

CIEN E4210 Forensic Structural Engineering**Prof. Robert****T. Ratay**

Review of significant failures, civil/structural engineering design and construction practices, ethical standards and the legal positions as necessary background to forensic engineering. Discussion of standard-of-care. Study of the process of engineering evaluation of structural defects and failures in construction and in service. Examination of the roles, activities, conduct and ethics of the forensic consultant and expert witness. Students are assigned projects of actual cases of nonperformance or failure of steel, concrete, masonry, geotechnical and temporary structures in order to perform, discuss and report their own investigations under the guidance of the instructor.

- **Introduction to the course** 1 week
 - About the course
 - Overview of forensic structural engineering
- **Review of “historic” and “recent” structural and construction failures** 1 week
 - Ronan Point Tower, Skyline Plaza at Bailey’s Crossroads,
 - Hartford Civic Center Coliseum, Kansas City Hyatt Hotel,
 - Riley Road Interchange, Mianus River Bridge, L’Ambiance Plaza,
 - Boston Central Artery Ceiling, Minnesota I-35W Bridge, Others
- **Loads and hazards**
 - Design, construction, in-service loads [Chapter 7]*
- **Modes of failure** [Chapters 11, 12, 13, 14]* 1 week
 - In steel, concrete, masonry and timber members, assemblies and complete structures under static, dynamic and earthquake loadings
- **Condition assessment of damaged structures**
 - Public Safety Issues
 - Engineering Principles
 - Documentation
 - Case Studies
- **Design codes, standards, specifications and manuals** [Chapter 2]* 1 week
 - Purpose of codes and standards
 - Load standards (SEI/ASCE 7, SEI/ASCE 37, etc.)
 - Material design codes (ACI, AISC, NCMA, NFPA)
 - Model Building Codes (BOCA, UBC, Southern, IBC)
 - State, city and local building codes (NYS, NYC, Massachusetts, etc.)
 - Bridge design codes (AASHTO, FHWA)
 - Eurocodes
- **Temporary structures in construction** [Chapters 3, 10]* 1 week
 - What are they?
 - Design philosophies and criteria
 - Design codes and standards (SEI/ASCE 37, FHWA, AISC, etc.)
 - Designer’s and contractor’s roles and responsibilities
 - Construction safety rules, regulations, OSHA and other industry standards
 - Case studies of failures of temporary structures
- **Mid-term quiz and Project assignment** 1 week
- **The design-construction process** [Chapter 1]* 1 week
 - Drawings and specifications
 - Shop drawings, erection plans
 - Value engineering, peer review
 - Project delivery methods
 - Contracting and subcontracting
 - Inspection and testing
 - Approval, acceptance, certification
 - Design and construction records
- **Forensic investigation process** 1 week
 - First steps after a failure [Chapter 5]*
 - Field observation and reporting of a failure

Assurance of public safety
Initial engineering assessment
Initial stabilization, repair and restoration

Engineering investigation after the dust settles [Chapter 6]*

Familiarization with the project
Planning the investigation
Site inspection and collection of physical evidence
Review of design and construction documents
Establishing the design, construction and service history
Formulating possible failure scenarios
Performing analytical and/or experimental studies
Evaluating probability of possible failure scenarios
Selecting most probable failure scenario
Demonstrating validity of opinion

Reporting

Interim communications
Oral presentations
Written reports
Presentation materials and exhibits

- **Legal matters and dispute resolution** 1 week
 - Liability of design professionals
 - Legal concerns after a failure [Chapter 17]*
 - Litigation and dispute resolution [Chapter 18]*

- **Performance criteria [Chapter 4]*** 1 week
 - Designer's standard of care
 - Contractor's duty to perform

- **The expert consultant and witness [Chapter 19]*** 1 week
 - Role, qualifications, activities, conduct
 - Ethics
 - Conflicts of interest
 - Impartiality versus advocacy
 - Reasonable degree of engineering certainty
 - Affidavit, deposition, trial testimony
 - Liability of experts
 - Practice guidelines (ASCE, ASFE, etc.)

- **The business of forensic engineering practice** 1 week
 - Solo versus group practice
 - Readiness
 - When the phone rings
 - Agreement
 - Timekeeping and invoicing
 - Networking and marketing

- **Presentation and debate of student project** 1 week

- **Final exam** 1 week
 - Throughout the semester
 - Reading and discussion of OSHA construction failure reports
 - Monitoring the news of ongoing investigations of recent failures
 - Review and discussion of reports from professor's forensics practice
 - Investigation and oral presentations by the students of actual cases of non-performance and failure of structures from professor's practice (steel, concrete, masonry, building façade, scaffolding, shoring and formwork, foundations and earth retaining structures)

* **Textbook:** *Forensic Structural Engineering Handbook, 2nd edition*, Robert T. Ratay, Editor, McGraw-Hill, Inc., 2010