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Industry-Experienced Graduate Student Program: Innovative Collaboration in Architectural Engineering at the University of Nebraska–Lincoln

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Abstract

In 2001, the Architectural Engineering Department at the University of Nebraska–Lincoln, along with industry partners, established an industry-experienced graduate student program. The program was developed to bring experienced design professionals to collaborate with the industry while pursuing a Ph.D. in architectural engineering. This program is designed to be mutually beneficial to industry partners, -graduate students, the University of Nebraska–Lincoln Architectural Engineering Department, and the building industry at large. The first doctoral candidate in the program graduated, and significant collaborative work was completed for the industry partner. All parties to this initial offering are pleased with the outcome and believe the benefits significantly outweigh the costs. This paper presents the program, lessons learned, and plans for the future. The authors are the faculty, the industry partner, and the graduate associated with this initial application of the program. CE Database subject headings: Industries; Graduate study; Engineering education; Architectural engineering; Education-practice interchange.

Keywords: Industry, Graduate education, Architectural engineering

Introduction

The Architectural Engineering (AE) Department at the University of Nebraska–Lincoln (UNL), along with industry partners, established an industry-experienced graduate student program (IEGSP). The program was developed to bring experienced design professionals to collaborate with the industry while pursuing a Ph.D. in AE. The authors are unaware of other Ph.D. programs of this nature. The program is designed to be mutually beneficial to industry partners, graduate students, UNL AE, and the building industry at large, with the following intended outcomes:

1. The development of working relationships was intended to benefit the industry partner by providing a connection with well-qualified interns and graduates for employment and a connection with faculty expertise for consultation and education. The UNL AE was intended to benefit by providing employment opportunities for interns and graduates and a way to stay connected to the design community. The building industry as a whole was intended to benefit by the strengthening of an industry-based program with the potential of well-qualified graduates to enhance the profession.
2. The collaborative work with the industry partner was intended to benefit the student by providing design experience with the industry partner on a wide range of projects. The industry partner was intended to benefit by the student's production, previous design experience, and education. The UNL AE was intended to benefit by a further connection with the industry.
3. The research outcome was intended to provide the student with the following abilities to: (1) study a subject in great depth and learn about something that has not been studied before; (2) enhance future faculty potential; (3) develop a niche area that will enhance a design career; (4) develop a reputation in a specific area; and (5) establish a publication record. The research outcome was intended to develop a market niche for the industry partner. The UNL AE was intended to further its research reputation, and the building industry benefits by the promotion of the adoption of innovative or emerging technologies.
4. The future faculty member/researcher outcome was obviously intended to provide the student with a future career. The industry partner was intended to benefit by a connection to academic programs and graduates that the student may be involved with in the future. UNL AE was intended to benefit by the strengthening of program, recognition, and

connection to academic programs that the student may be involved with in the future, and the building industry was intended to benefit by further multiplication of knowledge and more-qualified graduates.

First Experience

The first experience of the IEGSP started in 2001. The student was Michelle Eble-Hankins, Ph.D., P.E., LC. The industry partner was Alvine and Associates, represented by Steve Alvine, P.E., Chief Executive Officer. The UNL AE was represented by Clarence Waters, Ph.D., P.E., FAEI.

Michelle Eble-Hankins, Ph.D., P.E., LC, came to UNL AE in Summer 2001. She graduated with a B.S. in AE from Kansas State University in December 1995. Her initial industry experience was gained at Albert Kahn Associates in Detroit, Michigan, as an electrical engineer from 1996 to 2001. Albert Kahn Associates is a full-service architectural engineering firm, at which Eble-Hankins spent most of her time designing power and lighting systems for industrial facilities. She obtained professional status by passing the Electrical Professional Engineering (P.E.) Exam in 2001 and is registered in Michigan. She is also Lighting Certified (LC). She graduated from UNL with a Ph.D. in engineering (architectural engineering field) in August 2008. She currently works for Alvine Engineering as a senior lighting designer with the intent of furthering the architectural lighting service offerings.

Alvine and Associates (2011) is a mechanical, electrical, and plumbing consulting engineering firm headquartered in Omaha, Nebraska, with a nationwide client base. It has branch offices in Lincoln, Nebraska; Des Moines, Iowa; and Oklahoma City. It currently has approximately 75 total employees within these four locations. Alvine and Associates has a wide range of project experience, including commercial, higher education, retail, and residential. Alvine and Associates has three brands under which it conducts daily business: Alvine Engineering, which designs the traditional engineering disciplines; Alvine Aquatics, which designs zoo and aquariums, including the design of life-support systems; and IP Design Group, which designs telecommunications and data systems.

The UNL AE (2011), part of the Durham School of Architectural Engineering and Construction (DSAEC) in the College of Engineering, first enrolled students in 1998. The program offers the following degrees: (1) a B.S. in AE not accredited; (2) a Master of AE (MAE), requiring a UNL B.S. in AE or the equivalent accredited degree; (3) a Master of Engineering (M.Eng.), with a focus in AE; (4) an M. S. in AE; and (5) a Ph.D., a field of specialization within the College of Engineering's Ph.D. program. In Fall 2010, the DSAEC offered programs in AE, construction engineering, and construction management and had 32 tenured/tenure-track faculty, with 583 undergraduates

and 92 graduate students. The AE program had 225 undergraduates and 59 graduate students. The program focuses on the AE areas of mechanical, electrical, lighting, acoustics, and structures.

Industry-Experienced Graduate Student Program Description

The agreement between the parties was that over the course of the partnership, Eble-Hankins would spend approximately 20 h per week (average) working as a productive member of the Alvine and Associates staff. Knowing that the latter years of dissertation work are typically much more intensive than the early years, she worked more than 20 h per week (average) with Alvine and Associates for the first few years of the partnership. During that time, she designed power and lighting systems for a number of projects all over the country. In addition, she was also spending time on coursework at UNL. That balance between working with Alvine and Associates and working on school gradually shifted over the course of the partnership until, at the end, Eble-Hankins was a full-time student, having completed the required coursework and concentrating solely on research. In addition to working with Alvine and Associates and being a student, she also had several opportunities to teach during this process. Twice, she taught a sophomore-level course on the fundamentals of electricity. She also team-taught the advanced Building Power course twice, which was a 5th-year course, and she once team-taught the 5th-year Lighting Design course.

Funding for the IEGSP was established for Eble-Hankins initially at a level near what she was receiving while in the industry. The level of funding was planned to remain constant over the planned 5-year program. Approximately half of the funding was provided through a graduate research assistantship (GRA), two-thirds of which was continually provided by Alvine and Associates, and one-third funded by the faculty member using a start-up package, research grants, and teaching assistantships. This GRA included overhead to cover tuition and other costs. Other miscellaneous travel and expenses were included in the funding to allow Eble-Hankins to travel and be involved nationally. The other half of the funding was provided by a fellowship from the Architectural Engineering Industry-Experienced Graduate Student Research Fellowship fund. The fund, which was not endowed, was established to fund multiple industry-experienced graduate students on a competitive basis but has been used so far for only this one student. No criteria have been established to award these fellowships other than participation in the program. Alvine and Associates contributed to this fund at a level equal to the amount of Eble-Hankins' Fellowship. All parties felt the funding relationship was effective, even though it lasted longer than the planned 5 years, and do not anticipate changes moving forward.

Results

Development of a Working Relationship between University of Nebraska Architectural Engineering and Alvine and Associates

Strong relationships have been developed between AE and Alvine and Associates. Doug Alvine, President of Alvine and Associates, is in his second term as a member of the AE Advisory Committee. Employees of Alvine and Associates regularly assist with AE classes. Alvine helped teach the laboratory portion of AE 8220 Electrical Systems for Buildings II for two semesters. Other employees help on a regular basis with AE 8030 Building Communications Systems, AE 8010/8020 Graduate Project, and AE 8090 AE Interdisciplinary Team Design Project. Todd Shackelford, an Alvine employee, is hired on a regular basis to teach a section of AE 2250 Construction Graphics and Design Process.

Alvine and Associates regularly hires interns from the AE program. Many of these interns have become full-time employees after graduation. Alvine and Associates has successfully hired five full-time UNL AE graduates: (1) Paul Bauman, B.S. in AE, summa cum laude, 2005; MAE, 2006, mechanical/acoustics option; (2) Craig Johnson, B.S. in AE, magna cum laude, 2006; MAE, 2007, mechanical/acoustics option; (3) Brandon Rich, B.S. in AE, with distinction, 2006; MAE, 2007, lighting/electrical option; (4) Michelle Eble-Hankins, Ph.D., 2008; P.E., 2001; and (5) Sam Haberman, B.S. in AE, magna cum laude, 2006; MAE, 2007, lighting/electrical option.

Collaborative Work with Alvine and Associates

Over the course of the partnership, Eble-Hankins worked on a total of 129 projects for Alvine and Associates and billed approximately 4,700 h. Initially, she primarily assisted other electrical engineers on projects and then moved into a role in which she was the responsible electrical engineer for a number of those projects. She also dabbled in lighting design on several projects. More importantly, though, she developed a very strong relationship with the staff at Alvine and Associates, which eventually led to her accepting a permanent position with them after graduation.

Development of Research

Eble-Hankins' research (2008) centered on discomfort glare from sources of nonuniform luminances. The impetus behind the research question was that the existing discomfort glare metrics that have relied have consistently

relied on research using uniform luminance sources. Today, very few of our modern luminaires have uniform luminance across the luminous aperture. And those metrics, which were developed from uniform-luminance research, were being applied to sources with nonuniform luminance. The authors wanted to know if nonuniform luminance affects the perception of discomfort glare differently than uniform luminance. Human subjects were used in two different experiments to attempt to answer that question. The results showed that the perception of discomfort glare is different for nonuniform-luminance sources than for uniform ones. In fact, nonuniform-luminance sources were consistently found to be less discomforting than uniform ones. This finding was an interesting one, because the International Commission on Illumination recently published an extension to the discomfort glare metric that suggested that nonuniform sources should actually cause more discomfort than uniform ones. Currently, there are four publications from this work (Eble-Hankins and Waters 2004, 2009a, 2009b, 2009c).

Potential Future Faculty Member/Researcher That Has Both Strong Academic Background with Strong Industry Design Experience

Eble-Hankins graduated with a Ph.D. in AE in August 2008. At the time she graduated she had worked in industry for a total of 13 years, both at Albert Kahn and at Alvine and Associates. She has published four journal articles and has had significant teaching experience.

In her job-hunting efforts, she received an offer from an AE program at a university that focuses on undergraduate teaching. Although she did not accept the position, she still feels very strongly about teaching and hopes to continue to teach as time allows.

Conclusions

The first experience with the IEGSP was successful in developing strong working relationships between all of the partners. The research, an extension of Waters' past work, proved to be a successful project in terms of need in the lighting industry, and it provided Eble-Hankins the opportunity to study a subject in great depth, develop a reputation, and publish. The project did not help Alvine and Associates develop a market niche. Defining a research project that would help Alvine and Associates develop a market niche in lighting, the area of expertise of Waters, proved difficult.

In the future, the authors recommend broadly defining a research area that has the potential to help the industry partner develop a market niche and is of interest to a faculty member and then finding a student with similar

interests. Potential areas may include daylighting, daylighting control, lighting control optimization, HVAC controls optimization, HVAC commissioning, distributed energy systems, energy monitoring, and energy modeling.

Also, the authors recommend providing time for the students to really get to know the industry partner's business by spending less time on production-type work and more time developing/ researching. Industry problems should be defined for the students to solve. The large amount of production work completed by Eble-Hankins may have been a component of the extended length of the first experience with the program.

No further students have been recruited into the program yet. A few years after the start of the program the faculty member became the AE program administrator and found little time for further development. The administrative structure has changed, and the faculty member anticipates the recruitment of an industry partner, defining a research area of interest to the faculty member and the industry partner, and then recruiting a student in the near future after a sabbatical.

The magnitude of the design industry in Omaha, Nebraska, should provide significant opportunities for the IEGSP in the future. In addition, opportunities could easily be made with the design industry outside of Omaha, Nebraska, with regular travel built in to the IEGSP. The IEGSP should be continued and expanded. This program will help keep AE programs strongly tied to the industry they serve.

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