NEW ACADEMIC PROGRAM – IMPLEMENTATION REQUEST

I. PROGRAM NAME, DESCRIPTION AND CIP CODE

A. PROPOSED PROGRAM NAME AND DEGREE(S) TO BE OFFERED –
   Bachelor of Science in Architectural Engineering (BS-ARCE)

B. CIP CODE – 14.0401

C. DEPARTMENT/UNIT AND COLLEGE
   Department of Civil Engineering and Engineering Mechanics (CEEM)
   College of Engineering

II. PURPOSE AND NATURE OF PROGRAM – Describe the purpose and nature of your program and explain the ways in which it is similar to and different from similar programs at two public peer institutions. Please use the attached comparison chart to assist you.

The proposed program will prepare graduates with a unique set of skills for Arizona students for employment opportunities as architectural engineers in architecture, engineering, structural engineering or construction firms. Architectural engineers often provide a critical link between the engineering and architectural firms that collaborate on projects. Careers in engineering technology, building systems (mechanical, electrical, fire protection, etc.) and construction management are also available. Graduates with an Architectural Engineering B.S. will be trained to continue their education with graduate work in Civil Engineering, Construction Engineering, or Architecture.

The Bachelor of Science in Architectural Engineering (ARCE) at the University of Arizona will provide students with the fundamental knowledge and required skills to analyze and design building components and systems, including architectural, structural, mechanical and electrical systems, with an emphasis on sustainable buildings. Courses in the program are multidisciplinary in nature, encompassing math, science, architecture, and engineering fundamentals covering pertinent aspects of civil structural, mechanical, and electrical engineering. The program of study, which includes an engineering capstone project/architectural studio, aims to provide students with a unique set of interdisciplinary skills in the field of architectural engineering, in preparation for careers in industry and academia.

In particular, architectural engineers can occupy a key role in an architecture firm, interfacing with engineers from the structural design consultants and the construction management firm to facilitate smooth transition of the architect’s vision and developer’s to the final actualized product. Likewise, architectural engineers can occupy a key role in an structural engineering firm by liaising with the architect and developer to ensure that the construction project, both in
its original incarnation but also as changes to the contract, occur due to evolving conditions or unforeseen circumstances. These roles are crucial because even with the advent of Building Information Modeling (BIM) and advanced Computer Aided Design (CAD) tools, many large projects end up behind schedule, over budget, and more and more, in litigation between the parties involved in bringing the project to fruition [L. Griffis 2016]. These conflicts and delays cost the U.S. construction industry millions of dollars; thus improved coordination between the parties, including the architects and engineers, can have a significant benefit to the country. The proposed UA ARCE degree will contribute to these economic benefits.

Further, Architectural Engineering firms attempt to handle this coordination in-house. These firms often are awarded large comprehensive and complex construction projects where coordination is at a premium. With aspects of building construction requirements becoming more complex and technologically-intensive, including consideration of sustainability, energy use, smart systems, monitoring systems, and adaptive control. Engineers trained in one area of ARCE can work in related areas with more employment possibilities. Strong opportunities exist for advancement in this young and burgeoning field [BLS, 2012], with experience, activity in professional organizations, e.g. the American Society of Civil Engineers (ASCE) and the Architectural Engineering Institute (AEI), and voluntary professional certifications, e.g. Professional Engineer (PE) License.

The uniqueness of the ARCE degree that we are striving to achieve is combining the top-down architecture design approach with the component-up engineering design approach. A balance of coursework is required between the disciplines as well as covering compulsory topics as deemed by industry and our accreditation agency. The geographically nearest ARCE programs, UC-Boulder and Cal Poly-San Luis Obsipo, emphasize the architecture side of ARCE. We are emulating the University of Kansas and University of Texas-Austin programs that we believe offer the proper balance between disciplines. Table II-1 provides a summary of the degree requirements of each program. Table II-1 classifications are largely university driven. Detailed program descriptions are given in Table III-1 and discussed in the next section. We also include the UA’s B. Arch. as a reference point.
Table II-1 – Summary of Degree Requirements for Proposed UA ARCE, two leading ARCE programs and UA B. Arch.

<table>
<thead>
<tr>
<th>Program Name</th>
<th>University of Arizona</th>
<th>University of Kansas</th>
<th>University of Texas</th>
<th>University of Arizona (B. Arch.)</th>
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<tr>
<td>Currently enrolled students</td>
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<td>35-45</td>
<td>40</td>
<td>354</td>
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<td>Focus</td>
<td>Balanced engineering/architecture focus</td>
<td>Balanced engineering/architecture focus</td>
<td>Balanced engineering/architecture focus</td>
<td>professional accredited degree preparing students for Architectural Registration Exam and other careers in architecture.</td>
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<td>Target Careers</td>
<td>see above</td>
<td>see above</td>
<td>see above</td>
<td>Profession of architecture, other careers in the built environment that involve design (e.g., governmental plan review, design review, political advocacy); digital design and fabrication</td>
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<td>128</td>
<td>128</td>
<td>174</td>
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<td>57</td>
<td>55</td>
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<td>6</td>
<td>6</td>
<td>6</td>
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<td>None</td>
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<td>Total 18 units (Tier 1 &amp; 2)</td>
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<td>Supporting Coursework to be Completed Prior to Admission and/or Declaration of the Major</td>
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<td>None</td>
<td>None</td>
<td>33</td>
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</table>
### III. PROGRAM REQUIREMENTS

List the program requirements, including minimum number of credit hours, required courses, and any special requirements, including subspecializations, subplans, theses, internships, etc. Use the comparison chart to explain how your requirements are similar to and different from the two programs at the two public peer institutions to which you compared your program in Section II.

Table III-1 lists course requirements for our program and the curriculums for the Univ. of Texas and Kansas (UT and UK). Color coding provides course timing. Our program requires 128 units which is consistent with all UA engineering B.S. degrees. No specializations are required but a student may emphasize one of three options (structures, construction, and sustainability) through 9-units of technical electives. As the program expands we foresee broadening the set of elective courses and options to include mechanical and electrical systems.

Our program is consistent with UK and UT in terms of the core offerings. Our perception is that these programs are leaders in this field with UK, in particular, being heavily involved in
encouragement of new ARCE programs and ABET accreditation (more below). These programs also balance engineering and architecture within their programs compared to other programs that lean more heavily in one of the two fields. We believe that a balance is needed and will enhance the value of our degree.

The three programs have similar requirements in basic math and science, English, and general education. As described in Section IV.A., ABET requires coverage of four areas (building structures, building mechanical systems, building electrical systems, and construction/construction management) with a specialization in one area and synthesis-level knowledge in a second area. Our program provides that depth and breadth. We are somewhat less prescriptive than UK and do not require several engineering topics as does UT. Our industrial advisory group agrees with this balance at program initiation and encourages us to expand electives and selected electives in the future. Major engagement activities are a 6-unit design studio (taught by Architecture faculty) that will be integrated with a 3 unit capstone design course in the senior year.

Discipline specific courses will be taught by CEEM, ARCH, and AME as denoted by courses prefixes in Table III-2. Further, the new ARCE prefix is used to distinguish unique courses to the Architectural Engineering degree program. They will be taught by the two or three of participating departments. ARCE 201 and 400B will be led by CEEM faculty, ARCE 210, 220, 330, and 400A (design studio) will be taught by Architecture instructors, and ARCE320 is to be determined. ARCE 220 and 230 are focused content for ARCE that is taken in several more in-depth courses by Architecture students.

For clarity on the UA ARCE program, Table III-2 is its four year curriculum grid. The highlighted courses are new courses.
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<td>RHE306 Rhetoric &amp; Writing</td>
<td>3</td>
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<tr>
<td>ENGL102 Critical Reading &amp; Writing</td>
<td>3</td>
<td>UGS 302/303 First year signature course</td>
<td>3</td>
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</tr>
<tr>
<td>CHEM150 Chemistry</td>
<td>4</td>
<td>CH301 Principle of Chemistry I</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>Year 28</td>
<td></td>
<td>MATH225 Calculus I</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH126 Calculus II</td>
<td>4</td>
<td>M408C Diff. and Integ. Calculus</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 29</td>
<td></td>
<td>MATH220 Applied Differential Eqn</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH290 Linear Algebra</td>
<td>2</td>
<td>Approved Math/Science Elective</td>
<td>3</td>
<td></td>
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<tr>
<td>Calculus I</td>
<td>4</td>
<td>GEO303 Intro to Geology</td>
<td>3</td>
<td></td>
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<td>Year 30</td>
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<td>ENGL101</td>
<td>3</td>
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<tr>
<td>ENGL101</td>
<td>3</td>
<td>RHE306 Rhetoric &amp; Writing</td>
<td>3</td>
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<tr>
<td>ENGL102 Critical Reading &amp; Writing</td>
<td>3</td>
<td>UGS 302/303 First year signature course</td>
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<tr>
<td>CHEM150 Chemistry</td>
<td>4</td>
<td>CH301 Principle of Chemistry I</td>
<td>3</td>
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Total 128

University of Kansas, ARCH Eng. (Ref 1)

UT-Austin, ARCH Eng. (Ref 2)

UA, ARCH Eng. (Plan)
Table III-2: Architectural Engineering Curriculum

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>ENGR 102 a and b (3)</td>
<td>MATH 129 (3)</td>
<td>ARCE 201 - Intro to Arch. Eng. (1)</td>
</tr>
<tr>
<td>MATH 125 (3)</td>
<td>PHYS 141 (4)</td>
<td>CE 214 (3)</td>
</tr>
<tr>
<td>CHEM 151 (4)</td>
<td>ENGL 102 (3)</td>
<td>MATH 223 (4)</td>
</tr>
<tr>
<td>ENGL 101 (3)</td>
<td>Tier 1 Gen. Ed. (3)</td>
<td>PHYS 241 (4)</td>
</tr>
<tr>
<td>Tier 1 Gen. Ed. (3)</td>
<td>Tier 1 Gen. Ed. (3)</td>
<td>ARCE 220 - Arch. History (3)</td>
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**Year 3** | **Year 4**

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<th></th>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 381 (3)</td>
<td>AME 442 (3)</td>
<td>ARCE 400A - Capstone Design Studio (6)</td>
<td>ARCE 400B - Senior Capstone (3)</td>
<td></td>
</tr>
<tr>
<td>CE 301 (3)</td>
<td>Tier 2 Gen. Ed. (3)</td>
<td>ARCE 408A (2)</td>
<td>CE 438 (3)</td>
<td></td>
</tr>
<tr>
<td>CE 333 (3)</td>
<td>CE 389 (1)</td>
<td>CE 335 (3)</td>
<td>Tech. Elec. (3)</td>
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<tr>
<td>ENGR 211M (1)</td>
<td>CE 334 (3)</td>
<td>ENGR 211P (1)</td>
<td>Tech. Elec. (3)</td>
<td></td>
</tr>
<tr>
<td>CE 310 (3)</td>
<td>ARCE 330 - Arch. Lighting (3)</td>
<td>ENGR 211I (1)</td>
<td></td>
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<tr>
<td></td>
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<td></td>
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<tr>
<td>16</td>
<td>16</td>
<td>16</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Shaded blocks are new courses to be developed.

**A. CURRENT COURSES AND EXISTING PROGRAMS** -- list current courses and existing university programs which will give strengths to the proposed program. If the courses listed belong to a department that is not a signed party to this implementation request, please obtain the department head’s permission to include the courses in the proposed program and information regarding accessibility to the course(s) for students in the proposed program.

Beyond civil engineering, the most closely related UA degree and career path to architectural engineering is architecture. An architectural engineer is distinguished from an architect in their background and role in a building’s design. Architects focus on understanding a client’s needs and converting those desires to the building layout and design (i.e., what you see - exterior, room sizes, entry way, layout of overall space, construction materials, etc.). An architectural engineer designs what you don’t see (i.e., the beams, columns, floor slabs, foundations, heating ducts, wiring etc.). To train a student to design of those elements, an ARCE curriculum is heavily weighted to math, physics and the engineering sciences whereas an architecture program is light in those areas. ARCE design requires detailed background on the mathematics and physics of those components and design codes and standards. Architecture students receive a more rudimentary training on those topics. It is not uncommon for universities to offer both Architecture and Architectural Engineering B.S. degrees. Twelve of 21 schools with ABET-accredited ARCE programs also confer Architecture diplomas.

To complete the comparisons, CE trains students to design for the full range of civil infrastructure system while ARCE focuses entirely on building systems. ARCE requires 28 of the 56 units that are required in our CE degree and 9 units that are CE electives. The equivalent year difference is building systems/architecture courses.
Table III-3 and III-4 summarizes existing courses in the ARCE curriculum offered outside and within the College of Engineering, respectively.

### Table III-3. Courses offered by departments **outside** of the College of Engineering

<table>
<thead>
<tr>
<th>Catalog (units)</th>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 125 (3)</td>
<td>Calculus I</td>
<td>An accelerated version of MATH 124 or MATH 122B. Introduction to calculus with an emphasis on understanding and problem solving. Concepts are presented graphically and numerically as well as algebraically. Elementary functions, their properties and uses in modeling; the key concepts of derivative and definite integral; techniques of differentiation, using the derivative to understand the behavior of functions; applications to optimization problems in physics, biology and economics. A graphing calculator is required for this course. We recommend the TI-83 or TI-84 models. Calculators that perform symbolic manipulations, such as the TI-89, NSpire CAS, or HP50g, cannot be used. Except as per University policy on repeating a course, credit will not be given for this course if the student has credit in a higher level math course. Such students may be dropped from the course. Examinations are proctored.</td>
</tr>
<tr>
<td>MATH 129 (3)</td>
<td>Calculus II</td>
<td>Continuation of MATH 122B or MATH 125. Techniques of symbolic and numerical integration, applications of the definite integral to geometry, physics, economics, and probability; differential equations from a numerical, graphical, and algebraic point of view; modeling using differential equations, approximations by Taylor series. A graphing calculator is required for this course. We recommend the TI-83 or TI-84 models. Calculators that perform symbolic manipulations, such as the TI-89, NSpire CAS, or HP50g, cannot be used. Examinations are proctored.</td>
</tr>
<tr>
<td>MATH 223 (4)</td>
<td>Vector Calculus</td>
<td>Vectors, differential and integral calculus of several variables. Examinations are proctored.</td>
</tr>
<tr>
<td>MATH 254 (3)</td>
<td>Intro. to Ord. Differential Equations</td>
<td>Solution methods for ordinary differential equations, qualitative techniques; includes matrix methods approach to systems of linear equations and series solutions. Examinations are proctored.</td>
</tr>
<tr>
<td>CHEM 151 (4)</td>
<td>Chemistry I</td>
<td>Integrated lecture-lab course designed to develop a basic understanding of the central principles of chemistry that are useful to explain and predict the properties of chemical substances based on their atomic and molecular structure. Additionally, students will be introduced to modern laboratory techniques and participate in experimental activities that promote the development of basic and advanced science-process skills. The course is designed for students who require a strong foundation in general chemistry, such as science and engineering majors, pre-medical and pre-pharmacy students.</td>
</tr>
<tr>
<td>PHYS 141 (4)</td>
<td>Introductory Mechanics</td>
<td>A first course in Newtonian mechanics; introduces freshman-level students to the statics and dynamics of point particles, rigid bodies, and fluids. Topics include vector algebra, projectile and circular motion, Newton’s Laws, conservation of energy, collisions and conservation of momentum, rotational dynamics and conservation of angular momentum, statics, harmonic oscillators and pendulums, gravitation and Kepler’s Laws, fluid statics and dynamics.</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Description</td>
</tr>
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</tr>
<tr>
<td>PHYS 241</td>
<td>Electricity &amp; Magnetism</td>
<td>A first course in electromagnetic fields and their applications. Coulomb's and Gauss' Law, electric fields and potentials, electrical and magnetic properties of matter, Ampere's and Faraday's laws, elementary DC and AC circuits, Maxwell's equations.</td>
</tr>
<tr>
<td>ENGL 101</td>
<td>1st year composition</td>
<td>Exposition, emphasis on essays.</td>
</tr>
<tr>
<td>ENGL 102</td>
<td>1st year composition</td>
<td>Critical papers on selected subjects.</td>
</tr>
<tr>
<td>ARC 223</td>
<td>Environmentally adaptive systems I</td>
<td>This course introduces the fundamentals of environmentally adaptive architectural design, which includes bioclimatic, electromagnetic, and fluid physics, and the related interactions with material chemistry, form, and spatial composition.</td>
</tr>
<tr>
<td>Catalog (units)</td>
<td>Title</td>
<td>Description</td>
</tr>
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</tr>
<tr>
<td>ENGR 102A and B (1,2)</td>
<td>Introduction to Engineering</td>
<td>Students will attend a series of 50-minute lectures. Lecture topics will include contemporary technical challenges in engineering, engineering ethics and engineering teamwork. Students will complete a Career Plan, which involves preparation of a resume and development of an academic plan. Students will attend the UA Career Fair and participate in the College of Engineering New Student Welcome and Dept. Open Houses.</td>
</tr>
<tr>
<td>CE 214 (3)</td>
<td>Statics</td>
<td>Equilibrium of a particle, equivalent and resultant force systems, equilibrium, geometric properties of areas and solids, trusses, frames and machines, shear force and bending moments, friction.</td>
</tr>
<tr>
<td>CE 215 (3)</td>
<td>Mechanics of Solids</td>
<td>Material behavior; relationship between external forces acting on elastic and inelastic bodies and the resulting behavior; stress and deformation of bars, beams, shafts, pressure vessels; stress and strain; combined stresses; columns. Honors section is available.</td>
</tr>
<tr>
<td>CE 218 (3)</td>
<td>Mechanics of Fluids</td>
<td>Hydrostatics, continuity, irrotational flow, pressure distributions, weirs and gates, momentum and energy, surface drag, pipe friction, form drag, pipe fitting losses.</td>
</tr>
<tr>
<td>AME 230 (3)</td>
<td>Thermodynamics</td>
<td>Basic laws and examples of engineering applications of macroscopic thermodynamics; equations of state; reversible and irreversible processes.</td>
</tr>
<tr>
<td>ENGR 211I (1)</td>
<td>Dynamics</td>
<td>The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Dynamics - dynamics of particles and rigid bodies as applied to mechanical systems; introduction to mechanical vibrations.</td>
</tr>
<tr>
<td>ENGR 211P (1)</td>
<td>Engineering Economics</td>
<td>The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Engineering Economics - methods and modern techniques of engineering economic analysis for decision making, cost estimation, cash flow evaluation, taxes and depreciation, percent value, annual equivalent, internal rate of return, cost/benefit analysis, sensitivity analysis.</td>
</tr>
<tr>
<td>ENGR 211M (1)</td>
<td>Circuits</td>
<td>The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Circuits - gain a fundamental working knowledge of basic DC and AC circuits, learn how to solve DC, AC, and power related questions on electric circuits, identify electrical devices in an everyday setting and be able to describe their basic operating characteristics.</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Description</td>
</tr>
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</tr>
<tr>
<td>CE 301 (3)</td>
<td>Engineering Communications</td>
<td>Elements of written and oral communications for engineers including technical writing skills for proposal and report preparation, delivery techniques for oral presentations, and the effective use of audio/visual aids.</td>
</tr>
<tr>
<td>CE 310 (3)</td>
<td>Probability &amp; Statistics</td>
<td>Statistical decision theory and its application in civil engineering. Identification and modeling of non-deterministic problems in civil engineering and the treatment thereof relative to engineering design and decision making. Statistical reliability concepts.</td>
</tr>
<tr>
<td>CE 348 (3)</td>
<td>Structural Analysis</td>
<td>Analysis of Structures: beams, frames and trusses. Statically determinate structures; influence lines; deflections by the virtual work method. Statically indeterminate structures using the superposition method.</td>
</tr>
<tr>
<td>CE 389 (1)</td>
<td>Engineering Materials/Lab</td>
<td>Selected testing of steel, concrete, wood, and bituminous materials according to standard test procedures.</td>
</tr>
<tr>
<td>CE 333 (3)</td>
<td>Structural Analysis</td>
<td>Design of steel members, connections and simple structures, introduction to load and resistance factor design concept, including tension members, laterally supported and unsupported beams, columns, bolted and welded connections.</td>
</tr>
<tr>
<td>CE 334 (3)</td>
<td>Structural Design in Steel</td>
<td>Analysis and design of reinforced concrete members subjected to flexure, shear and axial loads; deflection of beams; bond and development of reinforcement.</td>
</tr>
<tr>
<td>CE 438 (3)</td>
<td>Behavior and Design of Structural Systems</td>
<td>Structural systems, gravity load resisting systems, lateral force resisting systems, tall building design, computer structural analysis, structural steel, reinforced concrete, building codes, seismic resistant design.</td>
</tr>
<tr>
<td>CE 408A (3)</td>
<td>Issues in Professional Engineering Practice</td>
<td>Introduction to non-technical issues impacting the practice of design professionals in the private and public sectors including: types of organizations; income, expenses, and profit; quality-based selection for obtaining and performing work; contracts; dispute resolution methods; professional ethics. (We will use two units of this content in new course ARCE408A)</td>
</tr>
<tr>
<td>CE 381 (3)</td>
<td>Construction Engr. Management</td>
<td>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.</td>
</tr>
<tr>
<td>AME 442</td>
<td>HVAC System Design</td>
<td>Analysis and design of air conditioning systems for commercial and industrial buildings, including equipment and component selection. Energy-efficient concepts will be emphasized.</td>
</tr>
</tbody>
</table>

**Elective courses**

- ARC 321 – Building Materials and Methods II (building envelope systems; fenestrations, roofing, exterior wall systems)
- ARC 326 – Site Analysis and Planning
- ARC 421 – Environmentally Adaptive Systems II (building mechanical, electrical, plumbing, lighting, acoustical, transportation systems)
- ARC 461A – Water Efficiency in Buildings
- ARC 461D – Computer Energy Analysis
- ARC 461E – Sustainable Design and the LEED Initiative (with eQUEST building energy simulation)
- ARC 461R – Sustainable Building Design Thinking (with IES VE building energy simulation)
- ARC 497b – Latin American Practice
- SBE 301 – Introduction to Design Thinking
- CE434 - Wood and Masonry Design
- CE432 - Advanced Steel Design
- CE437 - Advanced Concrete Design
- CE435 - Prestressed Concrete Design
- CE482 - Construction Project Planning/Scheduling
- CE483 - Construction Cost Estimating
- CE484 - Construction Materials and Methods (under development for S17 offering)

B. NEW COURSES NEEDED -- list any new courses which must be added to initiate the program; include a course prefix, number, title, catalog description and number of units for each of these courses.

ARCE201 - Introduction to Architectural Eng. (1 credit hour): Overview of the ARCE field and practices and potential career paths. Lectures by faculty and practitioners.
ARCE 210 – Building Information Modeling (3): Laboratory based course to train students on Building Information Modeling (BIM) using Revit or similar BIM software, including basics of construction documents.
ARCE 320 – Power systems engineering (3): Introduction to the design of commercial and industrial power systems. Emphasis is placed on the proper selection, specification, and installation of materials and equipment in accordance with industry standards.
ARCE 330 - Architectural Lighting (3): Lighting systems, design, measurement, and technology.
ARCE408A – Issues in Professional Engineering Practice (2): Introduction to non-technical issues impacting the practice of design professionals in the private and public sectors including: types of organizations; income, expenses, and profit; quality-based selection for obtaining and performing work; contracts; dispute resolution methods; professional ethics. (to be taken with CE408A)
ARCE400A - Architectural Engineering Design Studio (6): Architectural design studios; provides ARCE students with an understanding of architectural design process and practice as a basis for collaborating with architects.
ARCE 400B - Architectural Engineering Capstone Design (3): Team-based building capstone design experience drawing from studio experiences

C. REQUIREMENTS FOR ACCREDITATION
This program will be accredited through the Accreditation Board for Engineering and Technology (ABET) in the Architectural Engineering degree program. General engineering and program specific criteria will be satisfied (http://www.abet.org/wp-
content/uploads/2015/05/E001-15-16-EAC-Criteria-03-10-15.pdf). All UA engineering programs are currently fully accredited. Twenty-one architectural engineering programs are accredited nationally including the Universities of Texas and Kansas.

D. CAMPUS AND LOCATION OFFERING
The ARCE program will be offered in-person on the Main campus.

IV. STUDENT LEARNING OUTCOMES AND ASSESSMENT

A. STUDENT OUTCOMES – describe what students should know, understand, and/or be able to do at the conclusion of this program of study.

Learning criteria are defined by the Accreditation Board of Engineering and Technology for Architectural Engineering programs and their graduates. They are modified to be described as outcomes below.

1. Graduates must be capable of applying mathematics through differential equations, calculus-based physics, and chemistry.
2. The four basic architectural engineering curriculum areas are building structures, building mechanical systems, building electrical systems, and construction/construction management. Graduates are expected to reach the synthesis (design) level in one of these areas, the application level in a second area, and the comprehension level in the remaining two areas.
3. Students will be versed in engineering topics to support the engineering fundamentals of the four areas (noted above).
4. Graduates are expected to be capable of discussing the basic concepts of architecture in a context of architectural design and history.
5. Graduates design capabilities must:
   a. Consider the systems or processes from other architectural engineering curricular areas,
   b. Work within the overall architectural design,
   c. Include communication and collaboration with other design or construction team members,
   d. Include computer-based technology and considers applicable codes and standards, and
   e. Consider fundamental attributes of building performance and sustainability.

B. STUDENT ASSESSMENT - provide a plan for assessing intended student outcomes while the students are in the program and after they have completed the degree.

In ABET terminology, student outcomes are achieved upon graduation and are described above. Student objectives are achieved within 5 years of graduation. We will assess student outcomes and objectives using a continuous improvement process similar to that approved by ABET and followed by CEEM for our civil engineering B.S. degree. For student outcomes, we collect data
on a set of metrics within each course and the national Fundamentals of Engineering exam as indicators for each outcome. Data for graduates regarding student objectives is collected in a self-assessment and from employers. Further feedback is provided by employers through our alumni-industry council. We periodically examine that data to determine the acceptability of the results, identify areas in need of improvement, action plans for improvement and assessment of the program modifications. The College of Engineering and CEEM are well practiced in this process.

V. STATE'S NEED FOR THE PROGRAM

A. HOW DOES THIS PROGRAM FULFILL THE NEEDS OF THE STATE OF ARIZONA AND THE REGION? -- INCLUDE AN EXPLANATION OF THE PROCESS OR SOURCE FOR ARRIVING AT ALL NUMBERS USED IN THIS SECTION

The proposed Architectural Engineering (ARCE) B.S. program at the University of Arizona will serve as a key contributor to the needs of the state and the region. There are several reasons for the importance of the proposed ARCE program.

First, the field of Architectural Engineering (ARCE) is an emerging field with great growth potential. The U.S. Bureau of Labor Statistics (BLS) predicts employment growth in ARCE of 20% between 2012 and 2022 [BLS 2012]. In general, this is higher than the average of other occupations. Currently, entry level architectural engineers earn average starting salaries of about $62,000 a year with a bachelor's degree [NACE, 2014].

Second, the number of universities that have ARCE Programs is a relatively small percentage of Universities with overall Engineering programs. For instance there are approximately 225 Civil Engineering Programs in the US, but currently only 18 Architectural Engineering Programs [UnivSource, 2016]. Several of these programs have been started in recent years as traditional civil engineering programs have recognized this opportunity.

Third, the state of Arizona and the southwest region of the U.S. have growth potential for building and home construction. Opportunities in a geographic area are tied to population growth, though existing buildings will continue to need fixing and replacing [Learning Path, 2016]. Arizona was one of the top 10 states for domestic migrants in the past 5 years [Eller 2015]. Steady growth is predicted for Arizona and the U.S. [AZ Central 2015]; the Phoenix Metropolitan area had the 4th largest population gain in the country [Eller 2016]. Arizona’s job growth remained steady at 3.0% in early 2016, significantly higher than the national average of 1.9% [Eller 2016]. Arizona is situated regionally near the Inland Empire of Southern California, which has a high potential for strong growth [LA Times 2014].

Top construction markets nationwide, including cities in Arizona and southern California (e.g. Phoenix, Los Angeles, etc.) have shown a growth increase in the last two years; office building construction completions nationwide has grown from approximately 8 million sq. ft. in 2012 to approximately 50 million sq. ft. in 2015. The office markets in Phoenix continue to make strides
after lagging behind suburban submarkets in recent years: there was 3.9 million square feet of
canstruction in 2015 and another 2.3 million sq. ft. of space under construction in Phoenix as of
March 2016 [JL 2016].

Locally in Tucson, an increase in nearly 1000 construction jobs is predicted by 2017 [Eller 2015].
A potential further regional opportunity for ARCE is future work in Mexico as architectural
licensing bodies in the US (National Council on Architectural Registration), Canada (Canadian
Architectural Liscensing Authority) and Mexico (Federacion de Colegios de Arquitectos de la
Republica Mexicana) have recently finalized a reciprocal agreement to allow registered
architects work across the three countries [Dezeen, 2014]].

1. Is there sufficient student demand for the program?

To address this question, we surveyed the 18 other accredited Architectural Engineering
programs in the US. Only three (UC-Boulder, Univ. of Wyoming, and California Polytechnic-San
Luis Obispo) are west of Texas. Thus, we see opportunities for student recruitment and
placement of graduates. The only ARCE program in California has an enrollment of 50-60
students per year (per CPSLO website). We believe that a significant window exists to recruit in
CA, AZ, NM and Utah. We are at a competitive advantage in terms of tuition costs over UC-
Boulder ($51k/yr for out of state).

We also informally polled our CE students on their interest in an ARCE program. Approximately
one-third would have pursued this option. We also regularly advise students who are
interested in engineering and architecture and accept students in CE that begin their academic
careers in CAPLA. ARCE provides a place for those with a more quantitative background to
pursue a career in the building (vertical construction) area.

To support recruiting and placement, we have formed an advisory team and have sought their
input on this proposal. The CEEM alumni-industry council is also supportive of this proposal
and views an ARCE degree program as a strong growth opportunity. Finally, an example of a
recent program development is the University of Adelaide (Australia) who introduced an ARCE
program about 10 years ago in a CE department. The student population quickly matched and
now exceeds the number of CE students.

It is possible that CE will see a decrease in student numbers when the ARCE program is
introduced. Our goal is to grow CE and ARCE and will invest time and energy to insure both
programs succeed. Shifts of students interested in the ARCE program to and from Architecture
may also occur but both CEEM and ARCH see little competition between ARCE and ARCH. The
type of student coming to engineering is different than Architecture students given the
quantitative requirements in engineering but ARCE may draw some away. Conversely,
engineering students who are struggling with math and physics may move to architecture.
Again, however, we see growth in both areas and this degree as a means to draw students to
the UA.
2. What is the anticipated student enrollment for this program?

In further support of our projections, we reviewed the American Society of Eng. Education data on graduates and enrollment by degree (see table below). For 2014, the average ARCE graduating class was about 30 students (607 graduates from 21 programs – Table V-1)). Our projections assume that we will reach that enrollment level in three years. A total of 90 sophomore to senior students will be enrolled in the program at steady state (see Table V-2).

Table V-1 does show enrollment and graduation declines due to student response to the housing economy collapse. Of note, pre-2008 CE programs had record numbers. Students beginning enrollment in CE/ARCE programs in 2008 took three to four years to complete their degrees (in 2011) the 2012 and later years show the dramatic shift new students joining ARCE. Numbers nationally have changed with the CE job market being very strong. In Arizona, we are behind the growth curve but see changes in activity in Phoenix, in particular, and students are returning to CE/ARCE. A late summer flurry of newly declared CE students increased our enrollment from 116 to 131 BS students, largely juniors and seniors. Competition for freshman students in engineering is fierce and we have been working to change the stigma of limited CE job opportunities. After three years including calendar year 2017 with 38 graduates, from our junior class enrollment we project over 45 students will graduate in CY2018. Further, we are only now talking about an improved job market in AZ. We expect enrollment to further increase.

<table>
<thead>
<tr>
<th>Year</th>
<th>2008-09</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCE full-time enrollment</td>
<td>3618</td>
<td>3677</td>
<td>3381</td>
<td>3195</td>
<td>3234</td>
<td>3117</td>
</tr>
<tr>
<td>ARCE B.S. graduates</td>
<td>723</td>
<td>753</td>
<td>743</td>
<td>763</td>
<td>660</td>
<td>607</td>
</tr>
</tbody>
</table>

Table V-2. ARCE Enrollment Projections

<table>
<thead>
<tr>
<th>5-YEAR PROJECTED ANNUAL ENROLLMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Majors</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>Incoming students</td>
</tr>
<tr>
<td>Graduates</td>
</tr>
</tbody>
</table>

3. What is the local, regional and national need for this program? Provide market analysis data or other tangible evidence of the need for and interest in this program. This might include results from surveys of current students, alumni, and/or employers or reference to student enrollments in similar programs in the state or region. Include an assessment of the employment opportunities for graduates of the program during the next three years.
To our knowledge, no projections specifically for ARCEs are available and they are often lumped with civil engineers. CE’s expect an annual growth rate of 8% from 2014-2024 with a base of over 250,000 current jobs. However, the ARCE market is a small fraction of that for CE’s.

ARCE graduates will have employment opportunities in architecture, structural engineering, and construction firms. Jobs in those firms are cyclical and in many locations growth-dependent. Presently, openings are increasing throughout the US as the economy continues to improve. ARCE-specific positions are not as prevalent in the western US compared to the Midwest and East; primarily due to the limited number of graduates. However, significant new building development is occurring in major western cities. Los Angeles will have a number of skyline changing projections initiated in the next few years and Forbes magazine predicts that Phoenix will lead the nation in growth through 2019 (http://www.azcentral.com/story/money/business/jobs/2015/11/18/arizona-projected-lead-country-job-growth-forbes/75996164/). Our ARCE industry advisory group is similarly bullish about opportunities in the west for ARCE graduates including one firm stating that they would hire all of our graduates.

4. Beginning with the first year in which degrees will be awarded, what is the anticipated number of degrees that will be awarded each year for the first five years? (Please utilize the following tabular format).

Most engineering undergraduates follow the same curriculum as freshmen and declare their major before or during their sophomore year. Thus, if approved for initiation in AY2017-18, we will recruit freshman in AY2016-17 and begin sophomore level courses in AY2017-18. The first graduates will complete their degrees in May 2020 (at the end of year 3).

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>18</td>
</tr>
<tr>
<td>2nd</td>
<td>25</td>
</tr>
<tr>
<td>3rd</td>
<td>30</td>
</tr>
<tr>
<td>4th</td>
<td>30</td>
</tr>
<tr>
<td>5th</td>
<td>30</td>
</tr>
</tbody>
</table>

IV. APPROPRIATENESS FOR THE UNIVERSITY -- Explain how the proposed program is consistent with the University mission and strategic direction statements of the university and why the university is the most appropriate location within the Arizona University System for the program. Please explain how this proposed program is consistent with the College strategic plan.

The UA mission is to improve the prospects and enrich the lives of the people of Arizona and the world through education, research, creative expression, and community and business partnerships. Engineering is core to that mission as it solves problems for the societal good. Architectural engineering fills a specific niche related to the design and construction of building systems. Arizona continues to grow in metropolitan and rural areas and new building construction is anticipated to grow along with it. Given Arizona’s dependence on development and growth, this specialization has particular value to that industry. ARCE is well aligned with the UA values of interdisciplinarity, sustainability and societal impacts.
In terms of where this program should be located in the Arizona Univ. System, NAU does not have an architecture department and has a small CE program. ASU could also offer this type of program. However, our unique vision combines engineering and architecture and builds on our collaborations in senior design courses as well as emerging research links between CAPLA and COE.

V. EXISTING PROGRAMS WITHIN THE ARIZONA UNIVERSITY SYSTEM

No ARCE degree program is currently offered within the Arizona Univ. system.

VI. EXPECTED FACULTY AND RESOURCE REQUIREMENTS

A. FACULTY

1. Current Faculty
   Robert Fleischman, Professor, Dept. of CEEM
   Hongki Jo, Asst. Professor, Dept. of CEEM
   Kevin Lansey, Professor and Department Head, Dept. of CEEM
   Dean Papajohn, Professor of Practice (Construction Eng. Management), Dept. of CEEM
   Courtney Crosson, Asst., Professor, Architecture Degree Program, CAPLA
   Raymond Barnes, Lecturer, Architecture Degree Program, CAPLA
   Cholik Chan, Professor, Dept. of AME
   Perry Li, Professor, Dept. of AME

2. Additional Faculty -- We do not anticipate the need for new TTE faculty within the first three years of the program. We will draw on local industry (architectural, engineering and architectural engineering) to fill gaps in current programs as adjunct instructors for specific courses.

3. Current Student and Faculty FTEs -- CEEM currently enrolls 125 undergraduate and 50 graduate students. CEEM faculty consists of 12 FTE faculty members.

4. Projected Student and Faculty FTEs -- We anticipate growth in both the CE and ARCE students. Growth in CEEM graduate students should increase linearly to 75 students and our undergraduate enrollment goal is 200 (55 graduates per class). We have capacity in our classes so faculty FTE is not expected to grow in the next three years.

B. LIBRARY

1. Acquisitions Needed -- Describe additional library acquisitions needed during the next three years for the successful initiation of the program.

   No new library acquisitions are anticipated.
C. PHYSICAL FACILITIES AND EQUIPMENT

1. Existing Physical Facilities -- Assess the adequacy of the existing physical facilities and equipment available to the proposed program. Include special classrooms, laboratories, physical equipment, computer facilities, etc.

A critical facility for ARCE success is space for architectural design studios. We believe that this can be accommodated in CAPLA. Other facility needs are material testing laboratories and personal computing labs for Computer Aided Drawing (CAD). Both are available in both CAPLA and CEEM. New software purchases are likely.

2. Additional Facilities Required or Anticipated -- Describe physical facilities and equipment that will be required or are anticipated during the next three years for the proposed program.

None anticipated

D. OTHER SUPPORT

1. Other Support Currently Available -- Include support staff, university and non-university assistance.

2. Other Support Needed, Next Three Years -- List additional staff needed and other assistance needed for the next three years.

Teaching Staff (CEEM only)
The major CEEM resource is faculty. Many of the courses in the curriculum are already taught by UA or adjunct faculty. In the short term, enrollment in those classes would be increased to accommodate ARCE students. Initially, our present faculty can teach students in both programs, particularly with flexibility of faculty in the engineering mechanics area. As enrollment in further CE/ARCE increases, we may need to introduce new sections of those courses using adjuncts, increased faculty workloads or professors of practice in structural engineering and/or construction management. ARCE is a BS program so we will not change hiring for research emphasis positions.

For example, we can shift efforts within CE due to limited capacity in construction engineering management (CEM) with one professor of practice. Requiring CEM courses will shift that faculty’s load fully to CEM and require resources to teach engineering science classes by CEEM or adjunct faculty. We assume two adjuncts will be required at a cost of $20K including ERE. CEEM will coordinate ARCE201 and may work with a practicing ARCE as an adjunct faculty to support the course.

CEEM laboratories are taught by graduate teaching assistants with faculty oversight. We will likely have to increase the number of lab section or offerings relatively early in the ARCE program development since our sections ARCE near capacity.
Support Staff
Students admitted to the College of Engineering, in the Engineering-NMS category, are assigned academic advisors in the College’s Office of Academic Affairs. Such students are advised and supported in this arrangement until the students move into an engineering major (e.g. ARCE), after which they are advised and supported by the staff/faculty of the department that houses the major (e.g. CEEM). Capacity currently exists to handle the projected additional ARCE load. Engineering tutoring and other resources for lower division students are also available and the COE has geared up for increased enrollment using internal and differential tuition funds.

Once NMS students declare a major, COE departments are responsible for advising. In CEEM, our program coordinator handles advising of lower division CE students while faculty advise students after they reach advanced standing. CE undergraduate enrollment has been relatively flat for three years. In the short term, we anticipate that it will remain so or drop slightly as some CE students will select ARCE. For the next two to three years, current CEEM staff should be able to handle ARCE with CE. As we reach steady state in ARCE and grow CE, new staff will be needed, likely a 0.5 time FTE. As enrollments increase, the faculty may also need to re-visit advising upper division undergraduates. Advising positions can be financed through student headcount income or differential tuition.

COE academic advisors/program coordinators are also responsible for program’s administrative duties including new course development and course change paperwork, AARs, classroom requests and course scheduling. Given the breadth of ARCE course, the last item will entail coordinating between at least three department/colleges.

VII. FINANCING

A. SUPPORTING FUNDS FROM OUTSIDE SOURCES

None: this program will be tuition driven and is anticipated to be a revenue generator. We will be able to work with our present faculty to teach to students in both programs given current faculty, particularly in the engineering mechanics area. We also have other initiatives to increase CE numbers. Our Dean allocates funds to departments based on a scaled version of RCM. He expects departments to be entrepreneurial and is supportive of this program. CEEM understands that we must grow both programs. Having both CE and ARCE programs will insulate us from dramatic market changes as we’ve saw in 2008.

New costs will be covered by (1) differential tuition, (2) student credit-hour (SCH) revenue through RCM, and (3) RCM student headcount. Differential tuition (DT) in the COE is $450 and $900 per semester for lower and upper division students, respectively. The COE retains lower division DT for TA support in cross-departmental classes such as Engr. 102, CE214 and CE215 and college-wide advising and support services. Upper division DT and student headcount revenue is largely returned to the student’s department. Here, example use of these funds will be used for TA’s, academic advising support, and increased facilities needed by the new
students. SCH revenue will be returned to the teaching college and in COE is largely distributed to the department. This funding stream will provide resources for faculty participation and adjunct instructors at the College/Dept. level. For example, CE normally pays $7500 plus ERE for an adjunct instructor to teach a three unit course or about $9000. The breakeven point is about 20 students at the department level and less at the College level.

B. BUDGET PROJECTIONS FORM -- Complete the budget projections form describing the current departmental budget and estimating additional costs for the first three years of operation for the proposed program. Please note that these costs for each year are incremental costs, not cumulative costs. Include in this budget the anticipated costs for support for instruction, administration of the program, graduate students, marketing, the support discussed in Section VI-D.2, and any other costs that will be needed.

CEEM budget items
Other personnel includes costs for adjunct faculty to support new courses ($20K including ERE) and, in year 3, is for a half-time advisor at $20K plus $6K ERE.
Graduate assistants are for an additional section of the civil engineering materials lab (16% time).
CEEM graders are allocated based on class size and anticipated needs for new students.

VIII. OTHER RELEVANT INFORMATION

References
[LA Times 2014] Strong Growth is forecast for Inland Empire, Chris Kirkham, Los Angeles Times, October 23 2014
IX. REQUIRED SIGNATURES:

Managing Administrator’s Signature:  
Date: 8/17/16  
Kevin Lansey, Department Head, CRM Eng. And Eng. Mechanics

Managing Administrator’s Signature:  
Date: 8/18/16  
Robert Miller, Director, Architecture Degree Program

Managing Administrator’s Signature:  
Date: 8/23/16  
Jeffrey Jacobs, Department Head, Aerospace and Mechanical Engineering

Dean’s Signature:  
Date: 8/23/16  
Jeffrey Goldberg, Dean, College of Engineering

Dean’s Signature:  
Date: 8/18/16  
Mary Hardin, Dean, College of Arch., Planning and Land. Arch.

All programs that will be offered through distance learning must include the following signature:

Joel Hauff, Associate Vice President of Student Affairs & Enrollment Management/Academic Initiatives and Student Success

Signature: ___Not offered via distance learning  
Date: _______________

All programs that will be offered fully online must include the following signature:

Vincent Del Casino Jr., Vice Provost for Digital Learning and Associate Vice President of Student Affairs & Enrollment Management

Signature: ___Not offered cn-line  
Date: _______________

Note: In some situations signatures of more than one unit head and/or college dean may be required.
# BUDGET PROJECTION FORM FOR ACADEMIC PROGRAMS

**Name of program:** Bachelor of Science in Architectural Engineering

<table>
<thead>
<tr>
<th>EXPENDITURE ITEMS</th>
<th>INITIAL BASE BUDGET</th>
<th>ANNUAL INCREMENTAL COSTS</th>
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<td><strong>Continuing Expenditures</strong></td>
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<td>Local (software, marketing materials)</td>
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<td>Other Items (Attach description)</td>
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<td>Local (graders)</td>
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<td>Start-up Equipment</td>
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<td>Other Items (Attach description)</td>
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<tr>
<td><strong>GRAND TOTALS</strong></td>
<td>14000</td>
<td>34000</td>
</tr>
</tbody>
</table>


MEMORANDUM

DATE: 09.12.16-13:56
TO: Pamela Coonan, Senior Director, Academic / Curricular Affairs
FROM: Mary Hardin, Professor and Interim Dean
Robert Miller, Professor, Director School of Architecture
RE: Architectural Engineering Bachelor of Science degree
ACTION: IN SUPPORT OF DEGREE
COPY: Kevin E. Lansey; Professor and Department Head
PAGE: 1 of 1

This is to formally express our support of the proposed Architectural Engineering Bachelor of Science degree, housed in Civil Engineering and Engineering Mechanics.

We do not anticipate a negative impact on the Bachelor of Architecture or the Bachelor of Science in Sustainable Built Environments (SBE). We believe this will have a positive impact by making the School of Architecture and Civil Engineering more collaborative.

We anticipate delivering five courses for this degree. These four will be taught by NTT faculty who have yet to be identified:
ARCE 210 BIM Design and Documentation Strategies, starts Fall 2017-2018
ARCE 220 History of the Built Environment Survey, starts Fall 2017-2018
ARCE 400a ARCE Capstone Studio, starts Fall 2019-2020
ARCE 330 Architectural Lighting, starts Spring 2018-2019

The fifth is an existing course in the B.Arch taught by Assistant Professor Shane Smith that will be offered concurrently with ARC 223:
ARCE 223 BT3: EAS I – (Environmentally Adaptive Systems I), starts Spring 2017-2018

We anticipate that the SCH revenue for these courses will cover our costs of delivery.

END OF MEMORANDUM

If this MEMO contains information that does not accurately reflect your understanding of issues or events covered, please advise sender in writing.
Ray Barnes, Architect LEED AP (BD&C)

Courses Taught:
ARC 222 Building Technology II (2013-2016)
ARC 601 Integrative Graduate Region Studio (co-taught with Dr. Nader Chalfoun) (2013-2015)
ARC 461r/561r Environmental Technology Systems (2013-2016)
ARC 900 Research Project committees (2013-2015)

Educational Credentials:
1973. AS Arch., Pima Community College
1982. B.Arch., University of Arizona
2010. M.Arch., University of Arizona

Teaching Experience:
2011-2013. Adjunct Lecturer, University of Arizona, Tucson,
2013-Present. Lecturer, University of Arizona, Tucson,

Professional Experience:
1999-2012. Principal, Raymond E Barnes Design Architecture, Tucson, AZ
1981. Drafter, WBC Consultants, Inc. (Engineers), Tucson, AZ
1975-1976. Superintendent / Project Mgr., Tierra Construction Co., Tucson, AZ

Licenses/Registration:
1989-Present. Arizona #23450

Selected Publications and Recent Research:

Professional Memberships:
Past 25 years. The American Institute of Architects
Current. American Society of Heating Refrigerating and Air-Conditioning Engineers
Current. U.S. Green Building Council
Current. Society of Building Science Educators
CHOLIK CHAN
Professor; Associate Department Head/Graduate Studies

Education

Ph.D. Mechanical Engineering, University of Illinois at Urbana-Champaign, 1986
M.S. Mechanical Engineering, University of Hawaii at Manoa, 1980
B.S. High Honors, Mechanical Engineering, University of Hawaii at Manoa, 1979

ACADEMIC EXPERIENCE
University of Arizona—Aerospace and Mechanical Engineering: Assistant Professor (1987-93, FT; Associate Professor (1993-04, FT); Professor (2004-date, FT); Associate Head for Graduate Studies and Research (8/07-8/08, 9/09-date, FT)

NON-ACADEMIC EXPERIENCE
Air Force Research Laboratory, Albuquerque, New Mexico: NRC/AFRL Summer Faculty Fellow (sabbatical, 5/01-7/01)
NASA Ames Research Center, Moffett Field, California: Visiting Researcher (sabbatical, 1/01-3/01)
General Electric Corporate Research and Development, Schenectady, New York: Consultant (sabbatical, 1/94-7/94)
University of Illinois at Urbana-Champaign, Mechanical and Industrial Engineering: Visiting Research Associate (1986-87)

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS: None

CURRENT MEMBERSHIP IN PROFESSIONS ORGANIZATIONS: None

HONORS AND AWARDS
Member, Tau Beta Pi, National Engineering Honor Society (1980); ARCO Corporation Outstanding Graduate Student Award (1981); NSF Presidential Young Investigator Award (1990); Biographee in Marquis Who’s Who in Science and Engineering (1991-date); Biographee in Dictionary of International Biography (1995-date), Arizona Engineering Education Fellows, College of Engineering, University of Arizona (2012-14); Selected by AME seniors as the Senior Faculty member “most helpful to their college education” (Spring 2013, 2015)

INSTITUTIONAL AND PROFESSIONAL SERVICES (2010-15)
INSTITUTIONAL—AME [Advisory Committee (Ex Officio), Assoc. Head, Graduate Studies Committee, ABET Committee; Academic Program Review, APR Committee] COE [(Graduate Studies Committee] UA [Faculty Fellow; Asian Pacific American Studies Affairs; Faculty Advisor for Badminton Club, Hong Kong Student Association, Filipino American Student Association, ASME Student Chapter; Non-Ionizing Radiation Panel;Search Committee of Assistant Vice President—Dean of Student Affairs]

PRINCIPAL PUBLICATIONS (2010-15)


**Conference Papers**


COURTNEY CROSSON
AIA, LEED AP BD+C, LEED ND, Living Building Challenge Facilitator + Ambassador
ccrosson@email.arizona.edu

EDUCATION
2007-2010 Yale School of Architecture / New Haven CT
Masters in Architecture
First Prize in studio for Final Project: Net Zero Carbon Resort - UNECO site, Marrakech, Morocco
Honors: H.I. Feldman Award nominee for best architectural solution within advanced studio
2000-2004 Duke University / Durham NC
BA Art History
Graduation with Distinction for Final Thesis: Multiplicity, an Artist Collective, Investigating European Space and Union with Stefano Boeri
Honors: Magna cum Laude, Phi Beta Kappa, Nancy Kaneb Art History Award for most exceptional graduate, Dean's List with Distinction 2000-2004

EMPLOYMENT
ACADEMIC
2016-present University of Arizona School of Architect / Assistant Professor / Tucson AZ
2015-2016 University of Arizona School of Architect / Assistant Professor of Practice / Tucson AZ

PRACTICE
2012-2016 Buro Happold Engineering / Associate / Los Angeles CA
selected projects
Los Angeles Union Station Master Plan / Grimshaw Architects / Los Angeles CA
Los Angeles County Museum of Art Extension LACMA / Atelier Peter Zumthor / Los Angeles CA
Santa Monica City Hall Extension / Fredrick Fisher and Partners Architects / Santa Monica CA
Providence Saint John’s Master Plan / Moore Ruble Yudell Architects / Santa Monica CA
Rice University Integrated Campus Plan / Kieran Timberlake Architects / Houston TX
Institute for Energy Efficiency / Kieran Timberlake Architects / University of Santa Barbara CA
Shanghai Theatre Academy / Moore Ruble Yudell Architects / Shanghai China
LaKretz Cleantech Innovation Center / JFAK Architects / Los Angeles CA
Pacoima Wash Master Plan Los Angeles River / LA Mas / Los Angeles CA

2010-2012 Foster + Partners / Designer + Sustainability Consultant / Hong Kong China
2009 MUF Architecture Art / Designer + Project Manager / London UK
Dover Cultural Strategy / Dover UK

2007-2008 Duke University / Lead Designer + Project Manager / Muhuru Bay Kenya
WISER Secondary Girls Boarding School

Kibera Slum Upgrading Project

2003 Multiplicity + Boeri Architects / Researcher / Milan Italy

FELLOWSHIPS / AWARDS / GRANTS
2015 American Institute of Architects Emerging Leader Fellow / AIA National
2015, 2014 Share Our Skills Grant / Buro Happold Engineering
2010 Yale Law School / Community & Economic Development Clinic / Lustman Foundation Grant
2009 Yale Divinity School / Travel Grant / New Haven CT
2009 Yale School of Architecture / Teaching Fellowship / New Haven CT
2008 Yale Divinity School / Teaching Fellowship / New Haven CT
2007-2008 Jessica Jennifer Cohen Foundation / Foundation Grant
2005-2006 International Reading Association / Developing Countries Literacy Grant
2004-2005 Sanford Institute of Public Policy / Hart Fellowship / Duke University Durham NC
2003-2004 Duke Institute for the Arts / Benenson Award in the Arts / Duke University Durham NC
2002-2004 Kenan Institute for Ethics / 3 Service Learning Grants / Duke University Durham NC

PRESENTATIONS / EXHIBITIONS / CONFERENCES
2016 Passive Low Energy Architecture / Paper / USC
2016 Summit on Infrastructure and Public Private Partnership / Invited Panelist / Santa Monica CA
Invited Panelist: Investing in the Future: Empowering Performance-Based, Sustainable Infrastructure Projects for Smart Cities
2016  International Conference on Sustainable Design Engineering Construction / Paper / ASU
2016  Living Future International Conference / Presenter / Seattle WA
2016  Net Positive Energy + Water Conference / Invited Panelist / San Diego CA
2015  GreenBuild International Conference / Presenter / Washington DC
Presented: TRANSITION: Los Angeles Union Station and LEED ND
2015  Architecture + Design Museum / Exhibitor / Los Angeles CA
2015  American Institute of Architects National Convention / Presenter / Atlanta, GA
Presented: People Oriented Cities: Smart Growth Through Sustainable Transport
2015  Living Future International Conference / Presenter / Seattle, WA
2015  American Society of Civil Engineers / LA Sustainability Symposium / USC Los Angeles CA
2015  Municipal Green Building Conference / Presenter / Los Angeles CA
2014  Society for College and University Planning Conference / Presenter / Los Angeles CA
2014  AIA Committee on the Environment / Presenter / Los Angeles CA
2014  Net Positive Water Forum / Co-Organizer / Los Angeles CA
2014  Municipal Green Building Conference / Presenter / Los Angeles CA
2013  Living Building Challenge Panel / Panelist / Los Angeles CA
2010  Next / Contributor / Yale School of Architecture / New Haven CT
2009  Dover Cultural Framework Exhibition / Exhibit Designer / Dover Library / Dover UK
2005  Kibera Youth Photography Club Exhibition / Exhibit Designer / Java House / Nairobi Kenya
2003  Spatializing Global Consumption / Solo Instillation / Duke University Library / Durham NC
2002  Marks / Solo Art Exhibit / Duke University Library / Durham NC

PUBLICATIONS
Passive and Low Energy Architecture, conference proceedings.
Catchment, Storage, and Infiltration Optimization.” International Conference on Sustainable Design
Engineering and Construction, conference proceedings.
2007  CROSSON, C.  “Urban Informality and Slum Upgrading: Kibera, Kenya” People Building Better
2005.
February 2005.

TEACHING
2016-present University of Arizona School of Architecture / Assistant Professor / Tucson AZ
451b / UA Masterplan: Net Zero Toolkit / 4th year B.Arch Students
2015-2016 University of Arizona School of Architecture / Assistant Professor of Practice / Tucson AZ
Arc 452 / Capstone (Thesis) Studio / 5th year B.Arch Students
451a / UA Net Zero Energy + Water District / 4th year B.Arch Students

SERVICE
ACADEMIC
2016-present United State Green Building Council – Student Group (USGBC-S) / Faculty Advisor / UA
2015-present Sustainability Pedagogy Committee / Member / SoA UA
2015-present Architectural Engineering Degree Creation Advisory Committee / Member / UA

PROFESSIONAL
2013-2015 American Institute of Architects Los Angeles Board / Associate Director / Los Angeles CA
2014-2016 Living Building Challenge Los Angeles Collaborative / Co-Leader / Los Angeles CA
2010-2012 American Institute of Architects Hong Kong / Committee Member / Hong Kong China

PROFESSIONAL REGISTRATIONS / MEMBERSHIPS
2014-present AIA, Registered Architect, Arizona registration number 58857
2014-present Living Building Challenge Facilitator / Living Building Challenge Ambassador / LBC 2.1 + LBC 3.0
2013-present LEED Accredited Professional Neighborhood Development
2011-present LEED Accredited Professional Building Design + Construction
ROBERT B. FLEISCHMAN
Professor
Department of Civil Engineering and Engineering Mechanics

EDUCATION
Ph.D., Civil Engineering, Lehigh University, 1995
M.S., Civil Engineering, Lehigh University, 1989
B.S., Civil Engineering, Carnegie-Mellon University, 1985

ACADEMIC EXPERIENCE (all full-time)
Date of original appointment at rank of Assistant Professor: 2000
Date of Tenure: 2006 Date of Advancement to Rank of Professor: 2015
2008-2011 Chaired Professorships: Delbert R. Lewis Distinguished Professorship
1994-1995 Visiting Professor, Civil Engineering & Env. Eng. Dept., Syracuse University
1996-2000 Assistant Professor, Dept. of Civil Eng. & Geo. Sciences, Univ. of Notre Dame

NON-ACADEMIC EXPERIENCE
1985-1986 Assistant Engineer/Superintendent, Turner Construction Co., New York, NY
1995-1996 Design Engineer, Thornton & Tomasetti/C-B-M Consultants, Chicago, IL
2009 Faculty in Residence, Rutherford & Chekene Consultants, San Francisco, CA

CERTIFICATIONS AND PROFESSIONAL REGISTRATIONS: None

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATION
Member, American Society of Civil Engineers (ASCE), American Concrete Institute (ACI)
Earthquake Engineering Research Institute (EERI), Precast/Prestressed Concrete Institute (PCI)

HONORS AND AWARDS
2016 Charles Pankow Award, American Society of Civil Engineering (ASCE) for Innovation.
2014 NEES Outstanding Contributor Award, National Science Foundation (NSF)
2014 Leslie D. Martin Award of Merit, Precast/Prestressed Concrete Institute (PCI)
Faculty Fellow, Education, College of Engineering (COE), 2011-2013
2009 and 2004 Martin P. Korn Awards from the Precast/Prestressed Concrete Institute
2007 UA COE “Excellence at the Student Interface” & CEEM SCE Exemplary Member Award
2006 Charles C. Zollman Award from the Precast/Prestressed Concrete Institute
2004 George D. Nasser Award from the Precast/Prestressed Concrete Institute
National Science Foundation Faculty CAREER Award Winner (1997)
Articles on work appeared in ENR (cover), Civil Engineering, Modern Steel Construction,
Discovery Channel Nominated, NOVA Construction Innovation Award (1994)
SERVICE ACTIVITIES
University: University Graduate Council, University Cyberinfrastructure Committee (2015)
College: Engineering Innovation Building Executive Committee, Faculty Status Committee
Faculty Fellows Curriculum Improvement Committee, Engineering Fellowship Committee
Department: 2016 Centennial Lecture Committee, Graduate Studies Committee, Scholarship Committee (2011-2014), Laboratory Committee (2011-2013)
Participated in Faculty Online Learning Community Forums; Instructor for F.E. Review Session for UA Tau Beta Pi Chapter; Advised SCE Competition Teams for Pacific Region Conference

MOST IMPORTANT PUBLICATIONS/PRESENTATIONS IN LAST 5 YEARS

RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES
Proposed/moderated session for ASCE Structural Engineering Institute 2015 Structures Congress
Led 12 institutions/50 participants: 2013 $62M NSF NEES2 Ops Competition (1 of 2 finalists)
Taught Short Courses: EU-NICE Master’s Program in Evaluation & Reduction of Environmental Seismic Risk, La Sapienza Rome IT, June 2012: Precast Concrete; Floor Diaphragms
Co-coordinated Online Content, Technology and Access Effort for UA CEEM 2010-2012
Developed/delivered 3 online courses for UA CEEM Department: CE 214, CE 333 CE 334
EDUCATION
Ph.D., Civil Engineering, University of Illinois at Urbana-Champaign (UIUC), Urbana, IL, 2013
M.S., Civil Engineering, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea, 2001
B.S., Civil Engineering, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea, 1999

ACADEMIC EXPERIENCE (all full-time)
Date of original appointment at rank of Assistant Professor: 2013.
Aug. 2011 – Dec. 2011, Teaching Assistant, Civil Engineering, UIUC, IL
Mar. 1999 – Jan. 2001 Research Assistant, Civil Engineering, KAIST, Korea

NON-ACADEMIC EXPERIENCE
2014 – present, Scientific Advisor, Embedor Technologies, Urbana, IL
2001 – 2007, Manager/Bridge Engineer, Seoyeong Engineering Co. Ltd., Korea

CERTIFICATIONS AND PROFESSIONAL REGISTRATIONS
None

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATION
Member, American Society of Civil Engineers (ASCE)

HONORS AND AWARDS
Employee of the year, Seoyeong Engineering Co. Ltd., 2003

SERVICE ACTIVITIES
Editorial Board, Journal of Information Processing in Agriculture, 2014 - present
Editorial Board, Frontiers in Built Environment/Structural Sensing, 2015 - present
Symposium organizer/Chair, 11th International Workshop on Advanced Smart Materials and Smart Structures Technology, Aug. 2015
Proposal reviewer, National Science Foundation, 2014

MOST IMPORTANT PUBLICATIONS/PRESENTATIONS IN LAST 5 YEARS


**RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES**

Attended a number of national and international conferences as speakers and conference/session chairs.
KEVIN E. LANSEY
Professor and Department Head

EDUCATION
Ph.D. – Civil Engineering - The University of Texas at Austin, 1987.
M.S. – Civil Engineering - Virginia Polytechnic Institute and State University, 1982.
B.S. – Forest Engineering - State Univ. of New York--College of Environmental Science and Forestry (ESF), Syracuse, New York, 1981

ACADEMIC EXPERIENCE (all full-time)
University of Arizona, Head, CEEM, 7/2008-present
University of Arizona, Professor, CEEM, 7/2002-present
University of Arizona, Associate Professor, CEEM, 7/1994-6/2002
University of Arizona, Assistant Professor, CEEM, 9/1990-6/1994
University of Arizona Adjunct Assistant, Associate and Full Professor, Department of Hydrology and Water Resources
Oklahoma State University, Assistant Professor, School of Civil Engineering, 1987-1990

NON-ACADEMIC EXPERIENCE
Woodward Clyde Consultants, Staff Engineer, Wayne, New Jersey, Summer 1981 (FT)

CERTIFICATIONS AND PROFESSIONAL REGISTRATIONS

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATION
American Society of Civil Engineers (ASCE)
American Geophysical Union (AGU)

HONORS AND AWARDS
Outstanding reviewer ASCE JWRPM (2013)
Outstanding Honors College Faculty Member (2008)
Outstanding Faculty Award (1993, 2007)
Excellence in Engineering Education Award – MWH Soft (2005)
ASCE Huber Civil Engineering Research Prize for Young Researchers (2002)
AWPCA - Quentin Mees Research Award (with David Quanrud and Robert Arnold) (2002)
Udall Center Fellowship (1997)
Certificate for Excellence at the Student Interface-College of Engineering & Mines, 1996
Senior Award presented by UA CE graduating class of 1994

SERVICE ACTIVITIES
Editorial Board Member, Engineering Optimization (2005-date)
Tuition Benefits Committee, UA, (2014)

**MOST IMPORTANT PUBLICATIONS/PRESENTATIONS IN LAST 5 YEARS**


**RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES**

Attended 2015 ASCE EWRI conference
Attended 2014 Water Distribution System Symposium
Attended 2013 Computing and Control in the Water Industry
PEIWEN (PERRY) Li
Professor

Education

Ph.D.  Energy and Power Engineering, Xi’an Jiaotong University, China, 1995
M.S.  Energy and Power Engineering, Xi’an Jiaotong University, China, 1991
B.S.  Energy and Power Engineering, Xi’an Jiaotong University, China, 1988

ACADEMIC EXPERIENCE
University of Arizona—Aerospace and Mechanical Engineering: Assistant Professor (8/06-8/12, FT), Associate Professor (8/12-8/15, FT), Professor (8/15-date, FT)
Kyoto University—Mechanical Engineering: JSPS Fellow (3/96-6/96)

NON-ACADEMIC EXPERIENCE
University of Pittsburgh—Mechanical Engineering: Research Associate (12/01-8/06)
Kyoto University—Mechanical Engineering: Research Scientist (4/00-11/01)
Japanese National Mechanical Engineering Lab: Senior NEDO Research Scientist (6/97-3/00)

CERTIFICATIONS OR PROFESSIONAL REGISTRATIONS: None

CURRENT MEMBERSHIP IN PROFESSIONS ORGANIZATIONS: ASME

HONORS AND AWARDS
NEDO Fellowship, Energy Conservation Center and New Energy and Industrial Technology Development Organization (NEDO) of Japan (6/97-3/00); JSPS Fellowship (Japan Society for the Promotion of Science, 3/96-6/96); Excellent Graduate Student Prize, Xi’an Jiaotong University (1993, 1994); US Patent 8,245,440 B2 (8/21/12)

INSTITUTIONAL AND PROFESSIONAL SERVICES (2010-15)
INSTITUTIONAL—AME [Dissertation Exam Committees; Thesis Exam Committees; Comprehensive Exam Committees; Qualifying Exam Committees; Peer Review Committee; Shop Committee; Search Committee; Advisory Committee]
FONDECYT Program CONICYT, Chile; Reviewer of 3 books for Elsevier; International Workshop on Standardization of CSP Performance Model Projection; ASME K-20 Committee, K-15 Committee; Chinese in America Thermal Engineering Assoc.; Short Courses, University of Arizona; Participated in Technology Show, UA Biosphere; Master’s Committee, University of Guanajuato, Mexico; Consulting for MER Corp., Advanced Materials and Energy Tech., LLC; Organized/co-organized numerous sessions at conferences

**Principal Publications (2015)**


ROBERT MILLER, AIA, NCARB
Professor; Director of the School of Architecture
2011–2016 UA HeadsUp Steering Committee (collective of department heads), 2013–2015 co-Chair

Courses Taught:

Educational Credentials:
1979. M.Arch, Rice University, certificate in Urban Design.
1972. B.Arts in Architecture, Clemson University, cum laude.

Teaching Experience:
2010–present. School of Architecture, University of Arizona: Professor, Director.

Professional Experience:

Licenses/Registration:

Selected Publications and Recent Research:
2015. “Snapshots from a Professor in Residence.” Forthcoming, Centenary of the School of Architecture, Clemson University.

Professional Memberships:
Dean Papajohn, Associate Professor of Practice
Department of Civil Engineering and Engineering Mechanics

EDUCATION
Ph.D. Candidate – Civil Engineering, Arizona State University, Expected 2018
M.S. – Civil Engineering, University of Illinois at Urbana-Champaign (UIUC), 2004
M.A. – English, Iowa State University, 1994
B.S. – Civil Engineering, University of Illinois at Urbana-Champaign (UIUC), 1985

ACADEMIC EXPERIENCE
Date of appointment to Adjunct Faculty: August 2012
Date of appointment to Associate Professor of Practice: August 2016 (full-time)
2009-2011, Adjunct Faculty, Pima Community College, Tucson, AZ (part-time)
1994-2005, Teaching Associate & Specialist in Education, University of Illinois, Urbana-Champaign (full-time)

NON-ACADEMIC EXPERIENCE
2005-2015, Civil Engineering Manager, Pima County Department of Transportation, Tucson, AZ
1986-1992, Project Engineer, Daniel Creaney Company, Northbrook, IL

CERTIFICATIONS AND PROFESSIONAL REGISTRATIONS
State of Arizona, Professional Engineer, License 43928
State of Illinois, Professional Engineer, License 062-046141
Design-Build Institute of America, Associate
Institute of Sustainable Infrastructure, Envision Specialist

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS
American Society of Civil Engineers (ASCE)
Design-Build Institute of America (DBIA)

HONORS AND AWARDS
2015-2016, Professor of the Year Award and Senior’s Choice Award, Civil Engineering & Engineering Mechanics, University of Arizona
2016, Faculty Appreciation, Kappa Gamma Sorority, University of Arizona
2015-2016, Design-Build Institute of America Scholarship-Western Pacific Region Aug. 2015, Design-Build Educators Workshop Scholarship, Design-Build Institute of America, Denver, CO
2015 Metropolitan Pima Alliance Common Ground Award of Distinction, Aerospace Parkway
2015 Arizona Transportation Partnering Excellence Award, La Cholla Boulevard: Magee Road to Overton Road
2015 International Partnering Institute Award, La Cholla Boulevard: Magee Road to Overton Road
2015 Association of General Contractors (AGC) Arizona Award, La Cholla Boulevard: Magee Road to Overton Road
2015 Southern Arizona American Public Works Associations (APWA) Award, La Cholla Boulevard: Magee Road to Overton Road
2015 Pima Association of Governments (PAG) Timothy Ahrens Partnering Award, La Cholla Boulevard: Magee Road to Overton Road
2013, Faculty Appreciation, Chi Omega Sorority, University of Arizona

SERVICE ACTIVITIES
2015-2016, Committee member, Undergraduate Studies Committee, Civil Engineering & Engineering Mechanics, University of Arizona
Dean Papajohn, Associate Professor of Practice
Department of Civil Engineering and Engineering Mechanics

2011-2016, Member, Alumni Industry Council (AIC), Civil Engineering & Engineering Mechanics, University of Arizona
2006-2016, Editorial board member, ASCE Journal of Management in Engineering
2016, Judge, Partnering Awards, International Partnering Institute (IPI)
2015, Judge, ASCE Pacific Southwest Conference (PSWC)
2016, Board member, Arizona Transportation Builders (ATB)
2014-2016, Committee member, S. Arizona Construction Career Days, ATB
2014, Facilitator, ASCE PE Exam – Construction Management review class

MOST IMPORTANT PUBLICATIONS/PRESENTATIONS IN LAST 5 YEARS

RECENT PROFESSIONAL DEVELOPMENT ACTIVITIES
2015-2016, College of Engineering Faculty Orientation, University of Arizona
June 2016, Construction Research Conference, San Juan, Puerto Rico
Spring 2016, CON551 Alternative Project Delivery Methods, Arizona State University
Fall 2015, Effective Teaching Practices, 5 modules in 5 weeks, Association of College and University Educators (ACUE)
Oct. 2015, Making the Most of Faculty Mentoring workshop, University of Arizona
Oct. 2015, New Faculty Proposal Preparation workshop, College of Engineering, University of Arizona
Sept. 2015, Publish, Not Perish workshop, University of Arizona
Sept. 2015, Resources to Support Your Research workshop, University of Arizona
Aug. 2015, How Can I Use the D2L Gradebook Effectively? Workshop, Office of Instructional Assessment, University of Arizona
Aug. 2015, Faculty Orientation, University of Arizona
Aug. 2015, Design-Build Educators Workshop Scholarship, Design-Build Institute of America, Denver, CO
Fall 2015, CON598 Construction Industry Best Practices, Arizona State University
Spring 2015, CON598 Public Works Capital Construction, Arizona State University
Fall 2014, CON598 Sustainability in Construction, Arizona State University
April 2011-2016, Arizona Roads & Streets Conference, Tucson, AZ