



## UNDERGRADUATE CERTIFICATE – ADDITIONAL INFORMATION FORM

Note: Certificate programs offered at the University of Arizona, at the undergraduate or graduate level, are not approved as eligible programs for federal student financial aid. Although students enrolled in certificate programs are not eligible for any federal student aid programs, students may be eligible for private loans, outside scholarships, and University of Arizona department funding. For more information, please see [Federal Student Financial Aid Eligibility for Programs](#).

### I. General Information

- a. Proposed Title of Certificate: Construction Engineering Management (Undergraduate Certificate)
- b. CIP Code: 14.3301, Construction Engineering
- c. Anticipated first admission term: Fall 2020

II. **Requested by** [College, Department]: College of Engineering, Civil & Architectural Engineering and Mechanics Department

III. **Program Affiliation** – specify whether the UA offers an affiliated undergraduate program – the affiliated program may or may not have the same name as the proposed certificate. Civil & Architectural Engineering

### IV. Certificate Description

- a. Provide a catalog description of this program to be used to market the certificate. Include information regarding the main content, knowledge areas, key questions to be explored, skillsets to be developed and opportunities for application of the subject matter.

The certificate in Construction Engineering Management provides opportunities for students to develop an enhanced understanding of the construction industry in preparation to contribute to construction firms, project management consultants, and owners. Student will develop skills in construction management related to procurement, quantity

takeoff and cost estimating, project planning, scheduling, and control, cash flow, equipment and labor, and safety. Upon completion, students can find roles as field engineers, field superintendents, project engineers, construction managers, cost estimators, schedulers, etc. There is a need to attract new talent to the construction industry due to retirements and the growing need to build and rebuild infrastructure.

## V. Purpose

- a. Discuss the primary intent of this certificate and describe what makes this program distinct from other existing programs on campus.

This certificate prepares students for roles in the Architectural, Engineering, and Construction (AEC) industry. The AEC industry is involved in all aspects of the built environment, including all types of buildings, infrastructure, parks, etc. Architects and design engineers need an understanding of construction in order to design constructable facilities as well as interact with construction personnel. Construction projects are complex and require construction engineers to have knowledge of all aspects of the construction process from procurement to close out. Interaction between industry and students is a cornerstone of this certificate program with an emphasis on making all aspects of the program industry relevant. Students have the opportunity to interact with industry guest speakers, walk construction sites and talk with the construction team, handle plans and documents from industry projects, work on construction projects through internships, and connect with industry mentors.

## VI. Target Audience(s)

- a. Describe the target audience(s) for this certificate and the specific audience needs this certificate aims to address. Address the relevant points below based on your target audience(s).
  - i. Does this certificate meet the needs of an **industry or workforce partner**? Explain the industry needs this certificate is proposing to address. Provide a list of industry partners with whom you are working and confirmation of this support.

Industry is providing curricular guidance, assistance with content delivery, and financial support for the courses in this certificate program. There are numerous corporate contributors to the program, for example, Ashton, Core, DPR, ExxonMobil, Granite, Hensel Phelps, Holder, KE&G, and Sundt. Assistance has been provided by professional associations, for example, American Society of Cost Estimators, Arizona Builders Alliance, Arizona Transportation Builders, and Design-Build Institute of America-Western Pacific Region.

For confirmation of industry support, see the following web sites:

- [https://dpapaiohn.faculty.arizona.edu/sites/dpapaiohn.faculty.arizona.edu/files/2018-12-27\\_CEM%20Donors.pdf](https://dpapaiohn.faculty.arizona.edu/sites/dpapaiohn.faculty.arizona.edu/files/2018-12-27_CEM%20Donors.pdf)
- [https://dpapaiohn.faculty.arizona.edu/sites/dpapaiohn.faculty.arizona.edu/files/2019-07-10\\_CEM%20update%20Letter.pdf](https://dpapaiohn.faculty.arizona.edu/sites/dpapaiohn.faculty.arizona.edu/files/2019-07-10_CEM%20update%20Letter.pdf)
- [https://dpapaiohn.faculty.arizona.edu/sites/dpapaiohn.faculty.arizona.edu/files/2018-12-27\\_CEM%20update%20Letter.pdf](https://dpapaiohn.faculty.arizona.edu/sites/dpapaiohn.faculty.arizona.edu/files/2018-12-27_CEM%20update%20Letter.pdf)

- ii. Does this certificate provide an **introductory pathway to an existing graduate degree**? Provide the name(s) of the degree(s).

Civil Engineering  
Architecture

- iii. Does this certificate serve as **professional development for the targeted audience**? Explain how this certificate will help the audience develop professionally.

Students in this program learn how to analyze industry problems and document analysis and solutions such as schedules, cost estimates, site logistics plans, statement of qualifications, etc. Courses also help students prepare for the Fundamentals in Engineering (FE) and Professional Engineering (PE) exams.

**VII. Certificate Requirements** - complete the table below to list the certificate requirements, including number of credit hours required and any special requirements for completion. Certificate requirements should include sufficient units to provide a substantive program and an appropriate level of academic rigor and in no case be less than 12 units of credit.

Minimum total units required	
<i>*minimum 12 units</i>	12
Minimum upper-division units required	
<i>*minimum 6 units of credit must be upper division UA coursework</i>	9

<p><b>Total transfer units that may apply to the certificate.</b></p>	<p>6</p>
<p><b>List any special requirements to declare/admission to this certificate (completion of specific coursework, minimum GPA, interview, application, etc.)</b></p>	<p>Engineering student with advanced standing.</p> <p>Bachelor's degree (or higher) in engineering or closely related field, from an accredited institution. University of Arizona junior, senior, and graduate students in good standing in related fields such as engineering, architecture, planning, real estate, etc. shall be admitted.</p> <p>Students with junior or senior standing outside the university of Arizona in related fields such as engineering, architecture, planning, real estate, etc. shall be admitted with a GPA of 2.25 or higher.</p>
<p><b>Certificate requirements. List all required certificate requirements including core and electives. Courses listed must include course prefix, number, units, and title. Mark new coursework (New). Include any limits/restrictions needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.</b></p>	<p><b>Core courses (9 units or more of these)</b></p> <p>CE381 Construction Engineering Management (3 units) (required)</p> <p>CE482/582: Construction Project Planning, Scheduling, and Control (3 units)</p> <p>CE483/583: Construction Cost Estimating (3 units)</p> <p>CE393/493/593: Internship with a construction focus (3 units max. between</p>

	<p>CE293/393/493/593, restricted to students without a bachelor's degree)</p> <p>CE485/585: Construction equipment and methods (3 units)</p> <p><b>Supplementary courses (no more than 3 units of these)</b></p> <p>CE251 Elementary surveying (3 units)</p> <p>CE293: Internship (with a construction focus) (3 units max. between CE293/393/493/593)</p> <p>ARCE210: Building information modeling for engineers (3 units)</p>
<p><b>Internship, practicum, applied course requirements (Yes/No). If yes, provide description.</b></p>	<p>No. Not required.</p> <p>Internship credit can be applied to course requirements.</p>
<p><b>Additional requirements (provide description)</b></p>	<p>None</p>
<p><b>Any <a href="#">double-dipping restrictions</a> (Yes/No)? If yes, provide description.</b></p> <p><i>*A maximum of 6 units may double-dip with a degree requirement (major, minor, General Education) or second certificate.</i></p>	<p>No restrictions.</p>

**VIII. Current Courses**—using the table below, list all existing courses included in the proposed certificate. You can find information to complete the table using the [UA course catalog](#) or [UAnalytics](#) (Catalog and Schedule Dashboard> “Printable Course Descriptions by Department” On Demand Report; right side of screen). If the courses listed belong to a department that is not a signed party to this implementation request, upload the department head’s permission to include the courses in the proposed certificate and information regarding accessibility to and frequency of offerings for the course(s). Upload letters of support/emails from department heads to the “Letter(s) of Support” field on the UAccess workflow form. Add rows to the table, as needed.

Course prefix and number (include cross-listings)	Units	Title	Course Description	Pre-requisites	Modes of delivery (online, in-person, hybrid)	Typically Offered (F, W, Sp, Su)	Dept signed party to proposal? (Yes/No)
CE381	3	Construction Engineering Management	Provide an opportunity to develop an enhanced understanding of construction industry and practices in preparation to contribute to construction firms, project management consultants, and owners upon graduation and to improve project delivery by understanding linkages between design and construction	Advance Standing	In-person	F, Sp	Yes
CE482/582	3	Construction Project Planning, Scheduling, and Constrol	Develop an enhanced understanding of construction project planning, scheduling, execution, and control in preparation to contribute to construction firms, project management consultants, and owners upon graduation. Topics include network scheduling, critical path method, resource allocation, cost control, software applications to scheduling, and contract documents.	Advanced Standing in Engineering; <i>MATH 129 or MATH 250B</i> ; CE381 or equivalent experience; or with consent of instructor.	In-person	Sp	Yes
CE483/583	3	Construction Cost Estimating	Develop an enhanced understanding of quantity take-off and cost	Advanced Standing in	In-person	F	Yes

			estimating of construction resources including materials, labor, and equipment. Skills and knowledge of cost estimating will provide preparation for builders and designers to contribute to construction firms, project management consultants, and owners upon graduation. Topics include: types of cost estimates; budget estimates; preconstruction services estimates; quantity take-off; self-performed work estimates; subcontractor work estimates; and bid preparation.	Engineering; <i>MATH 129 or MATH 250B</i> ; CE381 or equivalent experience; or with consent of instructor.			
CE485/585	3	Construction equipment and methods	Develop an enhanced understanding of construction equipment and methods to contribute to construction firms, project management consultants, and owners upon graduation. Topics include: costing, safety, earth moving equipment, cranes, creating and securing deep digs, constructing deep foundations, and forms and temporary structures.	Advanced Standing in Engineering; <i>MATH 129 or MATH 250B</i> ; CE381 or equivalent experience; or with consent of instructor.	In-person	Sp	Yes
CE293/393/493/593	1-3 (3 max.)	Internship	Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.	Advanced standing	Hybrid	F, Sp, S	Yes
CE251	3	Elementary surveying	Theory of measurements and errors; vertical and horizontal control methods; topographic, public land and construction surveys; use of surveying instruments.	Math 111 or higher	In-person	F, Sp	Yes
ARCE210	3	Building information	This course focuses on the role of Building Information Modeling (BIM) in Architecture and Engineering.	ENGR 102A, ENGR 102B	In-person	Sp	Yes

		modeling for engineers	Students will learn the fundamental processes of BIM based on 3D computer drafting, including site analysis and data extraction, basic model building, dimensioning, planning, and elevations, parametric modeling, documentation, and 3D rendering.				

*Note: Future changes to the curriculum originally approved for the certificate must be approved by the Undergraduate Council.*

**IX. New Courses Needed** – using the table below, list any new courses that must be created for the proposed program. If the specific course number is undetermined, please provide level (ie CHEM 4\*\*). Add rows as needed. Is a new prefix needed? If so, provide the subject description so Curricular Affairs can generate proposed prefix options.

Course prefix and number (include cross-listings)	Units	Title	Course Description	Pre-requisites	Modes of delivery (online, in-person, hybrid)	Status*	Anticipated first term offered	Typically Offered (F, W, Sp, Su)	Dept signed party to proposal? (Yes/No)	Faculty members available to teach the courses

\*In development (D); submitted for approval (S); approved (A)

Subject description for new prefix (if requested). Include your requested/preferred prefix, if any:

**X. Faculty & Resources**

- a. **Current Faculty** - complete the table below. If UA Vitae link is not provided/available, attach a short CV (2-3 pages) to the end of the proposal or upload to the workflow form. UA Vitae profiles can be found in the [UA directory/phonebook](#). Add rows as needed. Delete the EXAMPLE rows before submitting/uploading. **NOTE: full**



proposals are distributed campus-wide, posted on committee agendas and should be considered “publicly visible”. Contact [Martin Marquez](#) if you have concerns about CV information being “publicly visible”.

Faculty Member	Involvement	UA Vitae link or “CV attached”
Dean Papajohn As the CEM program grows, other faculty may be involved in the future, including adjunct faculty from industry and related academic units. The undergraduate degrees in civil engineering and architectural engineering include required courses in CEM, so the department is committed to keeping these courses staffed.	CEM program coordinator, instructor, advisor, internship supervisor	<a href="https://profiles.arizona.edu/person/dpapajohn">https://profiles.arizona.edu/person/dpapajohn</a>

- b. **Additional Faculty** – Describe the additional faculty needed during the next three years for the initiation of the program and list the anticipated schedule for addition of these faculty members.

Not applicable

- c. **Library Acquisitions Needed** – Describe additional library acquisitions needed during the next three years for the successful initiation of the program.

Not applicable

- d. **Physical Facilities & Equipment** - Assess the adequacy of existing physical facilities and equipment available for the proposed certificate. Include special classrooms, laboratories, physical equipment, computer facilities, etc. Describe additional physical facilities and equipment that will be required or are anticipated during the next three years for the proposed program.

Not applicable

- e. **Other Support** - Describe other support currently available for the proposed certificate. Include support staff, university and non-university assistance. List additional staff and other assistance needed for the next three years.

Civil & Architectural Engineering office staff such as the Business Manager and the Academic Program Coordinator

- f. **Marketing & Recruitment** - Provide a detailed and robust marketing strategy for this certificate.

Marketing is targeted toward incoming students to CAEM and engineering students in other departments who want to diversify their background. CAEM students will be exposed to the certificate program through a number of venues, including:

- CAEM web site
- Advising orientation
- Required technical elective in construction
- Announcements at AGC chapter and DBIA chapter meetings

Marketing toward other engineering majors at U of A will include:

- CAEM web site
- Announcements in ENGR102
- Emails to academic advisors in all 15 engineering departments

- g. **Financial** - Provide a copy of the budget for the certificate including start-up costs and the anticipated costs for the first three years. Include some indication of how this fits with the overall department budget.

The basic components of this program are currently being offered through Civil & Architectural Engineering. No additional start-up or operational funds are anticipated.

- XI. Student Learning Outcomes and Assessment** – describe what students should know, understand, and/or be able to do after completing this certificate, and how student outcomes will be assessed. Provide a detailed curricular map linking student outcomes to specific courses and class activities. Consider working with Office of Instruction and Assessment to create a curricular map using Taskstream.

Students should be able to:

1. Explain the use of various procurement methods (CE381, CE293/393/493/593)
2. Interpret design documents (CE381, CE483/583, CE293/393/493/593, CE251, ARCE210)
3. Perform quantity takeoff and cost estimating (CE381, CE483/583, CE293/393/493/593)
4. Perform project planning, scheduling, and control (CE381, CE482/582, CE293/393/493/593)
5. Perform cash flow analysis (CE381)
6. Interpret Requests for Information and change orders (CE381, CE482/582, CE293/393/493/593)
7. Calculate equipment productivity and ownership costs (CE381, CE485/585, CE293/393/493/593)
8. Identify key safety practices (CE381, CE495/585, CE293/393/493/593)

- XII. Certificate Outcomes and Assessment**– identify factors that indicate that completion of the certificate enhances the undergraduate experience. Describe measures for programmatic assessment, and provide a detailed plan for assessing certificate outcomes.

The undergraduate experience will be enhanced based on the following:

- The certificate program was initiated based on industry input.
- Courses and course goals were developed with industry input.
- Courses include industry guest speakers and construction site visits.
- The internship is completed under the supervision of industry.

Program assessment includes the following:

- TCEs for courses
- Feedback from end of semester interviews with students involved in internships
- Industry feedback from an industry advisory committee

**XIII. Certificate Demand – is there sufficient student demand for the certificate?**

- a. What is the anticipated student enrollment for this certificate by the third year the certificate is offered? Please provide measurable indicators of student interest in the certificate (survey results of current students or alumni) and with reference to similar programs elsewhere. Provide market analysis or other tangible evidence to support projected enrollment numbers.

For 2019, Burning Glass reports 5,720 job postings in Arizona related to this field and 216,533 nationally. During the next 10 years, they predict high growth in Arizona, and average growth nationally. For construction managers, expected growth by 2028 in Arizona is 24.8%. Salaries for new graduates are in the \$60,000s, with 3-5 years of experience in the \$70,000s, and 6 years or more in the \$80,000s. In addition to the demand for construction managers in Arizona, nearby states such as California, Texas, and Colorado have a high demand as indicated by the number of job postings.

In May 2016, 21 students in CE483 filled out a survey including the question:

*If UA offered a certificate in construction Engineering Management (coursework and an internship), how likely would it have been for you to participate?*

On a scale from 1 (not likely) to 5 (very likely) the average response was 4.81.

Additionally, funding for the Construction Engineering Management courses continues to come in yearly from local construction firms, alumni, and friends of the department.

- b. What community needs, preparation for professional certification exams, degree program recruitment, or employability enhancements will this certificate provide? Please provide evidence of feedback from potential employers regarding the value of the proposed program.

The certificate program will fill a number of needs, including to: help students prepare for the construction portions of the FE and PE exams; prepare students for careers in construction; and provide the construction industry with prepared and motivated talent.

- c. Will there be any collaboration with other departments or universities to maximize resources? If there is collaboration, please include a memo of support from the applicable parties.

Our main collaborations have been with industry providing guidance and guest speakers. We have also been in contact with other universities to learn about courses and best practices.

#### **XIV. Contacts and Administration**

- a. List the name and contact information for the primary point of contact for the certificate.

Dean Papajohn, [dpapajohn@email.arizona.edu](mailto:dpapajohn@email.arizona.edu), 520-621-1713

- b. List the name and contact information for the person or persons who will serve in the role of Director of Undergraduate Studies (DUS) for the certificate. (This is not always the same as the DUS for affiliated programs or head of the managing academic unit.)

An oversight committee consists of three people.

CEM program coordinator: Dean Papajohn, [dpapajohn@email.arizona.edu](mailto:dpapajohn@email.arizona.edu), 520-621-1713

CAEM department head: Dominci Boccelli, [dboccelli@email.arizona.edu](mailto:dboccelli@email.arizona.edu), 513-375-6901

Industry advisor: Travis McCarthy (Sundt Construction), [tjmccarthy@sundt.com](mailto:tjmccarthy@sundt.com), 602-920-4276

**Carlson, Stephanie L - (scarlson)**

---

**From:** Boccelli, Dominic - (dboccelli)  
**Sent:** Tuesday, February 18, 2020 9:16 PM  
**To:** Marquez, Martin - (martinmarquez); Papajohn, Dean Steven - (dpapajohn); Baygents, James C - (baygents)  
**Cc:** Carlson, Stephanie L - (scarlson)  
**Subject:** RE: Construction Engineering Mgmt Undergraduate Certificate Proposal: question on admissions requirements

Martin,

Thanks for following up. The Department of Civil and Architectural Engineering and Mechanics supports the Construction Engineering Management (CEM) Certificate. This certificate is also supported by our alumni and industry partners, and is beneficial to the industry as there are many opportunities within the construction industry. The implementation of the CEM Certificate will allow us to reach other students that will prepare them for careers in the construction industry.

Thanks.

Dom

Dominic Boccelli  
Professor and Department Head  
Dept. of Civil and Architectural Engineering and Mechanics  
University of Arizona  
[dboccelli@email.arizona.edu](mailto:dboccelli@email.arizona.edu)  
513.375.6901

---

**From:** Marquez, Martin - (martinmarquez) <martinmarquez@email.arizona.edu>  
**Sent:** Wednesday, February 5, 2020 4:30 PM  
**To:** Papajohn, Dean Steven - (dpapajohn) <dpapajohn@email.arizona.edu>; Boccelli, Dominic - (dboccelli) <dboccelli@email.arizona.edu>; Baygents, James C - (baygents) <baygents@email.arizona.edu>  
**Cc:** Carlson, Stephanie L - (scarlson) <scarlson@email.arizona.edu>  
**Subject:** RE: Construction Engineering Mgmt Undergraduate Certificate Proposal: question on admissions requirements

**From:** [Florian, Jim - \(florianj\)](#)  
**To:** [Papajohn, Dean Steven - \(dpapajohn\)](#)  
**Cc:** [Carlson, Stephanie L - \(scarlson\)](#); [Marquez, Martin - \(martinmarquez\)](#)  
**Subject:** Re: Construction Engineering Mgmt Undergraduate Certificate Proposal: question on financial section  
**Date:** Wednesday, February 5, 2020 8:42:46 PM

---

Hello Dean,

Yes, this is adequate for a financial response for this certificate. Good luck with this new certificate

Best,  
Jim

On Jan 26, 2020, at 7:25 AM, Dean Steven Papajohn <[dpapajohn@email.arizona.edu](mailto:dpapajohn@email.arizona.edu)> wrote:

Hi Jim,

I have been working with Stephanie Carlson and Martin Marquez on an undergraduate certificate in construction engineering management (CEM). A proposal for the CEM certificate is attached. For the financial section we explain that the courses in the CEM certificate are all currently offered courses in the Civil Engineering degree program and no additional allocation of funds is required for a CEM certificate budget. From your perspective, is this an adequate way to respond to the financial section of the certificate application? We appreciate your input.

Thanks, Dean

----- Forwarded message -----

**From:** **Carlson, Stephanie L - (scarlson)** <[scarlson@email.arizona.edu](mailto:scarlson@email.arizona.edu)>  
**Date:** Tue, Jan 14, 2020 at 4:28 PM  
**Subject:** RE: Construction Engineering Mgmt Undergraduate Certificate Proposal  
**To:** Papajohn, Dean Steven - (dpapajohn) <[dpapajohn@email.arizona.edu](mailto:dpapajohn@email.arizona.edu)>, Marquez, Martin - (martinmarquez) <[martinmarquez@email.arizona.edu](mailto:martinmarquez@email.arizona.edu)>  
**Cc:** Boccelli, Dominic - (dboccelli) <[dboccelli@email.arizona.edu](mailto:dboccelli@email.arizona.edu)>, Baygents, James C - (baygents) <[baygents@email.arizona.edu](mailto:baygents@email.arizona.edu)>, Florian, Jim - (florianj) <[florianj@arizona.edu](mailto:florianj@arizona.edu)>, Corella, Arezu K - (arezu) <[arezu@email.arizona.edu](mailto:arezu@email.arizona.edu)>, Crosby, Danielle Alicia - (dshafer) <[dshafer@email.arizona.edu](mailto:dshafer@email.arizona.edu)>

Hi Dean,

I am attaching the feedback from our office for the Construction Engineering Management undergraduate certificate proposal. These recommendations to help advance your proposal are captured as tracked changes and comments on the proposal. Also attached are the Burning Glass reports we've generated that are referenced in the feedback comments.

Included on this email are Jim Florian for budget projection review and Jim Baygents for College of Engineering approval.

Also included are Arezu Corella and Danielle Crosby, to whom you'll want to reach out regarding admissions.

You can send us an updated proposal, addressing our feedback/recommendations. We will add the updated proposal to the Academic Programs Subcommittee meeting.

We're excited to help get this certificate approved! Please let us know if you have any questions along the way.

Best,

**Stephanie Carlson**

Program Manager, Curricular Affairs  
Academic Administration  
THE UNIVERSITY OF ARIZONA

Office: 520-621-2186  
[scarlson@email.arizona.edu](mailto:scarlson@email.arizona.edu)  
Pronouns: she/her/hers

--

Dean Papajohn, PhD, P.E.  
Associate Professor of Practice  
Civil & Architectural Engineering and Mechanics  
University of Arizona  
1209 E. Second Street, CE214B  
Tucson, AZ 85721  
520-621-1713  
<http://dpapajohn.faculty.arizona.edu/>

<2020-01-26\_Undergraduate Certificate Proposal for CEM.docx>