CEE 680A6 - STRUCTURAL STABILITY
Spring, 2015 - Tu Th 3:30 – 4:45 PM
Engineering E 105

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Office hours: Tuesdays, 1 – 3 pm, or by appointment

Course objectives: To introduce concepts of structural stability analysis of buildings and other structures, and to provide fundamental tools of mathematical and mechanics that are necessary in investigating stability of equilibrium and bifurcation of structural components and systems. Coverage includes the necessary and sufficient conditions for stability of equilibrium, stability of columns subjected to combinations of axial force and bending, lateral-torsional buckling of unbraced beams, buckling of compression members with elastic lateral support, and stability of rigid frames, arches, and thin plates and shells. Classical methods and energy-based formulations are developed in detail. Special topics include dynamic stability, post-buckling behavior of inelastic members, and visco-elastic stability.

Prerequisites: Graduate standing in CEE; Advanced Mechanics of Materials; Matrix Structural Analysis. A course in advanced engineering mathematics would be helpful but is not required.

Date	Topic	Reading
Jan 20	Fundamental concepts; stability of equilibrium; bifurcation; critical load	1.1 - 1.4
22	Fundamentals (cont'd); snap-through buckling; MDOF models	1.5 – 1.6
Jan 27	Stability of initially straight elastic columns	2.1; 2.3 - 2.5
29	Large deformation theory	2.2; App. 2.1
Feb 03	Columns with initial crookedness or eccentric load; Southwell plots	2.6
05	Nonprismatic members; shear deformations	
Feb 10	Inelastic behavior of columns – double, tangent modulus theory; Shanley's model	3.1-3.8
12	Energy-based approximate methods – Rayleigh and Timoshenko quotients	
Feb 17	Principle of stationary potential energy	
19	Introduction to the calculus of variations	
Feb 24	Approximate methods – Rayleigh-Ritz method	
26	Approximate methods – Galerkin method	
Mar 03	Beam-columns I – Introduction	4.1 - 4.3
05	Beam-columns II – Principle of superposition	4.4 - 4.5
Mar 10	Beam-columns III – Applications of Fourier series; beams on elastic foundations	4.8-4.9; 2.10-2.11
12	Stability of rigid frames –classical analysis	5.1–5.3

Mar 17 – 19 Spring break

Mar 24	Stability of rigid frames; axial load-bending stiffness effects; slope-deflection	2.7–2.9; 4.6-4.7
26	**Midterm examination**	
Mar 31	Review midterm examination	
Apr 02	Stability of rigid frames – matrix methods I	7.1-7.6
Apr 07	Stability of frames - matrix methods II; approximate solutions	Chapter 8
09	Torsional stability; flexural-torsional buckling of columns	6.1 – 6.8
Apr 14	Lateral-torsional buckling of beams; beam bracing	7.7 – 7.9
16	Buckling of circular rings and tubes under uniform pressure	
Apr 21	Buckling of arches	
23	Introduction to non-conservative systems; dynamic approach to stability analysis	
Apr 28	Dynamic approaches to stability analysis (cont'd); flutter instability	
30	Equilibrium of thin plates: transverse loading; boundary conditions; in-plane forces	
May 05	Buckling of simply supported thin rectangular plates; classic (Levy) solutions	
07	Buckling of thin plates (cont'd); enegy-based methods of solution	

May 11 (Monday) Final Examination 6:20pm – 8:20pm

Required text:

Galambos, T.V. and Surovek, A.E. (2008), *Structural Stability of Steel: Concepts and Applications for Structural Engineers*. John Wiley, New York, NY (ISBN: 978-0-470-03778-2)

Course grading:

Homeworks	25%
Mid-term exam	25%
Final exam	50%

Course Management

There will be approximately eight homework assignments during the course of the semester. You are encouraged to discuss homework assignments among yourselves, as this is a good way to learn the material, but any work you turn in must be written in your own hand and be your own work. In-class tests and exams are to be your own work. Late homework will *not* be accepted without a *prior* excuse from me.

A supplemental reading list contains references that can be easily accessed. While I have not assigned specific readings from this list, you might find this material helpful as a starting point for further independent study.

Cell phones must be turned off and left in your pack during class.