CE 166 CONSTRUCTION ENGINEERING

Course web site: on bCourses

Professor Arpad Horvath

University of California, Berkeley

Course Syllabus

Spring 2021

January 19, 2021

Catalog Description. Introduction to construction engineering and field operations. The construction industry, construction methods and practice, productivity improvement, equipment selection, site layout, formwork, erection of steel and concrete structures. Labs demonstrate the concepts covered. Field trips to local construction projects.

Objective. In addition to knowledge about construction materials, management methods and tools, and communication and negotiation skills, successful construction professionals – and civil and environmental engineers – need a thorough understanding of construction equipment, methods and techniques. This course is intended to provide a comprehensive overview of construction engineering methods, techniques and equipment. While primary emphasis is on the construction phase, the techniques and perspectives apply to the operation and maintenance, and the end-of-life stage of projects as well. After taking this course, students should be able to apply construction engineering methods to the construction, operation, maintenance and decommissioning of civil engineering facilities.

Instructor:

Professor Arpad Horvath
Email: horvath@ce.berkeley.edu
Office hours: Wednesdays 5:00–6:00 pm, Thursdays 11:00 am–12:00 pm, Fridays 9:00–10:00 am on zoom

Graduate Student Instructor:

Fiona Greer, Ph.D. student
Email: fionagreer@berkeley.edu
Office hours: Thursdays 1:30–3:30 pm and Fridays 1:30–2:30 pm on zoom

Schedule. The course is scheduled for Tuesdays and Thursdays 4:10–5:00 pm for lectures and Thursdays 5:10–8:00 pm for lab sessions. The course schedule is attached. Check bCourses for zoom links.

Course Materials, Textbook, and Readings. The course topics, the lectures, and most of the lab sessions will be recorded and only shared with other students in the course. **Course materials, including all recordings, are copyrighted, and reposting to third party sites or any other form of redistribution is strictly prohibited and protected by law and the Berkeley Code of Student Conduct.**

The required textbook is:

- Nunnally, S. W., Construction Methods and Management, Prentice Hall, Upper Saddle River, NJ, 8th edition, 2011, ISBN 13: 978-0-13-500079-3

The course Reader is available from Copy Central: https://copycentral.redshelf.com/book/1712142/ce-166-construction-engineering-1712142-none-arpad-horvath.

Reading assignments (T for textbook and R for Reader) and additional, recommended readings are shown in the schedule on page 4 and listed on pages 5-8.

You are also encouraged to read the following on a regular basis:

- **ENR.** (Engineering News-Record). ENR is the most widely read trade magazine for the architecture/engineering/construction industry. In recent years, it has become more "journalistic" and less technical. Copies can be found in the engineering library. Published weekly. The ENR web site

(www.enr.com) is a good source of construction information. For example, the various annual lists of the largest engineering and construction firms are useful for job hunting!

- **ASCE J. of Construction Engineering and Management** (https://ascelibrary.org/journal/jcemd4). This is a professional journal published monthly. UCB has full electronic access.

Assignments, Examinations and Grading. Contributions to the course grade are:

Project 1	=	13%
Project 2	=	12%
Project 3	=	20%
Problem sets 5@3%	=	15%
Midterm exam	=	10%
Final exam	=	30%
		100%

All exams will be "open-notes." No make-up examination will be allowed, except in emergency when *prompt notice* and *documentation* are given to the instructor.

Final grade:	≥ 90%	A-, A, or A+
	≥ 80%	B-, B, or B+
	≥ 70%	C-, C, or C+
	≥ 60%	D-, D, or D+
	< 60%	F

All grading decisions are final, except in case of grading error.

Plagiarism and Cheating. Everyone must develop their own solution to the problem sets. Projects will involve teamwork wherein every team member is expected to contribute an equal effort.

Violating UC Berkeley's Honor Code. You must abide by UCB's Honor Code: "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others." Students violating the Code of Student Conduct or otherwise acting unethically will be penalized. For more information: http://sa.berkeley.edu/code-of-conduct

Accommodation of Special Circumstances. Please inform the instructor in writing in the first two weeks of the semester regarding academic accommodation of religious beliefs, disabilities, or other special circumstances.

Lectures and Assignments. Updated March 27, 2021

DATE	TOPIC	READING	DUE
Jan. 19 Tu.	Introduction to Course; Introduction to Project 1		
Jan. 21 Th.	Construction Industry Characteristics; Economies of Scale	T1, R2	
Jan. 21 Th. Lab	World Wide Plaza project videos, Parts I and II		
Jan. 26 Tu.	Value Engineering and Constructability	T3, R4, R5, R6	
Jan. 28 Th.	Construction Equipment Utilization	T8, T9, T10, T11, R12	
Jan. 28 Th. Lab	World Wide Plaza project videos, Parts III and IV	R7	
			↓
Feb. 2 Tu.	Earthmoving Equipment and Utilization		
Feb. 4 Th.	Trenching and Pipesetting	T18, R19, R13, T14, T15, T16, T17	
Feb. 4 Th. Lab	Work in Project 1 teams		**PS 1**
			↓
Feb. 9 Tu.	Compaction	T20	
Feb. 11 Th.	Equipment Arrivals and Queuing	R21	
Feb. 11 Th. Lab	World Wide Plaza discussion; Introduction to Project 2		**PS 2**
Feb. 16 Tu.	Hoists and Cranes, Crane Utilization	T22, R23	
Feb. 18 Th.	Preparation for Project 1 presentations		
Feb. 18 Th. Lab	Project 1 presentations		**Project 1**
			↓
Feb. 23 Tu.	Field trip		
Feb. 25 Th.	Concrete and Asphalt Production and Construction	T31, R32	
Feb. 25 Th. Lab	Road Construction, Paving; Project 2 Meetings	T33, R34	
Mar. 2 Tu.	Equipment Economics	T24, R25	
Mar. 4 Th.	Equipment Economics		
Mar. 4 Th. Lab	Work in Project 2 teams		**PS 3**
Mar. 9 Tu.	Midterm Exam Review		
Mar. 11 Th.	Midterm Exam questions and answers		
Mar. 11 Th. Lab	Midterm Exam		
March 12	Field Trip (1-2 pm)		
Mar. 16 Tu.	Work on Project 2		
Mar. 18 Th.	Introduction to Project 3		
Mar. 18 Th. Lab	Project 2 Presentations		**Project 2**
			↓
Mar. 30 Tu.	Quantity Take-off, Cost Estimation	T26	
Apr. 1 Th.	Site Planning and Introduction to Project 3		
Apr. 1 Th. Lab	Introduction to Project 3		**PS 4**
Apr. 6 Tu.	Formwork Systems, Formwork Design	T27, R28	
Apr. 8 Th.	Formwork Design	R29, R30	
Apr. 8 Th. Lab	Field trip and Project 3 Consultation		
			↓
Apr. 13 Tu.	Environmental Effects in Construction	T41, R42, R43, R44	
Apr. 15 Th.	New Technologies in Construction	T35, R36, R37, R38	
Apr. 15 Th. Lab	Work in Project 3 teams		
Apr. 20 Tu.	Bridge Construction (watch video)		
Apr. 22 Th.	Bridge Construction (watch video)		
Apr. 22 Th. Lab	Construction Careers and Graduate School; Project 3 Meetings		**PS 5**
Apr. 27 Tu.	Work in Project 3 teams		
Apr. 29 Th.	Work in Project 3 teams		
Apr. 29 Th. Lab	Work in Project 3 teams		
May 4 Tu.	Final Exam Review		
May 6 Th.	Final Exam Review		
May 6 Th. Lab	Work in Project 3 teams		**Project 3**
May. 14, Fri., 8-11 am	Final Exam		

Readings (Textbook and Reader):

Introduction/Construction Industry/Economies of Scale

1. Nunnally, S.W. (2011). Introduction. *Construction Methods and Management* (8th ed., pp.1-10). Upper Saddle River, NJ: Prentice Hall. **[Textbook 1-10]**

2. Hornbostel, C. (1991). *Construction Materials: Types, Uses and Applications*. Wiley. **[Reader: 11-35]**

Value Engineering and Constructability

3. Nunnally, S.W. (2011). Contract construction. *Construction Methods and Management* (8th ed., p. 314). Upper Saddle River, NJ: Prentice Hall. **[Textbook 314]**

4. Young, James A., III. (1998). Constructability in the design firm. *Cost Engineering, 40*(2), 33-35. **[Reader: 37-39]**

5. Gaughan, M., Murphy, J., Wallace, W. L. and Weaver, E. (2015). The value of value engineering: Functionality without breaking the bank on a raw water transmission project in Texas. In *Pipelines 2015*. https://doi.org/10.1061/9780784479360.156 **[Reader: 41-52]**

6. Angus, R. B., Gundersen, N. A., & Cullinane, T. P. (1999). Appendix A: Value analysis and engineering. *Planning, Performing, and Controlling Projects: Principles and Applications*. Prentice Hall. **[Reader: 53-59]**

   Recommended Reading:

   - Acharya, P., Pfrommer, C. and Zirbel, C. (1995). Think value engineering. *Journal of Management in Engineering*, 11(6), 13–17. https://doi.org/10.1061/(ASCE)0742-597X(1995)11:6(13)

   - Abdel-Raheem, M., Burbach, V., Abdelhameed, A., Sanchez, G. and Navarro, L. (2018). Value engineering and its applications in civil engineering. In *Construction Research Congress 2018*. https://doi.org/10.1061/9780784481295.027

World Wide Plaza/Safety

7. Mroszczyk, J. W. (2015). Improving construction safety: A team effort. *Professional Safety*, June, 55-68. **[Reader: 61-74]**

Construction and Earthmoving Equipment Utilization

8. Nunnally, S.W. (2011). Earthmoving materials and operations. *Construction Methods and Management* (8th ed., pp.12-13, 17-22). Upper Saddle River, NJ: Prentice Hall. **[Textbook 12-13,17-22]**

9. Nunnally, S.W. (2011). Excavating and lifting. *Construction Methods and Management* (8th ed., pp. 24-34). Upper Saddle River, NJ: Prentice Hall. **[Textbook 24-34]**

10. Nunnally, S.W. (2011). Loading and hauling. *Construction Methods and Management* (8th ed., pp.52-65, 70-73). Upper Saddle River, NJ: Prentice Hall. **[Textbook 52-65, 70-73]**

11. Nunnally, S.W. (2011). Compacting and finishing. *Construction Methods and Management* (8th ed., pp. 87-90). Upper Saddle River, NJ: Prentice Hall. **[Textbook 87-90]**

12. Peurifoy, R. L., & Schexnayder, C. J. (2002). Piles and pile-driving equipment. *Construction planning, equipment, and methods*. McGraw-Hill. **[Reader: 75-103]**

Site Planning

13. Handa, V., Lang, B. (1988). Construction site planning. *Construction Canada,* 88(5), 43-49. **[Reader: 105-111]**

Recommended Reading:

- Zolfagharian, S., & Irizarry, J. (2014). Current trends in construction site layout planning. In *Construction Research Congress 2014*. https://doi.org/10.1061/9780784413517.176

Structural Systems

14. Nunnally, S.W. (2011). Concrete construction. *Construction Methods and Management* (8th ed., pp. 205-228). Upper Saddle River, NJ: Prentice Hall. **[Textbook 205-228]**

15. Nunnally, S.W. (2011). Steel construction. *Construction Methods and Management* (8th ed., pp. 264-275). Upper Saddle River, NJ: Prentice Hall. **[Textbook 264-275]**

16. Reid, R. L. (2012). Seismic retrofit aims to preserve historically important rail station. *Civil Engineering (08857024)*, 82(11), 18–20. **[Reader: 113-115]**

17. Fountain, H. (2012). Wood that reaches new heights. *New York Times*, 161(55793), 1. **[Reader: 116-117]**

Recommended Reading:

- Post, N. M. (2017). Tested steel module gets high grades: engineers predict coupled steel-plate walls, filled with concrete, will fundamentally change office-tower construction. ENR: Engineering News-Record, 8-9.

Trenching/Pipesetting

18. Nunnally, S.W. (2011). Excavating and lifting. *Construction Methods and Management* (8th ed., pp.34-38). Upper Saddle River, NJ: Prentice Hall. **[Textbook 34-38]**

19. Caterpillar Inc. (2000). *Caterpillar Performance Handbook*, 31st ed. Peoria, Illinois. **[Reader: 119-149]**

Compaction

20. Nunnally, S.W. (2011). Compacting and finishing. *Construction Methods and Management* (8th ed., pp. 75-87). Upper Saddle River, NJ: Prentice Hall. **[Textbook 75-87]**

Equipment Arrivals and Queuing

21. Hendrickson, C. and Au, T. (1989). Queues and resource bottlenecks. *Project Management for Construction: Fundamental Concepts for Owners, Engineers, Architects, and Builders*. Prentice Hall. **[Reader: 152-156]**

Hoists and Cranes, Crane Utilization

22. Nunnally, S.W. (2011). Excavating and lifting. *Construction Methods and Management* (8th ed., pp. 38-45). Upper Saddle River, NJ: Prentice Hall. **[Textbook 38-45]**

23. Shapira, A., Lucko, G., and Schexnayder, C. J. (2007). Cranes for building construction projects. *Journal of Construction Engineering and Management*, *133*(9), 690–700. https://doi.org/10.1061/(ASCE)0733-9364(2007)133:9(690) **[Reader: 157-167]**

Equipment Economics

24. Nunnally, S.W. (2011). Construction economics. *Construction Methods and Management* (8th ed., pp. 298-306). Upper Saddle River, NJ: Prentice Hall. **[Textbook 298-306]**

25. Nunnally, S. W. (2000). The replacement decision. *Managing Construction Equipment*. 8(2nd ed., pp. 308-313). Upper Saddle River, NJ: Prentice Hall. **[Reader: 169-171]**

Recommended Reading:

- Kannan, G. (2011). Field studies in construction equipment economics and productivity. *Journal of Construction Engineering and Management*, 137(10), 823–828. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000335

Quantity Take-off, Cost Estimation

26. Nunnally, S.W. (2011). Foundations. *Construction Methods and Management* (8th ed., pp. 156-170). Upper Saddle River, NJ: Prentice Hall. **[Textbook 156-170]**

Recommended Reading:

- Zhao, P. A., & Wang, C. C. (2014). A comparison of using traditional cost estimating software and bim for construction cost control. In *ICCREM 2014*. https://doi.org/10.1061/9780784413777.031

Formwork Systems, Formwork Design

27. Nunnally, S.W. (2011). Concrete form design. *Construction Methods and Management* (8th ed., pp. 229-244). Upper Saddle River, NJ: Prentice Hall. **[Textbook 229-244]**

28. Blair, S. (2017). Shoring braces historic walls safely above crews. *ENR: Engineering News-Record*, CA16. **[Reader: 173-175]**

29. Nelson, T. A., and Burnworth, S. (2016). The art of shoring. *Civil Engineering Magazine Archive*, *86*(4), 76–85. https://doi.org/10.1061/ciegag.0001090 **[Reader: 177-180]**

30. Allen, T. (2017). Bolstering efficiency. *International Construction*, 56(10), 22. **[Reader: 181-184]**

Concrete and Asphalt Production and Construction

31. Nunnally, S.W. (2011). Production of aggregate, concrete, and asphalt mixes. *Construction Methods and Management* (8th ed., pp. 109-124). Upper Saddle River, NJ: Prentice Hall. **[Textbook 109-124]**

32. Naik, T. R. (2008). Sustainability of concrete construction. *Practice Periodical on Structural Design and Construction*, *13*(2), 98–103. https://doi.org/10.1061/(ASCE)1084-0680(2008)13:2(98). **[Reader: 185-190]**

Recommended Readings:

- Zaumanis, M., Poulikakos, L. D., & Partl, M. N. (2018). Performance-based design of asphalt mixtures and review of key parameters. *Materials & Design*, 141, 185–201. https://doi.org/10.1016/j.matdes.2017.12.035
- Jackson, M.D., Oleson, J.P. Juhyuk, M., Yi, Z., Heng, C., & Gudmundsson, M.T. (2018) Extreme durability in ancient Roman concretes. American Ceramic Society Bulletin, 22-28.

Road Construction, Paving

33. Nunnally, S.W. (2011). Paving and surface treatments. *Construction Methods and Management* (8th ed., pp. 126-135). Upper Saddle River, NJ: Prentice Hall. **[Textbook 126-135]**

34. Fischetti, M. (2005). Paving the way. *Scientific American*, 293(4), 96–97. **[Reader: 191-192]**

Recommended Reading

- Jones, D. (2009). Mild behavior. *Roads & Bridges*, 47(10), 50.

New Technologies in Construction

35. Nunnally, S.W. (2011). Improving productivity and performance. *Construction Methods and Management* (8th ed., pp. 334-338). Upper Saddle River, NJ: Prentice Hall. **[Textbook 334-338]**

36. O'Brien, G. (2010). Building information modeling. *BusinessWest*, 27(10), 33. **[Reader: 193-197]**

37. Wilson, B. (2017). The future world around you: DOTs, design firms taking advantage of virtual reality. *Roads & Bridges*, *55*(12), 28. **[Reader: 199-201]**

    Recommended Reading

    - Sawyer, T. (2002). Researchers challenged to improve construction. *ENR* 248, no. 21: 50(3).

    - Guernsey, L. (2000, December 14). Hard hat, lunch bucket, keyboard. *The New York Times*, p. G1.

38. Rubenstone, J. (2018). What can AI do for you? Artificial intelligence sees new connections in project. *ENR: Engineering News-Record*, 22–27. **[Reader: 203-208]**

Tunneling

39. Nunnally, S.W. (2011). Rock excavation. *Construction Methods and Management* (8th ed., pp. 94). Upper Saddle River, NJ: Prentice Hall. **[Textbook 94]**

40. Harris, F. (1994). Ch. 10 tunneling. *Modern Construction and Ground Engineering Equipment and Methods*. Longman Scientific & Technical **[Reader: 209-227]**

Environmental Effects in Construction

41. Nunnally, S.W. (2011). Construction safety and health and equipment maintenance. *Construction Methods and Management* (8th ed., pp. 321-322). Upper Saddle River, NJ: Prentice Hall. **[Textbook 321-322]**

42. Horvath, A. and Hendrickson, C. (1998). Comparison of environmental implications of asphalt and steel-reinforced concrete pavements. *Transportation Research Record: Journal of the Transportation Research Board*, 1626, 105–113. https://doi.org/10.3141/1626-13 **[Reader: 229-237]**

43. Sharrard, A. L., Matthews, H. S. and Ries, R. J. (2008). Estimating construction project environmental effects using an input-output-based hybrid life-cycle assessment model. *Journal of Infrastructure Systems*, 14(4), 327. **[Reader: 239-248]**

44. Boyd, S., Stevenson, C., and Augenbraun, J. (2012). Deconstructing deconstruction: is a ton of material worth a ton of work? *Sustainability: The Journal of Record*, 5(6), 391–400. **[Reader: 249-258]**

    Recommended Reading

    - Millstein, D. E., & Harley, R. A. (2009). Revised estimates of construction activity and emissions: effects on ozone and elemental carbon concentrations in southern California. *Atmospheric Environment*, *43*(40), 6328–6335. https://doi.org/10.1016/j.atmosenv.2009.09.028