CEE
Structures Group
Graduate Student Orientation

Larry Fahnestock
Chair, Structures Group

Oscar Lopez-Pamies
Chair, Structures Group Grad Admissions
Welcome!
Illinois CEE Faculty – A Long Tradition of Excellence in Structural Engineering and Mechanics

Arthur N. Talbot
Hardy Cross
Nathan Newmark
Alfredo Ang
Robert Dodds, Jr.
Illinois CEE Alumni – A Long Tradition of Excellence in Structural Engineering and Mechanics

R. Shankar Nair, Ph.D., P.E., S.E., NAE (Ph.D. 1969)

James Harris, Ph.D., P.E., S.E., Hon.M.ACI, NAE (Ph.D. 1980)

Robert Smilowitz, Ph.D., P.E. (Ph.D. 1979)

Catherine French, Ph.D., P.E., Dist.M.ASCE (Ph.D. 1984)

Sharon Wood, Ph.D., NAE (Ph.D. 1986)
Illinois CEE Structures Program

- 14 full-time faculty (plus active emeritus faculty)
- Faculty are leaders in the profession (e.g., ASCE, AISC, ASCE, EERI, EMI, IACM, IAWE, SEI, SSRC, USACM)
- Extensive research funding (e.g., AISC, DARPA, DoD, DoE, IDOT/ICT, ITHA, NCHRP, NCSA, NIST, NSF)
- Education focused on high end of M.S. / Ph.D.
- ~70 M.S. and ~50 Ph.D. (full-time) students
- Diverse student body from all around the world
- Graduates pursue careers in consulting and design, research in government and industry labs, and academia
Philosophy of the Structures Faculty

- Conduct cutting-edge research across a broad spectrum of topics and with varied applications.
- Provide a distinctive program characterized by breadth, depth and quality, with strong grounding in fundamentals of both analysis/mechanics and behavior/design.
- Prepare students for long and productive careers as leaders in the field by emphasizing fundamental, non-perishable knowledge to foster lifelong learning.
Ph.D. Institutions of Structures Faculty

8 obtained their undergraduate degree in another country
6 were faculty elsewhere before coming to Illinois
5 have significant consulting experience
Research Interests of Structures Faculty

- Buildings, bridges, and other civil structures
- Steel, concrete, masonry, wood, composites
- Design codes, specifications and procedures
- Earthquakes, wind, blast, fire
- Experimental testing
- New construction, repair and retrofit
- Soil-structure interaction
- Structural stability and collapse
- Bio-inspired structures

- Large-scale numerical simulations
- Finite and boundary element methods
- Computational mechanics algorithms
- Fracture mechanics and fatigue
- Optimization of structures
- Fluid-structure interaction
- Functionally graded materials
- Structural health monitoring
- Structural control and smart materials
- Risk and reliability
- Inverse analysis problems

From the very practical, to the research frontier!
Faculty Expertise

- Behavior, Design and Resilient Performance
- Mechanics, Computation and Advanced Simulations
- Risk, Reliability and Life-Cycle Sustainability
Armando Duarte

Nathan Newmark Professor

Ph.D., University of Texas at Austin, 1996

Research Interests:
- computational methods and mechanics;
- multiscale material and analysis;
- computational fracture mechanics

Teaching:
- CEE 470: Structural Analysis
- CEE 571: Computational Plates and Shells
- CEE 598FEM: Generalized FEM
- CEE 570: Finite Element Methods

Hydraulic fractures from a horizontal wellbore

Stress around spot welds in a hat stiffener
Ahmed E. Elbanna

Associate Professor and *Donald Biggar Willet Faculty Fellow*

Ph.D., California Institute of Technology, 2011

**Research Interests:**

constitutive modeling (friction and adhesion); earthquakes: mechanics to engineering; modeling of biological materials; bio-inspired design optimization

**Teaching:**

- CEE 460: Steel Structures, I
- CEE 470: Structural Analysis
- CEE 572: Earthquake Engineering

**Related Articles:**

Grain fragmentation in sheared granular flow: weakening effects, energy dissipation, and strain localization

Sacrificial bonds and hidden length in biomaterials – a kinetic, constitutive description of strength and toughness in bone

Bio-inspired design optimization

Natural (top), Synthetic (bottom)

Pathogen interaction with biofilms
Oscar Lopez-Pamies

Professor and CEE Excellence Faculty Scholar

Ph.D., University of Pennsylvania, 2006

Research Interests:

- reinforced composites; foams; soft active materials (e.g., electro- and magneto-active composites, shape memory polymers); material defects; material and structural instabilities; fracture

Teaching:

- CEE 470: Structural Analysis
- CEE 471: Structural Mechanics
- CEE 598THM: Theory of Heterogeneous Materials

Recent Articles:

- “A WENO finite-difference scheme for a new class of Hamilton-Jacobi equations in nonlinear solid mechanics” (Computer Methods in Applied Mechanics and Engineering)
- “Fracture and healing of elastomers: A phase-transition theory and numerical implementation” (Journal of the Mechanics and Physics of Solids)
Arif Masud

John and Eileen Blumenschein Professor

Ph.D., Stanford University, 1993

Research Interests:

multi-scale and stabilized finite element methods for fluids and solids; fluid-structure interaction; computational micro-mechanics; multiscale modeling of materials

Teaching:

CEE 360: Structural Engineering
CEE 570: Finite Element Analysis
CEE 576: Nonlinear Finite Elements
CEE 577: Computational Inelasticity

Recent Articles:

“Coupled chemo-mechanical modeling of curing in the simulation based design of polymeric materials: Application to voids and interphases”

“A Unified Mixture Formulation for Density and Volumetric Growth of Multi-Constituent Solids in Tissue Engineering”
Jinhui Yan
Assistant Professor
Ph.D., University of California, San Diego, 2016

Research Interests:
Computational mechanics, renewable energy, additive manufacturing

Teaching:
CEE 360: Structural Engineering
CEE 490: Computer Methods

Research highlights:

Xiaojia Shelly Zhang
Assistant Professor
Ph.D., Georgia Institute of Technology, 2018

Research Interests:
Additive manufacturing, 3D/4D printing, nonlinear and multi-material topology optimization, stochastic programming, resilient and innovative infrastructure design

Teaching:
CEE 470: Structural Analysis
CEE 598SDO: Structural Design Optimization

Recent Articles:
“Multi-material topology optimization with multiple volume constraints: A general approach applied to ground structures with material nonlinearity.” (Struct. Multidisc. Optim., 2018)
“Stochastic sampling for deterministic structural topology optimization with many load cases: Density-based and ground structure approaches.” (CMAME, 2017)
Faculty Expertise

Behavior, Design and Resilient Performance

Mechanics, Computation and Advanced Simulations

Risk, Reliability and Life-Cycle Sustainability
Eun Jeong Cha

Assistant Professor

Ph.D., Georgia Institute of Technology, 2012

Research Interests:
Climate change; life-cycle analysis; stochastic modeling of structural loads; structural reliability; regional loss assessment; resilient built environment.

Teaching:
CEE 202: Engineering Risk and Uncertainty
CEE 360: Structural Engineering
CEE 574: Probabilistic Loads and Design

Related articles:
"Effect of climate change on hurricane damage and loss for residential buildings in Miami-Dade County"

"Modeling the Damage and Recovery of Interdependent Civil Infrastructure Network Using Dynamic Integrated Network Model"
Paolo Gardoni

Alfredo H. Ang Family Professor
Director, MAE Center

Ph.D., University of California at Berkeley, 2002

Research Interests:
earthquake engineering; reliability, risk and life cycle analysis; decision making under uncertainty; performance assessment of deteriorating systems; ethical, social, and legal dimensions of risk; policies for natural hazard mitigation and disaster recovery

Teaching:
CEE 360: Structural Engineering
CEE 491: Decision and Risk Analysis
CEE 598RA: Reliability Analysis

Recent Articles:
“Seismic fragility increment functions for deteriorating reinforced concrete bridges”
“Multi-hazard reliability assessment of offshore wind turbines”
“Stochastic modeling of structural deterioration in infrastructure systems”
B. F. Spencer, Jr.

Nathan and Anne Newmark Endowed Chair in Civil Engineering

Ph.D., T&AM, University of Illinois, 1985

Research Interests:
smart structures and materials; computer vision, machine learning; structural health monitoring; wireless sensors; hybrid simulation

Teaching:
CEE 360: Structural Engineering
CEE 472: Structural Dynamics, I
CEE 573: Structural Dynamics, II

Recent Projects:
• Jindo Bridge: world’s largest deployment of wireless sensors
• Rapid infrastructure assessment using UAVs and computer vision
Bassem Andrawes
Professor and *CEE Excellence Faculty Fellow*
Director, Newmark Structural Engineering Lab
Ph.D., Georgia Institute of Technology, 2005

**Research Interests:**

earthquake engineering; seismic retrofitting and emergency repair of structures, bridge engineering; structural applications of smart & advanced materials (e.g., shape memory alloys, SMA-FRP composites, carbon nanotubes)

**Teaching:**

CEE 463: Reinforced Concrete, II
CEE 468: Prestressed Concrete
CEE 598HBD: Highway Bridge Design

**Recent Articles:**

“Active confinement of reinforced concrete bridge columns using shape memory alloys” (*ASCE Journal of Bridge Engineering*)
Larry Fahnestock

Professor and *CEE Excellence Faculty Fellow*

Chair, Structures Group

Ph.D., Lehigh University, 2006

**Research Interests:**

steel structures; earthquake engineering; seismic stability; progressive-collapse mitigation; large-scale testing; seismic bridge design; long-term bridge response and performance

**Teaching:**

- CEE 460: Steel Structures, I
- CEE 462: Steel Structures, II
- CEE 465: Design of Structural Systems
- CEE 598SSD: Seismic Steel Design

**Recent Articles:**


James M. LaFave

Professor and *CEE Excellence Faculty Scholar*

Associate Dean for Facilities and Capital Planning
Grainger College of Engineering

Ph.D., University of Michigan, 1997

Research Interests:
structural testing & modeling of concrete, masonry, timber, GFRP, metal, and elastomeric connections; seismic assessment of bridges; integral abutment bridge behavior; fiber-reinforced concrete; cross-cultural engineering communication

Teaching:
CEE 199: The Structure of Ballparks
CEE 461: Reinforced Concrete, I
CEE 465: Design of Structural Systems
CEE 560: Steel Structures, III

Recent Articles:
“Experimental investigation of concrete fatigue in axial compression”
“Passive vibration mitigation for highway sign trusses susceptible to wind-induced vibrations”
Franklin T. Lombardo

Assistant Professor

Ph.D., Texas Tech University, 2009

Research Interests:
wind engineering; extreme wind characterization; infrastructure resilience; multi-hazard analysis; risk and reliability; uncertainty quantification; social response to natural disasters

Teaching:
- CEE 202: Engineering Risk and Uncertainty
- CEE 460: Steel Structures, I
- CEE 498WE: Wind Engineering

Recent Articles:
"Characterization of damage patterns using idealized tornado models"

“Comparison of two methods of near-surface wind speed estimation in the 22 May 2011 Joplin, MO tornado”

“Development of empirically-based fragility curves for residential construction in the May 2011 Joplin, MO tornado”
Ann C. Sychterz
Assistant Professor

Research Interests:
Form-finding methods for cable and tensile structures
Optimized sensor placement for civil structures
Structural dynamics
Machine learning and robotics for civil structures
Damage mitigation and risk assessment in large-scale structures
Adaptive, deployable, and bio-inspired structures

Ph.D., Swiss Federal Institute of Technology Lausanne, 2018

Teaching:
CEE 465: Design of Structural Systems

Recent Articles:
Related Programs and Faculty

• Other CEE Groups of Interest
  - Construction Materials (e.g., NDE and materials degradation)
  - Geotechnical Engineering (e.g., soil-structure interaction)
  - Transportation Engineering (e.g., railroads and mobile sensing)

• Other Departments of Interest
  - Aerospace Engineering, Computer Science, Mechanical Science and Engineering, Mathematics

• Representative Research Centers in CEE
  - Illinois Center for Transportation (ICT)
  - MAE (Multi-hazard Approach to Engineering) Center
  - RailTEC

• Other Facilities of Interest
  - Advanced Transportation Engineering Lab (ATREL)
  - U.S. Army Construction Engineering Research Lab (CERL)
CEE Structures MS Program

Typically a minimum of 36 credit hours

- Non-Thesis Option (“Coursework Only”):
  9 graduate courses (4 credit hours each)

- Thesis Option:
  7 grad courses (4 credit hours each) and two 4-hour thesis units
CEE Structures MS Program

For either option:

- Graduate courses are numbered CEE 4xx (except for some lower-level 4xx courses, such as 460, 461 and 465, which are for undergraduates only) or CEE 5xx
- At least three 500-level courses are required (two for grades)
- Strongly recommended set of 5 core courses:
  - CEE 462 – Steel Structures, II
  - CEE 463 – Reinforced Concrete, II
  - CEE 471 – Structural Mechanics
  - CEE 472 – Structural Dynamics, I
  - CEE 570 – Finite Element Methods
- Then options for breadth or depth beyond the core
CEE Structures MS Program

For either option:

- Typical Programs for the Non-Thesis (“Coursework Only”) Option:
  - 3 Courses in each of 3 Semesters
  - 4 Courses in each of Fall and Spring, and then 1 in Summer (or 3 – 4 – 2)
  - 4 Courses in Fall and 5 in Spring (or vice versa) is not recommended
- No thesis committee or final oral examination is needed (MS-thesis students do need a research advisor, and they typically take 21-24 months to degree completion)
- Seminar every semester (CEE 595S)
Structures Grad Course Groupings

• Structural Analysis and Mechanics
  ■ Structural Analysis (CEE 470) – required if equivalent not taken previously
  ■ Structural Mechanics (CEE 471)
  ■ Structural Dynamics, I (CEE 472); Structural Dynamics, II (CEE 573)
  ■ Finite Element Methods (CEE 570)
  ■ Computational Plates and Shells (CEE 571)
  ■ Nonlinear Finite Elements (CEE 576)
  ■ Computational Inelasticity (CEE 577)
  ■ Theory of Heterogeneous Materials (CEE 598THM); Generalized Finite Element Methods (CEE598GFM)

• Advanced Structural Design
  ■ Steel Structures, II (CEE 462); Reinforced Concrete, II (CEE 463)
  ■ Masonry Structures (CEE 467); Prestressed Concrete (CEE 468); Wood Structures (CEE 469)
  ■ Highway Bridge Design (CEE 562); Seismic Steel Design (CEE 598SSD); Structural Design Optimization (CEE 598SDO)
  ■ Wind Engineering (CEE 498WE)

• Advanced Structural Behavior
  ■ Steel Structures, III (CEE 560)
  ■ Earthquake Engineering (CEE 572)
Other Course Groupings

• Structural Risk and Reliability
  ▪ Decision and Risk Analysis (CEE 491)
  ▪ Probabilistic Loads and Design (CEE 574)
  ▪ Reliability Analysis (CEE 591)

• Construction Materials
  ▪ Concrete Materials (CEE 401)
  ▪ Construction Materials Characterization (CEE 501)
  ▪ Fracture and Fatigue (CEE 575)

• Geotechnical Engineering
  ▪ Soil Mechanics and Behavior (CEE 483); Applied Soil Mechanics (CEE 484)
  ▪ Excavation and Support Systems (CEE 580)
  ▪ Deep Foundations (CEE 585)

• Computational Science and Engineering
  ▪ Numerical Analysis (CSE 401)
  ▪ Parallel Programming (CSE 402)
Typical CEE Structures MS Program

- Structural Analysis and Mechanics (3 or 4)
  - Structural Analysis (CEE 470) → often taken as an undergraduate
  - Structural Mechanics (CEE 471)
  - Structural Dynamics, I (CEE 472)
  - Finite Element Methods (CEE 570)
  - Higher level analysis and/or mechanics courses

- Advanced Structural Design (3 or 4)
  - Steel Structures, II and Reinforced Concrete, II (CEE 462 and 463)
  - Masonry, Prestressed Concrete, and/or Wood (CEE 467, 468 and/or 469)

- Structural Behavior (2 or 3)
  - Steel Structures, III (CEE 560)
  - Earthquake Engineering (CEE 572)
  - Other higher level behavior courses

- Courses from Materials, Geotech, Computing, Architecture, etc. (0 or 1)
- *There are many other course choices, depending on your interests!*
CEE Structures Courses 2020-2021

• Fall 2020
  ■ CEE 463 – Reinforced Concrete, II
  ■ CEE 470 – Structural Analysis
  ■ CEE 471 – Structural Mechanics
  ■ CEE 472 – Structural Dynamics, I
  ■ CEE 491 – Decision and Risk Analysis
  ■ CEE 574 – Probabilistic Loads and Design
  ■ CEE 576 – Nonlinear Finite Elements
  ■ CEE 598 SDO – Structural Design Optimization

• Spring 2021
  ■ CEE 462 – Steel Structures, II
  ■ CEE 468 – Prestressed Concrete
  ■ CEE 490 – Computer Methods
  ■ CEE 470 – Structural Analysis
  ■ CEE 562 – Highway Bridge Design
  ■ CEE 570 – Finite Element Methods
  ■ CEE 572 – Earthquake Engineering
  ■ CEE 573 – Structural Dynamics, II
  ■ CEE 577 – Computational Inelasticity
  ■ CEE 591 – Reliability Analysis
  ■ CEE 598 – Theory of Heterogeneous Materials
CEE Structures PhD Road Map

- Complete MS degree
- Continue coursework
  - 8 courses total beyond the MS degree
  - Most students take a variety of courses, including some in other departments (MechSE, CSE, Math, MatSE)
- Start working on dissertation research
- Qualifying Exam (often taken at the end of MS studies)
- Complete remainder of coursework
- Preliminary Exam, for approval of dissertation topic and research proposal
- Continue research full-time, attend conferences, write technical papers, work on dissertation
- Final Examination (on dissertation)
Other Aspects of the MS and PhD Road Map

- Nearly all PhD (and some MS) students have 25% to 50%-time TAs, RAs, or Fellowships
  - Assistantships and fellowships are typically 25% or 50%; both include a *full tuition waiver*
  - Assistantships and fellowships are usually paired with a specific faculty member for research and/or teaching support
- The faculty advisor plays a key role, particularly in research
- Graduate research advisors:
  - We do not assign students to research advisors (though we do that for academic advisors of MS students)
  - Requires shared technical interests, as well as compatible personalities
  - Most often the faculty member has obtained grant funding to support the research work
  - Extensive one-to-one teaching, collaboration, and career mentoring is involved
CSE Graduate Concentration

Computational Science and Engineering

http://cse.illinois.edu/
Structural Engineering Seminars

- CEE 595S
- Required every semester
- Mondays, 4-5p
- Roughly every other week
- Typically 7 seminars, must attend 6
- This semester, 6 online seminars
- Stay tuned for more details from Prof. Lombardo
Structural Engineering Conference

The Illinois CEE Structural Engineering Conference is held during the spring semester at the I-Hotel and Conference Center on campus.

Grad student registration is free!!
Student Organizations

• Chi Epsilon
• Earthquake Engineering Research Institute (EERI)
• Engineers in Action Bridge Program
• Structural Engineering Graduate Student Organization (SEGSO)
• Monthly meetings with presentations from companies and free Papa Del’s pizza  
• Network with industry professionals  
• Multiple leadership opportunities  
• Get to know professors in the department outside of the classroom  
• Volunteer in the CU community  
• Hangout with fellow students  

All CEE grad students are invited to initiate  

Interested? Any questions? Email smhoang2@illinois.edu
Earthquake Engineering Research Institute
UIUC Chapter

Seismic Design
Coach and consult in the annual national competition

Advanced Topics & Special Seminars
Brush shoulders with experts in earthquake engineering

National Networking
Network with scientists and engineers across the world

Find us on Facebook or contact by email (eeri.illinois@gmail.com)
What do we do?
Design and construct pedestrian suspended bridges for isolated communities

Where have we been to?
Bolivia (2018 Summer), Panama (2017 Summer), Guatemala (2016 Summer)

How can you be involved?
Bridge design, travel to construct, external relations, marketing, fundraising…
Honestly anything helps

Faculty advisor:
andrawes@illinois.edu | Prof. Andrawes
SEGSO is an organization created by graduate students to improve the graduate school experience. Our purpose is to organize and plan professional, academic and social events for the betterment of Structural Engineering graduate students at UIUC.
Meet the Board

Setare Hajarolasvadi  
*President*

Aradhana Agarwal  
*Vice President*

Alfredo Sanchez  
*Treasurer*

Martina Guerrero  
*Board Member*

Justin Nevill  
*Professional Chair*

Marcelino Anguiano  
*Media Manager*

Antonio Zaldivar  
*Secretary*

Sophie Hoang  
*Board Member*
Events

Social

Potluck dinners, happy hours, student/professor parties, trivia nights, cookouts, etc.

Professional

Professional weekend in Chicago, seminars with industry professionals.

Academic

Academic seminar series, student research seminars.
Chicago Professional Weekend

**Professional Panel**
Get familiar with top structural engineering companies, ask questions from industry professionals, network.

**Construction Site Visit**
See some structural engineering in action!

**...and Much More!**
Explore the city, go on a boat tour, have dinner with industry professionals and make long-lasting friendships.
Structural Engineering Professional Panel

**When?** Friday September 18th, 10 am.-12 pm. CT

**Where?** On Zoom!

- Learn more about the companies you will be talking to in the virtual job fair.
- Know what the companies will be looking for in a candidate.
- Hear how you can have a smooth transition from academia to industry.
- Interact and ask questions from the panelists.
Participate!

Get Involved with SEGSO!

– **Subscribe** to our mailing list to get important information about SEGSO events ([link](#)).

– **Board positions available** for 2020-2021 and beyond!

– **Email** SEGSO <segso.uiuc@gmail.com> or Setare Hajarolasvadi <hajarol2@illinois.edu> if interested.
Contact us!

• Group Email: segso.uiuc@gmail.com
• Facebook: http://www.facebook.com/UIUC-SEGSO
• Instagram: uiuc_segso
• Twitter: @UIUCSEGSO
• CEE Website: http://segso.cee.illinois.edu/
Prof. Jeff Roesler
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Jill Randell
Assistantships & Payroll
1104 Newmark
jrandell@illinois.edu

Marissa Miller
Structures/SHRM Area Staff
3129 Newmark
marissam@illinois.edu
Final Comments

• Complete “New Graduate Student Program Review Form” today (submit “Plan of Study” before end of semester)

• Register for courses

• Register for seminar (CEE595S)

• Consult your academic advisor with questions. Additional points of contact are:
  ■ Prof. Fahnestock – Structures Chair (fhnstck@illinois.edu)
  ■ Prof. Lopez-Pamies – Structures Grad Coordinator (pamies@illinois.edu)
  ■ Marissa Miller – Structures Support Staff (marissam@illinois.edu)

• Don’t leave this meeting if you have questions

• Have a great semester!
Questions?