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Core Curriculum Participation of Architecture, Engineering, and Construction Programs

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ABSTRACT

The core curriculum is a required part of four-year degree programs in higher education. The purpose is to ensure the essential knowledge and skills needed for a successful college, career, community, and life experience and participation. In the United States, each state has a similar list of requirements that slightly differ in category definitions and number of credit hours. The architecture, engineering, and construction degrees include the core curriculum courses as a part of the degree requirements defined by the state, regional accreditation, and professional accreditation procedures. The core curriculum courses also offer an opportunity for early preparation and recruitment for professional degree programs. This paper reviews the core curriculum participation of Texas architecture, engineering, and construction programs. As part of this study, the Texas General Education Core Curriculum database is queried for approved core curriculum courses taught by architecture, engineering, and construction programs at higher education institutions. The data is presented using the core curriculum categories, program rubrics, and the common numbering system designations. The existing patterns and established trends are presented. The paper discusses the opportunities and required resources for successful core curriculum offerings by the architecture, engineering, and construction programs.

INTRODUCTION AND BACKGROUND

Four-year degree programs in higher education are composed of required core curriculum courses, discipline-specific courses, and free or prescribed electives. Although some degree programs may have additional requirements (for example, co-ops, practicums, or internships) or a modified structure (for example, combined undergraduate/ graduate degrees, multiple majors, or minors), core and discipline-specific components define the roadmap.

Professional accreditation standards recognize this composition and establish their standards within these parameters. In the last 80 years, the professional degree programs experienced a decrease in total credit hours in their curriculum, including the architecture, engineering, and construction programs (AEC) [1]. It is possible to find examples of program requirements reduced from over 210 credit hours to 120 credit hours [2]. In this evolutionary process, the credit hour reductions are usually in the discipline-specific coursework while the core curriculum components remain relatively intact. In this context, some AEC programs explored the possibility of offering courses within the core curriculum criteria.

The core curriculum courses are typically planned for the first two years of the degree programs. In the last three decades, the first year (and in some instances, the second year) curriculum also became a focus of attention for recruitment, retention, and attrition efforts [3-7]. The retention

and attrition rates are usually at the center of this discussion as they can be directly linked to other metrics, including graduation rates. Several AEC programs also explored the idea of an interdisciplinary/multi-disciplinary curriculum, which utilized a common curriculum in the first and second years for multiple majors [8-10].

Two specific observations can be noted from the decades-long research work: 1) the first and second-year success and retention rates of the students are directly related to their overall success and graduation rates, and 2) early contact with students/potential students increases the recruitment and retention efforts, especially for STEM disciplines.

Core curriculum courses offer a unique opportunity to reach out and contact students without adding credit hours to their degree requirements. For the students that have already selected an AEC major, it accomplishes the proven effect of "early contact." Since the core curriculum classes are open to all majors at a university, it also provides a venue to recruit new majors by providing a different perspective. The idea here is to offer a course based on an AEC perspective to address core learning objectives such as critical thinking skills, empirical/quantitative skills, and/or social responsibility.

The first step in this research is to understand the current status of core curriculum participation of the AEC programs. As a starting point for this work and establishing a simplified methodology, this paper reviews Texas architecture, engineering, and construction programs' core curriculum participation and explores the possibilities. As part of this paper, the Texas General Education Core Curriculum database is queried for approved core curriculum courses taught by architecture, engineering, and construction programs at higher education institutions.

TEXAS CORE CURRICULUM AND AEC PROGRAMS

The Texas Higher Education Coordinating Board designed a new 42 credit hour core curriculum for all undergraduate students in Texas, implemented in 2014 [11]. The components and requirements of the core curriculum are presented in Table 1. These requirements comply with the Texas Education Code [12] and the Coordinating Board rules [13].

Table 1. Components and Requirements of the Texas Core Curriculum

FCA Transcript Code	Component Area	Required Semester Credit Hours
010	Communication	6
020	Mathematics	3
030	Life and Physical Science	6
040	Language, Philosophy and Culture	3
050	Creative Arts	3
060	American History	6
070	Government/Political Science	6
080	Social and Behavioral Sciences	3
090	Component Area Option	6
	TOTAL	42

Among the areas listed in the Table1, it would be unlikely to find the participation of AEC programs for communication (010), mathematics (020), life and physical science (030), American history (060), and government/political science (080) components.

Texas maintains a database of higher education programs through the Texas Higher Education Coordinating Board [14]. This database is searched for the "architecture," "construction," and "engineering" keywords for public universities. Table 2 shows the results of the database search.

In Table 2, there are 32 institutions listed, with seven under architecture, 15 under construction, and 32 under engineering categories. There is one institution with architecture and engineering programs, nine with construction and engineering programs, and six with architecture, construction, and engineering programs.

Table 2. Texas Architecture, Construction, and Engineering Program Inventory

INSTITUTION	ARCHITECTURE	CONSTRUCTION	ENGINEERING
Angelo State University			X
Lamar University		X	X
Midwestern State University			X
Prairie View A&M University	X	X	X
Sam Houston State University		X	X
Stephen F. Austin State University		X	X
Tarleton State University		X	X
Texas A&M International University			X
Texas A&M University	X	X	X
Texas A&M University-Galveston			X
Texas A&M University-Central Texas			X
Texas A&M University-Commerce		X	X
Texas A&M University-Corpus Christi			X
Texas A&M University-Kingsville			X
Texas A&M University-San Antonio			X
Texas A&M University-Texarkana			X
Texas Southern University			X
Texas State University		X	X
Texas Tech University	X	X	X
The University of Texas at Arlington	X	X	X
The University of Texas at Austin	X		X
The University of Texas at Dallas			X
The University of Texas at El Paso		X	X
The University of Texas at San Antonio	X	X	X
The University of Texas at Tyler		X	X
The University of Texas Permian Basin			X
The University of Texas Rio Grande Valley			X
University of Houston	X	X	X
University of Houston-Clear Lake			X
University of Houston-Downtown			X
University of North Texas		X	X
West Texas A&M University			X

Since Table 2 relies on keyword searches of the program names, it is possible to have an overlap for institutions that have combined program names such as “architectural engineering” or “construction engineering.”

CORE CURRICULUM PARTICIPATION

For the institutions listed in Table 2, the core curriculum courses are searched through the Texas General Education Core Curriculum WebCenter using the Fall 2021 dataset [12]. The listing for each institution is then reviewed for offerings that are likely to be offered by architecture, construction, or engineering programs based on the rubric and course title. Table 3 presents the core curriculum courses identified for the universities listed in Table 2.

Table 3. Core Curriculum Participation of AEC Programs

INSTITUTION	Course	Component Code
Lamar University	INEN 2373 - ENGINEERING ECONOMICS	080
Prairie View A&M University	ARCH 1301 - ARCHITECTURAL HISTORY I	040
	ARCH 1302 - ARCHITECTURAL HISTORY II	040
	ARCH 1303 - ARCHITECTURAL DESIGN I	050
	ARCH 1327 - MULTIMEDIA DIGITAL APPLICATION	090
Tarleton State University	ENGR 2303 - ENGINEERING ECONOMY	080
	ENGT 2303 - ENGINEERING ECONOMY	080
Texas A&M University	ENGR 101 - ENERGY RSRCE USE IMPRTCE	030
	ARCH 213 - SUSTAINABLE ARCHITECTURE	040
	ARCH 346 - ARCH HERITAGE CULTURE	040
	ENGR 482 - ETHICS AND ENGINEERING	040
	ARCH 249 - SURVEY WORLD ARCH HIS I	050
	ARCH 250 - SURVEY WORLD ARCH HIS II	050
	ARCH 350 - HIST/THEOR MOD/CONT ARCH	050
	ENDS 101- DESIGN PROCESS	050
	ENDS 115 - DESIGN COMM FOUNDATION	050
	ARCH 212 - SOCIAL & BEHAV FACT DESN	080
	ARCH 458 - CULT ETHICAL GLOBAL PRAC	080
	ENGR 101 - ENERGY RSRCE USE IMPRTCE	090
Texas Tech University	ARCH 2311 - HISTORY WORLD ARCHITECTURE I	040
	ENGR 2392 - ENGR ETHICS &IMPACT ON SOCIETY	040
	ARCH 2315 - HISTORY WORLD ARCHITECTURE II	050
	ARCH 1311 - DESIGN ENVIRONMENT AND SOCIETY	080
	IE 2324 - ENGINEERING ECONOMIC ANALYSIS	080
	ENGR 2331 - PROF COMMUNICATION FOR ENGRS	090
The University of Texas at Arlington	ARCH 2300 - MSTRWKS W ARCH	040, 090
	ARCH 1301 - INTRO ARCHITECTURE/INT DESIGN	050, 090
	IE 2308 - ENGINEERING ECONOMICS	080, 090
The University of Texas at Austin	ARC 308 - ARCHITECTURE AND SOCIETY	050
	ARC 312C - APPROPRIATE MATERIALS	050
	ARC 318K - WORLD ARC: ORIGINS TO 1750	050
	ARC 318L - WRLD ARC: INDTRL REV TO PRSNT	050
	ARC 342C - MEX ARCH: PRE-COLUMB-CONTEMP	050
	EE 302 - INTRO TO ELECTRICAL ENG	090
	EE 302H - INTRO TO ELEC ENGR: HONORS	090
	ES 301 - ENGR DESIGN/PROBLM SOLVING	090
	ECE 302 - INTRO ELECTRICAL ENGINEERING	090
	ECE 302H - INTRO ELECTRICAL ENGR: HONORS	090
The University of Texas at El Paso	CE 2326 - ECON FOR ENGRS & SCIENTISTS	080
The University of Texas at San Antonio	ARC 1113 - INTRO TO THE BUILT ENVIRONMENT	040, 090
	ARC 1513 - GRT BLDGS & CITIES OF THE WRLD	050, 090
	ARC 2413 - HISTORY OF ARCHITECTURE I	050, 090
	EGR 1343 - IMPACT OF MODERN TECH ON SOC	090
	EGR 1403 - TECHNICAL COMMUNICATION	090
University of Houston	ARCH 2350 - SURVEY OF ARCHITECTURAL HIST I	050
	ARCH 1359 - DESIGN SINCE 1945	090
	ENGI 2304 - TECHNICAL COMMUNICATIONS	090
University of North Texas	ENGR 1030 - TECH SYSTEMS	090

The college preparedness or first-year academic inquiry courses are excluded in this review as they are challenging to identify by the course title and, in most cases, include content outside AEC subject matter.

As shown in Table 3, only 34% (11 out of 32) universities offer core curriculum classes through their architecture, construction, and engineering programs. The offerings are limited to architecture culture/history classes, engineering economics, visual communications, and professional ethics. The following categorical observations can be noted from the data:

- **Architecture/Architecture History Related Offerings:** Only 21% (7 out of 32) in Table 2 and 64% (7 out of 11) of the institutions in Table 3 offer at least one architecture and/or architecture history-related course. These offerings include different levels of architectural history under various titles, including "architecture history," "great buildings and cities," and "architecture and society." All seven of these institutions in Table 3 have an architecture degree program.

- **Engineering Economics:** Economics subject is often offered as a core course under the Social and Behavioral Sciences category (080) by Colleges of Business. 13% (4 out of 32) in Table 2 and 36% (4 out of 11) of the institutions in Table 3 offer at least one engineering economics course with titles such as "economics for engineers and scientists" and "engineering economics analysis."

- **Design/Visual Communication:** 19% (6 out of 32) in Table 2 and 55% (6 out of 11) of the institutions in Table 3 offer at least one design/visual communication course with titles such as "design communication foundations" and "technical communication."

- **Sustainability/Energy/Social Responsibility:** 9% (3 out of 32) in Table 2 and 27% (3 out of 11) of the institutions in Table 3 offer at least one sustainability/energy/social responsibility course with titles such as "impact of modern technology on society" and "sustainable architecture."

- **Ethics:** 9% (3 out of 32) in Table 2 and 27% (3 out of 11) of the institutions in Table 3 offer at least one ethics course with titles such as "engineering ethics and impact of society" and "ethics and engineering."

It should also be noted here that the database search did not result in any core curriculum course offered under a "construction" rubric. This may be related to the relatively young age of the construction discipline.

DISCUSSION AND CONCLUSIONS

The goal of this paper was to conduct a review of the core curriculum participation of Texas architecture, engineering, and construction programs to understand the current status and explore the possibilities. Among the 32 universities with architecture, construction, or engineering program, only 11 participate in the core curriculum delivery. Most of the offerings are designed for specific majors except for architecture culture/history.

It is essential to recognize the resource-intensive nature of core curriculum development, delivery, and assessment. This may be the primary reason for the limited participation. However, the lack of established disciplinary norms may also play a factor. For example, architecture history is an established sub-discipline with clearly defined content, while the history of construction or enginnering subject does not have the same recognition.

Perhaps an effort to develop construction/engineering history and culture coursework would increase the recruitment and retainage of STEM majors, especially if the course can be made available to all majors. In addition, sustainability, energy, and disaster recovery/resilience can also provide opportunities from a construction/engineering perspective.

The natural next step in this research work is to expand this methodology to a national stage and explore AEC participation efforts and best practices.

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