Development of a Curriculum for a New Architectural Engineering Program at Texas A&M University-Kingsville

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ABSTRACT

This paper presents an overview of the development of the curriculum for a new architectural engineering program at Texas A&M University-Kingsville. The program proposal has been submitted to the appropriate state agencies for approval, which it is expected to receive in early 2005. If approved, the first cohort of students will be admitted into the program in the fall semester of 2005. The mission of the program will be to prepare students to undertake the necessary design experience in the building industry to become registered engineers with a specialization in Building Architectural Engineering, and to instill in them the importance of lifelong learning, including pursuing advanced studies leading to graduate degrees.

The program will be a traditional four-year engineering degree program requiring 131 semester credit hours of coursework sufficient to satisfy all the accreditation requirements of the Accreditation Board for Engineering and Technology (ABET). The proposed curriculum includes coursework in communications, social science and humanities, mathematics and science, engineering fundamentals, and the three basic curriculum areas of architectural engineering: structures, building mechanical and electrical systems, and construction/construction management

INTRODUCTION

Currently, the only ABET accredited program in Architectural Engineering in the state of Texas is offered at the University of Texas at Austin (UT) in the Department of Civil Engineering, and is the number one ranked architectural engineering program in the country based on the Gourman report[4]. The Architectural Engineering program (comprising 40% of the student body in the Civil Engineering Department) has averaged 270 admissions applications per year over the last two years. Freshman admission into the program is limited to an average of 78 students or 29% of the applicants according to Dr. Edward Gibson[2], former Associate Chairman for Architectural Engineering. The main reason for limiting enrollment of freshman students

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according to Dr. Gibson is limited space, including laboratory and studio facilities. The students who are not accepted into the program may opt to go into other related fields, or pursue architectural engineering studies out of state.

Nationwide, there are only thirteen ABET accredited Architectural Engineering programs in the United States: California Polytechnic State University - San Luis Obispo, San Luis Obispo, CA; University of Colorado at Boulder, Boulder, CO; Drexel University, Philadelphia, PA; Illinois Institute of Technology, Chicago, IL; Kansas State University, Manhattan, KS; The University of Kansas, Lawrence, KS; The University of Miami, Coral Gables, FL; Milwaukee School of Engineering, Milwaukee, WI; North Carolina Agricultural and Technical State University, Greensboro, NC; Oklahoma State University, Stillwater, OK; Pennsylvania State University, University Park, PA; Tennessee State University, Nashville, TN; **The University of Texas at Austin, Austin, TX;** and The University of Wyoming, Laramie, WY. Furthermore, other than the program at the University of Texas at Austin, the closest one to Kingsville is at Oklahoma State University in Stillwater, OK. This program is housed in the school of architecture with the faculty teaching architectural engineering numbering five. The enrollment is approximately 50 students, 65% of who are from Oklahoma and the remaining 35% international and from other states[3]. The program is not a traditional engineering program, in the sense that admission into the professional program is only allowed at the junior level not the freshman level. This is a very selective program, accepting only 15 students per year. The program produces 10 to 15 graduates each year.

The programs at Texas and Oklahoma State exemplify the two types of existing programs in Architectural Engineering: those housed in engineering (typically four year programs) and those housed in architecture (most are five year programs). There are other programs that are not ABET accredited, such as the program at the University of Illinois at Urbana-Champaign (housed in architecture), and other new programs that will be seeking accreditation in the near future: the University of Missouri at Rolla and the University of Nebraska at Omaha (both housed in engineering).

The field of architectural engineering is currently experiencing an exciting growth, as illustrated by the growth and development of the Architectural Engineering Institute (AEI), which is part of the American Society of Civil Engineers (ASCE)[1]. Furthermore, the National Council of Examiners for Engineering and Surveying has recently added a professional engineering licensing exam in the area of architectural engineering. This clearly indicates that the demand for programs in architectural engineering is strong and with the increase in building construction, the demand for architectural engineers is expected to continue to grow. Therefore, Texas A&M University - Kingsville is excided about the opportunity to develop a new architectural engineering program, which will be housed (with civil engineering) in the college of engineering in a new department, the Department of Civil and Architectural Engineering. This paper presents an overview of the curriculum and the efforts towards accreditation.

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OVERVIEW OF THE PROPOSED ARCHITECTURAL ENGINEERING PROGRAM

Mission Statement

Building on the existing focus of the B.S. degree programs in the Frank H. Dotterweich College of Engineering, particularly the Civil Engineering program, the proposed B.S. program in Architectural Engineering will subscribe to the following mission statement:

> *The mission of the undergraduate program in architectural engineering is to prepare students to undertake the necessary design experience in the building industry to become registered engineers with a specialization in Building Architectural Engineering, and to instill in them the importance of lifelong learning, including pursuing advanced studies leading to graduate degrees.*

Program Educational Objectives

The program will emphasize the following educational objectives:

- To provide graduates with the necessary engineering skills to engage in lifelong careers as practicing professional architectural engineers who are ethical and socially responsible.
- To develop engineering graduates with a broad understanding of the problem-solving and design skills necessary to operate in the interdisciplinary arena of architectural engineering.
- To provide candidates with the knowledge and skills of mathematics, science, and engineering necessary to pursue post-baccalaureate studies.

Students who complete the B.S. degree in Architectural Engineering will be able to:

- apply fundamental knowledge of mathematics, science, and engineering to solve problems related to building architectural engineering,
- design and conduct experiments, as well as to analyze and interpret data in the interdisciplinary arena of architectural engineering,
- design the fundamental components of a system or process to meet desired needs in building architectural engineering,
- function on multi-disciplinary teams,
- identify, formulate, and solve fundamental building architectural engineering problems,
- understand the importance of professional and ethical responsibilities of engineers,
- communicate effectively,
- understand the impact of building architectural engineering solutions in a global and societal context,
- recognize the need for, and engage in, lifelong learning,
- exhibit knowledge of contemporary issues in the building industry, and
- use the techniques, skills, and modern engineering tools necessary in building architectural engineering practice.

These eleven student-learning outcomes correspond to those required by the Accreditation Board for Engineering and Technology (ABET) under Criteria 3.

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Intention Regarding ABET Accreditation

The College of Engineering will seek accreditation with ABET for the proposed B.S. in Architectural Engineering program prior to the graduation of the first cohort of graduates, approximately a four-year time frame. In order to achieve this goal, collection of self-study documentation will begin immediately after the program is approved. With this documentation, a self-study report will be prepared for ABET accreditation, which is expected to be completed in the third year of the program. The performance of the program and its continuous quality improvement will be assessed using surveys of students, parents, and intern employers to evaluate the satisfaction with the program.

Evaluation and Assessment Process

The evaluation process for the proposed B.S. degree in Architectural Engineering will be similar to those of other existing engineering programs, particularly the one for the civil engineering, which has been in place since fall 1999 and includes a continues quality improvement assessment process. This process uses input from stakeholders, performance of students on the Fundamentals of Engineering examination, job placement of graduates, and input from an Industrial Advisory Board for program outcomes assessment. Input from faculty and administration will ensure that the program mission is followed, while input in the form of surveys from students (at graduation), alumni (at three and fives years from graduation), and their employers will provide essential data for programmatic feedback. The Dean's Office and the Career Services Office will collect graduate placement data. Changes in job market need/demand will be monitored from information published by the Architectural Engineering Institute, the Association of Architectural Engineers, the Texas and National Societies of Professional Engineers, the Texas Workforce Commission, and the Texas Higher Education Coordinating Board. The data will be reviewed annually for continuous quality improvement of the program. The Industrial Advisory Board for the proposed B.S. in Architectural Engineering program is composed of industry leaders, employers of graduates, and alumni, and will be charged with steering and evaluating the program. Using this information, the program outcomes will be subjected to continuous quality improvement evaluation as specified by ABET.

Furthermore, admission and retention rates will be tracked using data routinely compiled by the Office for Institutional Research (OIR) of Texas A&M University-Kingsville. Data collected from surveys of dropouts will also be used to identify problems with retention, while data from surveys of graduates will help identify programmatic problems affecting retention. The faculty of the Architectural Engineering program will evaluate this data annually to improve the retention rate and the overall program quality.

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ARCHITECTURAL ENGINEERING PROGRAM CURRICULUM

Table 1: Semester Credit Hours (SCH) Requirements of proposed program.

	SCH
a. Foundation Courses: general education/core curriculum Communication (English): 6 SCH. ENGL 1301 and ENGL 1302. Rhetoric and Composition Mathematics: 3 SCH. Three SCH from MATH 2413. Calculus I (Field of Study Curriculum (FOSC) course) Natural Sciences: 6 SCH. PHYS 2325 and PHYS 2326 (FOSC courses) Humanities and Visual and Performing Arts: Two areas, 6 SCH total. Visual/Performing Arts: Fine Arts Elective, 3 SCH. Humanities: Social Science or Humanities Elective, 3 SCH. Social and Behavioral Sciences: Three areas, 15 SCH total. HIST 1301 and HIST 1302. American History POLS 2301. The Government and Politics of the United States POLS 2302. The Government and Politics of Texas Social Science or Humanities Elective, 3 SCH. Communication: 3 SCH. BCOM 3304. Business Communication Computer Literacy: 3 SCH. AEEN 1310. Computer Based Graphics and Design I Kinesiology: 3 SCH total. EDKN, Band, or ROTC	42
b. Required Courses (of all students) *Architectural Engineering Courses (34 SCH)* AEEN 13XX. [AEEN 1310] Computer Based Graphics and Design **(Already included in list a. above)** AEEN 13XX. [AEEN 1320] Introduction to Architectural Design AEEN 23XX. [AEEN 2325] Introduction to Development in Architecture AEEN 33XX. [AEEN 3303] Structural Analysis AEEN 33XX. [AEEN 3304] Reinforced Concrete Design AEEN 33XX. [AEEN 3331] Building Construction AEEN 33XX. [AEEN 3335] Environmental Systems for Buildings AEEN 43XX. [AEEN 4316] Structural Steel Design AEEN 43XX. [AEEN 4320] Building Services Engineering AEEN 43XX. [AEEN 4326] Construction Engineering AEEN 42XX. [AEEN 4279] Senior Design Project I AEEN 42XX. [AEEN 4289] Senior Design Project II *General Engineering Courses (29 SCH)* CEEN 2301. Mechanics I (Statics) (FOSC course) CEEN 3143. Geotechnical Engineering Laboratory CEEN 3144. Construction Materials CEEN 3145. Construction Materials Laboratory CEEN 3311. Strength of Materials CEEN 3317. Engineering Economics CEEN 3342. Geotechnical Engineering CEEN 3392. Hydraulics and Fluid Mechanics	77

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EEEN 3331. Circuits and Electromagnetic Devices (FOSC course) ITEN 2321. Architectural CAD MEEN 1201. Engineering as a Career MEEN 3347. Thermodynamics *Mathematics and Science (17 SCH)* CHEM 1311. General Inorganic Chemistry I (FOSC course) CHEM 1111. General Inorganic Chemistry Laboratory I (FOSC course) MATH 2413. Calculus I **(Already included in list a. above)** MATH 2414. Calculus II (FOSC course) MATH 3320. Differential Equations (FOSC course) PHYS 2325. University Physics I **(Already included in list a. above)** PHYS 2125. University Physics I Laboratory (FOSC course) PHYS 2326. University Physics II **(Already included in list a. above)** PHYS 2126. University Physics II Laboratory (FOSC course) STAT 4303. Statistical Methods *General Education Courses* **(Already included in list a. above)** ENGL 1301 and ENGL 1302. Rhetoric and Composition BCOM 3304. Business Communication HIST 1301 and HIST 1302. American History POLS 2301. The Government and Politics of the United States POLS 2302. The Government and Politics of Texas EDKN – Kinesiology (3 semester credit hours total)	
c. Prescribed Elective Courses *(6 SCH)* Engineering Electives, 6 SCH from the following list: *Structural Engineering* CEEN 4314. Matrix Methods in Structural Analysis CEEN 4315. Timber Behavior and Design CEEN 4320. Foundation Engineering Analysis CEEN 4368. Foundation Engineering *Construction Engineering and Project Management* CEEN 2212/2113. Surveying ITEN 2330. OSHA for General Industry ITEN 4353. Construction Management MEEN 3354. Operations Research Methods in Engineering *Services Engineering* CEEN 4364. Design of Water and Wastewater Conveyance Systems ITEN 3313. Energy and Power Technology MEEN 3348. Heat Transfer MEEN 4349. Air Conditioning	6
d. Elective Courses (from approved list) Fine Arts Electives, 3 SCH **(Also included in List a. above)** Social Science or Humanities Electives, 3 SCH **(Also included in List a. above)** Mathematics and Science Electives, 6 SCH	6
TOTAL SCH REQUIREMENTS	131

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Supporting Fields that will Complement the Proposed Program

The following programs on campus complement the proposed B.S. program in architectural engineering: civil, electrical, and mechanical engineering, as well as industrial technology. Civil engineering will cover aspects of the proposed curriculum that deal with statics, structures, strength of materials, fluid mechanics, foundations, construction materials, construction engineering, steel design, concrete design, and economics. Mechanical engineering will cover aspects of the proposed curriculum that deal with thermodynamics, as well as plumbing, heating, ventilation and air conditioning systems design. Electrical engineering will cover aspects of the proposed curriculum that deal with circuits and electromagnetic devices, as well as electrical power building systems design. And, industrial technology will cover aspects of the proposed curriculum that deal with computer-aided design and building construction.

CONCLUSIONS

It is anticipated that the program will be approved in the spring of 2005 and the first cohort of students admitted in the fall of 2005. The proposed architectural engineering program will be a traditional engineering program, and it will build on the strengths of the exciting programs at TAMUK. The experience so far has been very positive and the Architectural Engineering profession has been very helpful in the development of the program. With respect to enrollment, we have had a number of students inquire about the program since it was first proposed and we are very excited about the opportunity to offer the program. Most of these potential students did not know that there was such a discipline in engineering. The hope of the authors is that by the next ASEE conference we will have some exciting enrollment numbers to report.

ACKNOWLEDGMENTS

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