CE 464A/564A – Spring 2018
Integrated Highway Bridge Design using LRFD Methodology

Lead Instructor: **Brooks Keenan, P.E.**

Office Hours **By appointment only**

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Class Meeting: **Friday 2:00 PM – 5:00 PM**
Civil Engineering Room 201 (Edward Nowatzki Memorial Lecture Hall)

Web Site: **www.d2l.arizona.edu**

This course is taught by a team of volunteer professionals as listed below:

Lecturer	Subject	Affiliation	E-mail	Phone
Alejandro Angel, PE	Roadway & Geometry	PSOMAS	aangel@psomas.com	292-2300
Brent Borchers, PE Brooks Keenan, PE	Geotech & Foundations	Terracon	bmborchers@terracon.com BrooksKeenan@comcast.net	770-1789
Brooks Keenan, PE (lead instructor)	Substructures & LRFD Methodology	Crown Engineering	BrooksKeenan@comcast.net	909-9067
Tom McGovern, PE	Roadway & Geometry	PSOMAS	tmcgovern@psomas.com	292-2300
Ann Moynihan, PE	Bridge Hydraulics	Pima County RFCD	Ann.Moynihan@pima.gov	724-4638
Ted Buell, PE	Superstructures	HDR	Ted.Buell@hdrinc.com	584-3632
Dave Zaleski, PE	Structures & Field Trips	Pima County DOT	Dave.Zaleski@pima.gov	724-6467

Prerequisites:

CE 310 – Probability in Civil Engineering
CE 323 – Hydraulic Engineering and Design
CE 343 – Geotechnical Engineering and Design
CE 363 – Transportation Engineering and Pavement Design
CE 335 – Structural Design in Concrete

Course Objectives:

Understanding methods for the integrated design of components typically found in transportation structures including bridge superstructures and substructures, retaining walls, pavements, highway geometrics, traffic, drainage, geotechnical, etc.

1) Introduce students to concepts underlying the design of various components typically found in highway structures by using the Load and Resistance Factor Design (LRFD) methodology.
2) Emphasize quantification of uncertainties in design processes and importance of deformation-based design procedures.
3) Emphasize the importance of inter-disciplinary interaction for design of transportation structures.
4) Emphasize importance of considering construction procedures in design and vice versa
5) Introduce national standards produced by the Federal Highway Administration (FHWA) and American Association of State Highway and Transportation Officials (AASHTO).
6) Discuss brief case-histories using local projects with the objective of emphasizing concepts.

Reference Texts:

1) AASHTO LRFDUS-7 (2014). **AASHTO LRFD Bridge Design Specifications – 7th Edition**
2) FHWA NHI-06-088 (2006). **Soils and Foundations Reference Manual,** Volumes I and II - downloadable free of charge at www.ncsconsultants.com/downloads
3) FHWA-HIF-12-003 (2012). **Evaluating Scour at Bridges – 5th Edition**, Hydraulic Engineering Circular (HEC) 18. HEC 18
4) FHWA-HIF-12-004 (2012). **Stream Stability at Highway Structures – 4th Edition,** Hydraulic Engineering Circular (HEC) 20. HEC 20
5) FHW- NHI-09-111 and -112 (2009). **Bridge Scour and Stream Instability Countermeasures, Experience, Selection, and Design–Volumes 1 and 2 – 3rd Edition**, Hydraulic Engineering Circular (HEC) 23. HEC 23
6) **Guidelines for Establishing Scour and Freeboard for Bridges in Pima County,** (2012) PCRFCD/PCDOT. Pima County Scour and Freeboard

Topics Covered:

1 – Overview and Layout of Bridge Structures based on Traffic Projection, Roadway Geometrics, Site
2 – Bridge Hydraulics and Scour
3 – LRFD, Loads and Load Combinations
4 – Introduce the importance of construction methods in design and vice versa
5 – Methods for Bridge Superstructure Design
6 – Methods for Bridge Substructure Design
7 – Bridge Deck and Appurtenant Structures
8 – Constructability Evaluations, QA/QC, Plans, Specifications and Estimates
9 – Construction Management
10 – Course Summary, Introduction to Advanced Topics.

The attached schedule provides more detail on the weekly schedule of topics that will be covered and the responsible instructor.

Contribution to professional component: (Units)

Math and basic science:	0
Engineering topics:	0
Design experience:	3

Relationship to program outcomes:

This course contributes to satisfying program goals 1, 2, 3, and 4 as defined by our faculty. The course also contributes to satisfying ABET outcome criteria 3A, 3C, 3E, 3K, 3L and 3M to the degrees indicated on the Course Classification Form.

Weekly Quizzes/Homework Assignments:

There will be a quiz or homework assignment in the week following each lecture. You can take the quizzes online through the course website on D2L. Each quiz will be available from 8:00 am until 1:00 pm on Tuesday and from 6:00 pm until 11:00 pm on Wednesday. Missed quizzes cannot be made up. The instructors may select to assign a homework assignment instead of the weekly quiz. In that case, the homework will be due at the beginning of the following lecture of which it is assigned. Homework will not be accepted after a lecture has begun. Each quiz or homework assignment will be worth 5% of the final grade for undergraduate students and 4% of the final grade for graduate students.

Graduate Student (564A) Design Summary Report:

Graduate students enrolled in CE 564A are required to write a design summary report on any component of the case study bridge using LRFD. This report will be a written synopsis that includes: identification of the bridge component, detailed description of the design process, assumptions of unknown variables, and an appendix of calculations. The proposed topic should be discussed with the instructor teaching that portion of the course by **Friday, February 23rd**. A Draft Design Summary Report, including preliminary calculations, is due by **Friday, March 23rd** and the Final Design Summary Report is due by **Friday, April 27th**.

Grading Policy:

Task	**CE 464A Undergraduates**	**CE 564A Graduates**
Weekly Quizzes/Homework	70%	56%
Construction Field Visit Report	5%	5%
Graduate Student Design Summary Report		14%
Final Exam	25%	25%

Final grades are calculated using the percentages above. Once calculated the final course grade will be rounded to the nearest tenth percent and assigned the letter grade corresponding to the following ranges:

A – 100.0 – 90.0
B – 89.9 – 80.0
C – 79.9 – 70.0
D – 69.9 – 60.0
E – 59.9 – 0.0

Class schedule:

The course consists of fourteen 180-minute lectures, held once per week. There will be about 20 minutes of break-time given at times and lengths at the lecturer's discretion (e.g., two 10-minute breaks, three 10-minute breaks, etc.).

Lecture No.	Friday	Topic	Instructor
1	1/12	Introduction to LRFD Methodology / Bridge Design Process / Bridge Construction Plans	Brooks Keenan / Dave Zaleski
2	1/19	Roadway Design & Geometry	Tom McGovern / Alejandro Angel
3	1/26	Bridge Hydraulics & Scour	Ann Moynihan
4	2/2	Overview of Bridges / Bridge Selection Process / AASHTO LRFD Specifications	Dave Zaleski
5	2/9	Comparison of ASD, LFD, and LRFD / Loads / Load Combinations	Brooks Keenan
6	2/16	Substructures: Overview of Soil Mechanics	Brent Borchers
7	2/23	Substructures: Shallow / Deep Foundations	Brent Borchers
8	3/2	Superstructure Design Overview & Case Study / Structural Analysis	Ted Buell
9	**3/9**	**SPRING RECESS**	**NO CLASS**
	3/16	Reinforced Concrete Refresher / Superstructure Design Case Study (cont'd)	Ted Buell
10	3/23	Substructure Design Overview & Case Study	Brooks Keenan
11	3/30	Substructure Design Case Study (cont'd)	Brooks Keenan
	4/6	Computer Lab – Software Modelling	Brooks Keenan / Ted Buell
12	**4/13**	**SCE STUDENT CONFERENCE**	**NO CLASS**
13	4/20	Appurtenant Structures	Brooks Keenan / Ann Moynihan
14	4/27	Construction Specifications for Bridges / Bridge Construction Methods / Summary of Course	Dave Zaleski / Jim Cunningham / all
	TBD	**Final Exam**	Brooks Keenan / Dave Zaleski

Accessibility and Accommodations:
Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Disability Resource Center (520-621-3268) to establish reasonable accommodations. For additional information on the Disability Resource Center and reasonable accommodations, please visit http://drc.arizona.edu**.**

Code of Academic Integrity:
Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog.
See: http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity

UA Nondiscrimination and Anti-harassment Policy:
The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Threatening Behavior Policy:
The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

Subject to Change Statement:
Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.