Instructors: Dr. Najafi and Dr. Ghandehari

COURSE SYLLABUS

The University of Texas at Arlington

College of Engineering

Department of Civil Engineering

CE 5387 – Construction Productivity

(3 Credit Hours)

Name of Instructors: Dr. Mohammad Najafi, P.E., and Dr. Mostafa Ghandehari

Contact Information and Office Hours:

Dr. Najafi:

428 Nedderman Hall
817-272-0507
Najafi@uta.edu

Monday and Wednesday, 2:00 – 5:00 PM (Additional Office Hours by Appointment).

Dr. Ghandehari:

430 Nedderman Hall
817-272-5688
ghandeha@uta.edu

Monday and Wednesday: 11:00 AM - 12:00 PM; Tuesday and Thursday: 3:30-5:00 PM (Additional Office Hours by Appointment)

Teaching Assistant (TA): Jwala Raj Sharma

Office Number: Civil Engineering Laboratory Building (CELB) – Room 141
Office Telephone Number: 817-272-9164
Office Hours: Tuesday and Thursday, 1:30 to 4:30 PM
Email: jwalaraj.sharma@mavs.uta.edu

Course Number, Section Number, and Course Title:

- Section 001-LEC (21175) Room 111 Nedderman Hall
- Section 002-LEC (21176) Off Web

CE 5387 – Construction Productivity

Time and Place of Class Meetings: Monday and Wednesday, 7:00 – 8:20 PM, Room 111, Nedderman Hall.

Description of Course Content: Evaluation of construction project management's effectiveness. An investigation of the advanced techniques required for improvement of construction projects including time, cost, quality management, preplanning, field evaluation techniques, time-lapse photography, safety, human factors, and communications.

General Student Learning Outcomes: Upon completion of the course, the student will have:

- an ability to apply knowledge of mathematics, science, and engineering,
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability,
- an ability to function on multi-disciplinary teams,
- an ability to identify, formulate, and solve engineering problems,
- an understanding of professional and ethical responsibility,
- an ability to communicate effectively,
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context,
- a recognition of the need for, and an ability to engage in life-long learning,
- a knowledge of contemporary issues, and
- an ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
Specific Student Learning Outcomes: Upon completion of CE 5387, the students will:

- understand importance of productivity in construction operations,
- understand measurement, evaluation, and presentation of productivity data,
- know methods to improve both productivity and performance in a construction project,
- understand the variables impacting project effectiveness, productivity, and performance, such as, planning and scheduling, cost estimating, project control, project organization, project layout, total quality management, project safety, constructability, project communications, contract management, project design, LEED, and lean construction, and so on,
- acquire ability to use computer software for productivity evaluation, design of construction operations, and contract management, and
- acquire ability to use statistical models to analyze data and make decisions to improve productivity of construction operations.

Prerequisite: CE 5379, CE 5386 and IE 5318; or consent of instructor.

Textbooks and Other Course Materials:

No required textbook. The students are required to utilize a variety of library and Internet sources, including lecture materials, sources provided on WebCT, the following text books, journal and conference papers, theses and dissertations, magazines and library search engines, such as Engineering Village and ASCE Database, to prepare for course requirements. WebCT will be used for course management. MicroCYCLONE Simulation System (available at Purdue University Web site), Sage Timberline Contract Control Software and/or Primavera Expedition Software (available at the Civil Engineering Lab, Room 226 Nedderman Hall) will be utilized.

Reference Books:
The following are books are available in the 3-hour reserve section of the Engineering Library. Additional reference materials are listed starting from Page 6.


Descriptions of Major Assignments and Examinations with Due Dates: There will be one midterm and one final exam, one term project with presentation, a term paper with presentation, and several assignments and class presentations. In most class periods, time will be allocated for students’ presentations. Students are encouraged to take advantage of this opportunity, study sources related to construction productivity, and make short but formal presentations to class to obtain maximum points for class attendance, participation and presentations category. See Active/Cooperative Learning Section for more details.

Grading Policy: Grades will be determined according to the following scale (the grading scale may be lowered at the discretion of the instructor, but will not be raised):
<table>
<thead>
<tr>
<th>Grade</th>
<th>% Required</th>
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<tbody>
<tr>
<td>A</td>
<td>90-100</td>
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<td>B</td>
<td>80-89</td>
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<tr>
<td>C</td>
<td>70-79</td>
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<tr>
<td>D</td>
<td>60-69</td>
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<tr>
<td>F</td>
<td>Less than 60</td>
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Students will be required to accumulate points from the following:

Assignments (Including HW and Labs), Class Attendance, Assignments, Participation & Presentations 20%
Term Paper 15%
Project 20%
Midterm 20%
Final Exam (Comprehensive) 25%

Total 100%

**Active/Cooperative Learning:** This class supports a new pedagogy that promotes active learning for students’ higher order critical thinking. Active learning promotes full student participation in class. Instructor may assign students to do assignments in teams and all the team members receive the same grade. If a team member refuses to cooperate on an assignment, his or her name should not be included on the completed work. Additionally, instructor may ask students to discuss lecture materials in groups and ask one of the group members to present the topic to the class.

**Attendance Policy:** Students are expected to attend all classes. For total professional development, class participation and oral discussions will be encouraged. Everyone is asked to arrive on time and be seated promptly for duration of class to minimize the disruption to others.

**Drop Policy:** Students need to consult UTA Web site for information on the university drop policy.

**Americans with Disabilities Act:** The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 92-112 - The Rehabilitation Act of 1973 as amended. With the passage of federal legislation entitled Americans with Disabilities Act (ADA), pursuant to section 504 of the Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens.

As faculty members, we are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty of their need for accommodation and in providing authorized documentation through designated administrative channels. Information regarding specific diagnostic criteria and policies for obtaining academic accommodations can be found at www.uta.edu/disability. Also, you may visit the Office for Students with Disabilities in room 102 of University Hall or call them at (817) 272-3364.

**Academic Integrity:** It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University.

"Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, and the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts." (Regents’ Rules and Regulations, Series 50101, Section 2.2)

**Student Support Services Available:** The University of Texas at Arlington supports a variety of student success programs to help you connect with the University and achieve academic success. These programs include learning assistance, developmental education, advising and mentoring, admission and transition, and federally funded programs. Students requiring assistance academically, personally, or socially should contact the Office of Student Success Programs at 817-272-6107 for more information and appropriate referrals.
**Final Review Week:** A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabi. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. Classes are held as scheduled during this week and lectures and presentations may be given.

**Librarian to Contact:**
Barbara R. Howser  
Librarian  
UT Arlington Science & Engineering Library  
Mailing address: 702 Planetarium Place, Arlington, TX 76019  
Phone: 817.272.7519  
Email: howser@uta.edu

**E-Culture Policy:** The University of Texas at Arlington has adopted the University email address as an official means of communication with students. Through the use of email, UT-Arlington is able to provide students with relevant and timely information, designed to facilitate student success. In particular, important information concerning registration, financial aid, payment of bills, and graduation may be sent to students through email.

All students are assigned an email account and information about activating and using it is available at www.uta.edu/email. New students (first semester at UTA) are able to activate their email account 24 hours after registering for courses. There is no additional charge to students for using this account, and it remains active as long as a student is enrolled at UT-Arlington. Students are responsible for checking their email regularly.

**Laptop and cell phone use in the classroom:** In order to minimize distraction to class, the use of laptop and cell phones, including text messaging, in the classroom is **NOT allowed.** Those students, who violate this rule, will lose part or all of their participation points.

**Grade Grievance Policy:** Refer to UTA Catalog.

**Assignment and Project Guidelines:** Will be announced in class. **NOTE:** If the assignment guidelines are not followed, the Grader will either reject the assignment outright, for extreme cases, or deduct points for items that do not conform to the specifications. See also **Academic Integrity** section above. **Section 2 Off Web (21176)** students must submit their assignment on WebCT by the due date and time. Additionally, these students must make arrangements with other students to perform the group project. The graded homework will be mailed or emailed to students.

**Exam and/or Quiz Guidelines:** will be announced in class. See also **Academic Integrity** section above.

**Make-up Exam Policy:** All students must take the final exam. Only extenuating circumstances will be accepted as excuse for missing the exam. Health related excuses require **medical reports** and the **signature of a physician** that provided the treatment. **Section 2 Off Web (21176)** students need to attend the exams in class or make appropriate arrangements with the instructor at least two weeks before the specific exam date.

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**CE 5387 – Construction Productivity**  
**TENTATIVE COURSE OUTLINE**

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Topic</th>
<th>References</th>
<th>Learning Objectives</th>
<th>Assignment Due</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 1 – LEED</strong></td>
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</tbody>
</table>
| Wednesday | January 20| LEED                             | Category C  
<p>| <strong>Week 2 – Introduction &amp; Elements of Construction Productivity</strong> |           |                                   |                                                                           |                                                                                     |                |
| Monday    | January 25| Introduction to Construction Productivity | Ref # 1 &amp; 2                                                             | Defining productivity, effects &amp; reasons of low productivity in construction industry, performance vs. productivity, characteristics of construction industry. |                |</p>
<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Topic</th>
<th>References</th>
<th>Learning Objectives</th>
<th>Assignment Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday</td>
<td>January 27</td>
<td>Responsibilities &amp; Roles of Project Participants to Improve Productivity</td>
<td>Ref # 1 &amp; 2</td>
<td>Current practices for developing work methods, needs to improve construction productivity, off-site and onsite project activities, effects of preplanning on productivity, monitoring construction project.</td>
<td></td>
</tr>
</tbody>
</table>

**Week 3 – Productivity Data Gathering and Presentation**

<table>
<thead>
<tr>
<th>Monday</th>
<th>February 1</th>
<th>Data Gathering for Productivity Improvement</th>
<th>Ref # 1, 2 &amp; 3</th>
<th>Statistical aspects of data gathering, definition and objectives of productivity study, various scientific and shortcut methods used in data gathering and productivity study, Method Productivity Delay Model (MPDM).</th>
<th>Term Paper Topic Assignment # 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday</td>
<td>February 3</td>
<td>Presenting and Implementing Productivity Improvement Findings</td>
<td>Ref # 1, 2 &amp; 4</td>
<td>Techniques for data analysis and presentation, using new technologies to improve productivity, impact factors affecting productivity (human factors, company organization, motivation theories and so on).</td>
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</tr>
</tbody>
</table>

**Week 4 – Line of Balance and Queueing Models**

<table>
<thead>
<tr>
<th>Monday</th>
<th>February 8</th>
<th>Line of Balance</th>
<th>Ref # 3</th>
<th>Analysis of a set of data following different distributions, repetitive process in construction, production curves, project control using production curves.</th>
<th>Term Paper Outline Assignment # 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday</td>
<td>February 10</td>
<td>Queueing Systems</td>
<td>Ref # 3</td>
<td>System states, Markovian models, finite population queueing, shortcomings of queueing models.</td>
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</tr>
</tbody>
</table>

**Week 5 – Modeling Process and Building Models**

<table>
<thead>
<tr>
<th>Monday</th>
<th>February 15</th>
<th>Modeling Process</th>
<th>Ref # 3</th>
<th>NORMAL, COMBI, &amp; COUNTER elements, building a model.</th>
<th>Draft Paper Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday</td>
<td>February 17</td>
<td>Building Models</td>
<td>Ref # 3</td>
<td>Defining flow units, cycle times, resource flow patterns, cyclic structures of work tasks.</td>
<td></td>
</tr>
</tbody>
</table>

**Week 6 – Library Research Tools, Modeling Concepts and MicroCYCLONE**

<table>
<thead>
<tr>
<th>Monday</th>
<th>February 22</th>
<th>Library Research Tools and Writing Term</th>
<th>Guest Lecturer: Ms. Barbara Howser, Science &amp; Engineering Liberian</th>
<th>How to write a term paper, project report, theses and dissertations. How to use library resources and different databases.</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Wednesday</td>
<td>February 24</td>
<td>Modeling Samples: MicroCYCLONE</td>
<td>Ref # 3</td>
<td>Building a model on MicroCYCLONE, calculate productivities and costs of a construction operation. Examples of earthmoving and concrete operations, design a construction operation.</td>
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</table>

**Week 7 – TQM, Lean Construction & Quantifying Lost Productivity**

<p>| Monday    | March 1     | Lost Productivity                                              | Ref # 2      | Define impact factors affecting productivity and how to quantify lost productivity.                                                                 | Form Groups &amp; Select the Group Project |</p>
<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Topic</th>
<th>References</th>
<th>Learning Objectives</th>
<th>Assignment Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday</td>
<td>March 3</td>
<td>TQM &amp; Lean Construction</td>
<td>Ref # 2</td>
<td>Define TQM, TPQM and lean construction.</td>
<td>Assignment # 3</td>
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<tr>
<td><strong>Week 8 – Term Project and Term Paper</strong></td>
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<tr>
<td>Monday</td>
<td>March 8</td>
<td>Term Project Guidelines</td>
<td>Ref # 4</td>
<td>Methods for effective technical writings and communications in construction projects.</td>
<td>Term Project Progress Reports</td>
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<tr>
<td>Wednesday</td>
<td>March 10</td>
<td>Term Paper Presentations</td>
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<td>Final Paper Due</td>
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<tr>
<td><strong>Week 9 – Spring Break</strong></td>
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<tr>
<td>Monday</td>
<td>March 15</td>
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<tr>
<td>Wednesday</td>
<td>March 17</td>
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<tr>
<td><strong>Week 10 – Contract Management</strong></td>
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<tr>
<td>Monday</td>
<td>March 22</td>
<td>Contract and Record Management</td>
<td>Ref # 1, 2 &amp; 7</td>
<td>Methods for effective record keeping and documentations, such as daily reports &amp; correspondences</td>
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<tr>
<td>Wednesday</td>
<td>March 24</td>
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<tr>
<td><strong>Week 11 – Decision Theory</strong></td>
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<tr>
<td>Monday</td>
<td>March 29</td>
<td>Decision Theory Part 1</td>
<td>Ref # 5 &amp; 6</td>
<td>Identification of values and uncertainties of decision and obtaining optimum decision.</td>
<td>Project Progress Report Assignment # 4</td>
</tr>
<tr>
<td>Wednesday</td>
<td>March 31</td>
<td>Decision Theory Part 2</td>
<td>Ref # 5 &amp; 6</td>
<td>Quality control using principles of statistics and probability.</td>
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<td><strong>Week 12 – Effective Project Management</strong></td>
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<td>Monday</td>
<td>April 5</td>
<td>Effective Project Management</td>
<td>Ref # 7</td>
<td>Manage project owner, subcontractors and other parties in the project.</td>
<td>Lab Assignment</td>
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<tr>
<td>Wednesday</td>
<td>April 7</td>
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<td><strong>Week 13 – Statistical Quality Control</strong></td>
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<tr>
<td>Monday</td>
<td>April 12</td>
<td>Quality Control Part 1</td>
<td>Ref # 5 &amp; 6</td>
<td>How to control construction quality using principles of statistics and probability – Part One.</td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td>April 14</td>
<td>Quality Control Part 2</td>
<td>Ref # 5 &amp; 6</td>
<td>How to control construction quality using principles of statistics and probability – Part Two.</td>
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<td><strong>Week 14</strong></td>
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<tr>
<td>Monday</td>
<td>April 19</td>
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<tr>
<td>Wednesday</td>
<td>April 21</td>
<td>Meetings, Negotiations, Labor Relations, and Dispute Resolution</td>
<td>Ref # 7</td>
<td>How effectively start, layout and manage a construction project.</td>
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<tr>
<td><strong>Week 15 – Project Presentations</strong></td>
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<tr>
<td>Monday</td>
<td>April 26</td>
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<td>Project Reports &amp; Presentations Due</td>
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<td>Wednesday</td>
<td>April 28</td>
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<td><strong>Week 16 – Project Presentations</strong></td>
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<tr>
<td>Monday</td>
<td>May 3</td>
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<td></td>
<td>Term Project Presentations</td>
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<tr>
<td>Wednesday</td>
<td>May 5 – Last Day of Class</td>
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<td>Term Project Presentations</td>
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<td><strong>Week 17 – Final Exam</strong></td>
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<td>Wednesday, May 12, 8:15 – 10:45 PM</td>
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<td>Final Exam (Comprehensive)</td>
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</tbody>
</table>
A). Productivity and Project Management
- Means’ Construction Cost Data
- CII Website.
- Instructors’ Lecture Materials, Notes and Handouts.

B). Construction Methods
- Caterpillar Performance Handbook

C). Green Building and Sustainable Construction
- Lean Construction Web Site and Publications.

D). Engineering Economics

E). Engineering Ethics

F). Construction Safety
• Construction Industry Institute, Austin, Texas: "Indirect Cost of Injury," CII Product of Research Taskforce, Jimmie Hinze, University of Washington, Seattle, 1991.
• Snee & Hoerl, 2003, "Leading Six Sigma.” Prentice Hall

References in Lean Construction

With the exception of the textbooks, the papers listed can be found online at the IGLC website http://www.iglc.net/conferences/ or at the indicated link.

Origins of Lean Production

  - Additional Reading
    • James Womack and Daniel Jones, Lean Thinking, Simon and Schuster, New York, NY. 2003 – Preface and Chapter 1-7 is enough.

Production Theories in Construction


- Additional Reading

### Lean Construction


- Additional Reading

### Work Structuring - Production System Design


- Additional Reading
Production Management (Last Planner System)


- Additional Reading

Value Management, Relational Contracting, Lean Design, and Target Costing


- Additional Reading
  - Lean Construction Journal - Volume 2, issue 1; April 2005

Lean Supply and Lean Assembly


**Lean Construction Implementation**


**Lean Construction vs. Conventional Construction Management**


