%

### Laboratory

**TOPICS:**

**Introduction**

**Civil Engineering Achievements**

- High-Rise Buildings**
- Bridges**
- Arenas and Domes**
- Dams**
- Interstate Highway System**
- Airports**
- Space vehicles**
- Other Constructed Facilities**

**Why Study Civil Engineering Failures**

**Failure Education**

**Education and Training in Failure Analysis - Skills to Prevent Failures**

**Failures in Civil Engineering Constructed Facilities**

**Failures on Internet**

**Definition and Classification of Failures**

**Causes of Failure**

**Failure Modes and Patterns**

**Types of Failure**

**Failure Mechanism**

**Failure Investigation – Forensic Engineering**

**Synthesis of the Investigation**

**Development of a Failure Profile**

**Development of Failure Hypothesis**

**Investigation and Synthesis Process vs. Insight, Awareness, and Method of Quality Control**

**Litigation and Public Issues**

**Design Codes and Specifications**

**Some Factors Affecting Structural Integrity**

**Redundancy**

**Lifeline Design**

**Material Properties**

**Construction Method**

**Construction sequence**

**Communication Among Parties**

**Inspection and Resident Engineers**

**General Building Failures**

**Progressive Failures**

**Building Failures During Construction**

**Arena Failures**

**Structural Demonology - Building Façade Problems**

**Impact, Explosion, Bombing, and Terrorism Failures**

**Residential Building Failures**

**Foundation Failures**

**Earthquake Failures**

**Bridge Failures**

**Special Structure Failures**

**Dam Failures**

**Environmental Failures**

## **Case Studies - Environmental Failures**

**Love Canal**

**Frankfort Wild Turkey Spill**

**Coal Refuse Dam Failure Spill**

**Valley of the Drums - Bullitt County, Kentucky**

**Stringfellow Acid Pit**

**Seymour Recycling Facility**

**Kettleman Hills Waste Landfill**

## **Responsibilities**

**Recommendations for Better Design and Constructed Facilities to Reduce the Possibility of Future Failures**

**Criteria and Check List – Learned from Past Civil Engineering Failures**

14. Hinman, Eve E, "Lessons from the Oklahoma City Bombing," ASCE Press, New York, 1997.
15. Fisher, J. W., "Fatigue and Fracture in Steel Bridges: Case Studies," Wiley-Interscience, New York, 1984.
16. Journal of Performance of Constructed Facilities, Technical Council on Forensic Engineering, ASCE, 1987-2001.
17. Engineering News-Record, -2001.
18. Forensic Engineering – The International Journal, Pergamon Press, Elmsford, New York, -2001.
19. Journal of the National Academy of Forensic Engineers, -2001.
20. Internet Website: <http://www.struct.kth.se/research/bridges/Bridges.htm>
21. Internet Website: <http://www.worldstallest.com/>
22. Internet Website: <http://www.xs4all.nl/~hnetten/world.html>
23. Internet Website: <http://www.xs4all.nl/~hnetten/disaster.html>
24. Internet Website: <http://www.structurae.de/DataEnglish.html>
25. Internet Website: <http://www.bridgesite.com/softwarelinks.html>
26. Internet Website: <http://www.pubs.asce.org/>
27. Internet Website: <http://lowery.tamu.edu/ethics/>
28. Internet Website: <http://englib.cornell.edu/ice/lists/historytechnology/successfail.html>
29. Internet Website: [http://nisee.ce.berkeley.edu/bertero/html/multiple\\_defense\\_lines.html](http://nisee.ce.berkeley.edu/bertero/html/multiple_defense_lines.html)
30. Internet Website: [http://www.eerc.berkeley.edu/loma\\_prieta/astaneh.html](http://www.eerc.berkeley.edu/loma_prieta/astaneh.html)
31. Internet Website: <http://www.antenna.nl/wise/uranium/mdaflf.html>
32. Internet Website: <http://doll.eng.sunysb.edu/disaster/>
33. Internet Website: <http://www.greatachievements.org/>
34. Internet Website: <http://pyne.kinfolk.org/rbp2/okcbomb.html>

## TERM PROJECT

### Objectives:

1. Investigate and describe the physical nature of the facility involved, the way in which it failed, and the immediate aftermath of the failure
2. Outline the technical reasons for the failure and analyze the interrelation with one another and with the characteristics of the facility
3. Investigate and describe the process involved in the realization of the facility (planning, regulation, design, construction, and operation) and the roles and actions of the various participants as they relate to the development of the failure
4. Examine the nature of the individual, group, organizational, and institutional factors that may have affected the processes and the way in which various actors participated in these processes
5. Analyze the interrelationships between the technical reasons for failure, and the intra-and interorganizational factors characterizing the project process
6. Suggest, on the basis of your own analysis, what mechanisms might have been introduced to avoid this failure, how these mechanisms may be applicable generally (taking into account other failures discussed on the subject), and what the constraints might be on the implementation of such mechanisms

### Report

The term project report should be 3,000 to 5,000 words (excluding appendices) structured as follows:

1. Abstract of 200 words should outline the nature and major findings of the study.
2. Description of failure should constitute no more than 1/3 of the report; added material can be included in appendices. Drawings, photographs, and other graphic material should be used whenever applicable.
3. Analysis of failure should constitute the major portion of the report, divided into appropriate chapters or sections. Analyses should be detailed, supported by quantitative data where possible. Diagrams, charts, and graphs should be used as much as possible to illustrate the analyses.

# GRADUATE COUNCIL


## INVESTIGATOR REPORT

Course/Courses/Program: CE 585 Civil Engineering Failures

Category (check one):  New  Change  Drop

Date for Council Review: 3/27/03

Recommendation (check one):  Approve  Approve with Reservation  Disapprove

Investigator's Signature: 

### INSTRUCTIONS:

The following questions are included as an outline only. Be as specific and as brief as possible. If the investigation was routine, please indicate this. Attach supplements as needed. Please return the form to Becky Fister, 355 P.O.T., 0027, at least two days before the next Council meeting.

1. List any modifications made in the course proposal as submitted originally and reason(s) why.  
None.

2. If no modifications were made, review considerations which arose during the investigation and the resolutions.  
The course has been offered as a special topics course three times previously, most recently in Fall 2002, when there were more than 10 students. Building failures is apparently a hot topic these days because of the need for defense against terrorists. The instructor has detailed plans on how to differentiate graduate students from undergraduates in the course.

3. List contact(s) with program units and the considerations discussed therein.  
I called the instructor and asked him a few questions.

4. Additional information as needed.  
Another no-brainer.