Accreditation of Construction Engineering Programs: Requirements and Recent Experience

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CONSTRUCTION ENGINEERING EDUCATION IN PERSPECTIVE

ASCE-CI CONSTRUCTION ENGINEERING EDUCATION COMMITTEE PURPOSE

1. to foster the advancement of Construction Engineering education;
2. to serve as a forum for interchange among Construction Engineering programs, related engineering programs, and industry;
3. to interact with other professional and technical organizations on construction engineering education;
4. to assist in updating ABET criteria and guidelines for Construction Engineering degree accreditation; and
5. to encourage the recognition of Construction Engineering in the Professional Engineering licensure process.
CONSTRUCTION ENGINEERING DEGREE PROGRAMS
(ABET – EAC - Accredited or Aspiring)

<table>
<thead>
<tr>
<th>University</th>
<th>Founded</th>
<th>1st Grad</th>
<th>1st Acrd</th>
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<td>NORTH CAROLINA STATE UNIVERSITY</td>
<td>1952</td>
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<td>1984</td>
<td>1989</td>
<td>1989</td>
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<td>AMERICAN UNIVERSITY IN CAIRO</td>
<td>1987</td>
<td>1992</td>
<td>1997</td>
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<td>UNIVERSITY OF NEBRASKA – LINCOLN (Omaha)</td>
<td>2005</td>
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<td>UNIVERSITY OF CENTRAL FLORIDA</td>
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<td>UNIVERSITY OF ALABAMA</td>
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<td>SAN DIEGO STATE UNIVERSITY</td>
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<tr>
<td>VIRGINIA TECH</td>
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<td>2007</td>
<td>2009</td>
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<tr>
<td>KING FAHD UNIV. OF PETROLEUM &amp; MINERALS</td>
<td>2008</td>
<td>2010</td>
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<td>MARQUETTE UNIVERSITY</td>
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<td>2010</td>
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<td>TEXAS TECH</td>
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<tr>
<td>ARIZONA STATE UNIVERSITY</td>
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</tbody>
</table>

CONSTRUCTION ENGINEERING GRADUATES

CONSTRUCTION ENGINEERING ACCREDITATION CRITERIA DEVELOPMENT

- ASCE-CI Construction Engineering Education Committee
  - ASCE Committee on Curricula & Accreditation (CC&A)
  - ASCE Educational Activities Committee (EdAC)
- ABET - Engineering Accreditation Commission (EAC)
ABET ENGINEERING CRITERIA
BRIEF SUMMARY

ALL ENGINEERING PROGRAMS MUST HAVE:

• Educational Objectives
  • Defined with constituency input

• Educational Outcomes
  • Defined and measurable
  • Evaluated through on-going outcomes assessment
  • Improved through on-going application of assessment results

• Professional Component
  • One-year of mathematics and basic sciences
  • One and one-half years engineering topics to include engineering sciences and engineering design
  • General education component which complements technical content and is consistent with program and institutional objectives

ABET 2011 CONSTRUCTION ENGINEERING PROGRAM CRITERIA - CURRICULUM

The program must prepare graduates to:

• Apply knowledge of mathematics through differential and integral calculus, probability and statistics, general chemistry, and calculus-based physics;
• Analyze and design construction processes and systems in a construction engineering specialty field applying knowledge of methods, materials, equipment, planning, scheduling, safety, and cost analysis;
• Explain basic legal and ethical concepts and the importance of professional engineering licensure in the construction industry; and
• Explain basic concepts of management topics such as economics, business, accounting, communications, leadership, decision and optimization methods, engineering economics, engineering management, and cost control.

ABET 2011 CONSTRUCTION ENGINEERING PROGRAM CRITERIA – FACULTY

• The program must demonstrate that the majority of the faculty teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and design experience.
• The faculty must include at least one member who has had full-time experience and decision-making responsibilities in the construction industry.
ABET ENGINEERING CRITERIA
BRIEF SUMMARY

BASIC CRITERIA CONSIDERS:
- Students
- Program educational objectives
- Program outcomes
- Continuous improvement
- Curriculum
- Faculty
- Facilities
- Institutional support
- Program Criteria

ROLE OF INDUSTRY

• INVOLVEMENT IN EDUCATION COMMITTEES
• INVOLVEMENT IN ACCREDITATION PROCESS
• INVOLVEMENT IN CEM PROGRAMS
  ▪ Guest lectures
  ▪ Site visits
  ▪ Advisory boards
  ▪ Objectives and outcomes development and assessment
  ▪ Internship, Co-op and summer employment programs
  ▪ On-campus recruiting
  ▪ Professional development education
  ▪ Service as faculty resource

ADVANTAGES

• Curriculum tailored to student objective
• Curriculum tailored to industry objective
• Increased visibility to potential students
• Increased visibility to industry
• Better allegiance by industry and graduates
• Adequate coverage of material that belongs at undergraduate level
• Opportunity to build more depth and rigor at graduate level
• Opportunity to justify and support a critical mass of faculty in specialty
RECENT EXPERIENCES

Lesson Learned Definition

Knowledge gained from experience, successful or otherwise, for the purpose of improving future performance.

UA Background

- First construction classes in late 1990s
- Construction Mgt. Certificate in 2003
- Construction Engineering Minor in 2005
- State approval for degree April 2006
- Program began August 2006
- First graduate May 2008
- Accreditation visit Fall 2009
ASU Background

- First construction classes in late 1950s (CM program)
- CE Program at the same time
- Reorganization of FSE in 2009, combined CM and CEE program under one School
- State approval for degree April 2010
- Program began October 2010
- First graduate?
- Accreditation visit Fall 2013 or 2014

Lessons Learned (1)

- Evolution
- Good fortune
- Industry support
- Alumni support
- The product

Lessons Learned (2)

- Critical mass
- Recruit at the senior level
- Visibility and publicity
- Full service
- High level support
- Politics
Lessons Learned (3)

- Program:
  - Engineering Design component
  - Capstone
- Internship requirement
- Industry advisory board

Advantages at UA/ASU

- Regional vacuum
- Local cluster of outstanding construction companies (demand)
- Growth-oriented universities
- Resources
- Student interest

Advice

- Lessons good departure point
- Adapt to local conditions
- Leverage strengths
- Full service
- Show stoppers:
  - University support
  - Local industry support
  - Critical mass
PE LICENSURE

PE Licensure for Construction Engineers

1. Engineers specializing in construction desire to have a professional development path;
2. Increasingly regulations and specifications (e.g. OSHA, ACI) require a PE for some construction processes;
3. Need to distinguish between professional credentials of engineering and non-engineering construction graduates;
4. Increasing role of the construction engineer as coordinator of other design consultants in design-build;
5. Need to reduce the loss of new engineering graduates desiring to pursue construction careers, who decide to initially take traditional design employment in order to gain PE but never return to construction;
6. Construction engineers DESIGN the CONSTRUCTION PROCESS.

Milestones

1999 - Developed Statement of Concerns on the Process of Professional Engineering Licensure & the Const. Engineer
• 2000 - Meeting with North Carolina Board Executive Director and incoming President of NCEES
• 2001 - Published “Guide to Professional Licensure for the Construction Engineer” and distributed
• 2001 – Input to NCEES Model Rules for Experience Evaluation in ways beneficial to construction engineers
• 2002 - Sought support from state PE licensing boards
• 2002 - NCEES Board agrees to undertake study
• 2004 - NCEES Professional Activities and Knowledge study
• 2005 - 1600 members of CI surveyed by NCEES;
• 2005 - NCEES validation of PAKS results.
• 2005 – Formed NCEES Construction Engineering Subcommittee with members from construction industry.
• 2008 – First exam with Construction module included.
## Civil Exam Specification

### Prior to 2008

<table>
<thead>
<tr>
<th>Morning 40 questions</th>
<th>Environmental 20%</th>
<th>Geotechnical 20%</th>
<th>Structures 20%</th>
<th>Transportation 20%</th>
<th>Water Resources 20%</th>
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<td>Geotechnical</td>
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<td>&amp; Water Resources</td>
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### Effective April 2008

<table>
<thead>
<tr>
<th>Morning 40 questions</th>
<th>Construction 20%</th>
<th>Geotechnical 20%</th>
<th>Structures 20%</th>
<th>Transportation 20%</th>
<th>Water Resources &amp; Environmental 20%</th>
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<td>&amp; Environmental</td>
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</tbody>
</table>

## Construction Engineering Breadth Exam Knowledges - 20% Morning

- **Construction**
  - Earthwork Construction & Layout
  - Estimating Quantities & Costs
  - Scheduling
  - Material Quality Control & Production
  - Temporary Structures
- **Geotechnical**
- **Structures**
- **Transportation**
- **Water Resources & Environmental**

| Total Items | 40 |
Construction Engineering Depth Exam
Knowledges - Afternoon

- Earthwork Construction and Layout 4
- Estimating Quantities and Costs 7
- Construction Operations and Methods 6
- Scheduling 7
- Material Quality Control and Production 4
- Temporary Structures 5
- Worker Health, Safety and Environment 3
- Other Topics 4

Total Items 40

Exam Preparation - 2 year process

- Item Writing and Review
- Exam Assembly
- Exam Quality Review
- Exam Pretest
- Exam Administration
- Exam Results Analysis

- 30 Volunteer Construction Engineers:
  - Geographically distributed
  - All licensed PE’s
  - Varied specialties and background
  - 25 from industry, 5 academics

Exam Results

- Two nation-wide exam administrations per year
- Five exam administrations since April 2008
- Civil exam has about 15,000 takers per year
- Construction ranks consistently at the middle of five areas

- Construction module has about 3,000 takers/yr
- See NCEES website for other information
SUMMARY

- Construction Engineering degree programs continue to increase in number and in graduates in response to industry need.
- ABET Construction Engineering program criteria has been available since 1976.
- ASCE Commentary for Construction Engineering program criteria is available.
- Creating a degree program is a significant but worthwhile effort.
- State boards and NCEES have been receptive to the inclusion of the construction engineering discipline in the PE examination.
- Improvements have been made in the NCEES Model Rules for experience evaluation of construction engineers.
- A Construction Engineering module has been implemented in the Civil PE Exam

Questions

?