

The Beginning DESIGN Experience for Architecture and Architectural Engineering Students at Oklahoma State University

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Abstract

The process of DESIGN is the creative act that architectural engineers and architects rely upon to carry out their professional endeavors. Designs must first be created, then analyzed and evaluated, and then reconsidered as the non-linear cycle of design continues. Because beginning students have limited experience with the creative act of design, five years ago we created the course titled “Introduction to Architecture” to help ease the students’ transition into the design studio. This beginning studio course was specifically developed to introduce freshman students to the basic concepts and ideas involved in the creation of Architecture, and the non-linear problem solving that is a part of our creative professions.

The practice of Architecture is a complex integration of aesthetic and technical systems that typically requires a team of experts in related fields working together to create a building. Architectural engineers are responsible for the design and analysis of the technical systems required in building design. These systems must not only function in a safe and efficient manner, but should be integrated with the architectural planning, aesthetics and other systems in buildings. This requires architectural engineers to have a general knowledge of all the aspects of architecture and technology, in addition to an expertise in their individual field.

Housed within the College of Engineering, Architecture and Technology, the School of Architecture at Oklahoma State University offers five-year professional degree programs in both Architecture and Architectural Engineering¹. The integration of these programs through shared faculty, facilities and course work is unique in architectural engineering education and is a strength of the School. The primary thrust of both programs is the preparation of graduates to enter private practice as consulting engineers or architects. It is one of fifteen Architectural Engineering programs in the United States and as such produces graduates who are particularly prepared for the integrated team approach used in professional practice.

The curriculum is organized to give beginning students time to take most of their courses in general education, while learning about some of the fundamentals in architecture and architectural engineering. This structure gives the student enough background to decide whether to pursue architecture, architectural engineering or some other discipline. The first two years of both curricula are nearly identical, with the only differences in the area of general education. Admission to third year is required for both architecture and architectural engineering students, with the top 30 students in architecture and 15 students in architectural

engineering admitted. The last three years of the architectural engineering curriculum are structured such that students take courses primarily in architectural engineering and related subjects. The architectural engineering curriculum is shown in Table 1; those courses common to both Architecture and Architectural Engineering programs are indicated with an asterisk (*).

TABLE 1: Bachelor of Architectural Engineering Curriculum

*ARCH 1111	Introduction to Architecture	1	*ARCH 1216	Architectural Design Studio I	6
*MATH 2145	Calculus I (A)	5	*PHYS 2014	General Physics (N,L)	4
*ENGL 1113	English Composition I	3	*ENGL 1213	English Composition II	3
*HIST 1103	Survey of American History	3	*ELECT ---3	General Education Elective (S)	3
*POLS 1113	American Government	3			
First year (fall)		15	First year (spring)		16
*ARCH 2116	Architectural Design Studio II	6	*ARCH 2216	Architectural Design Studio III	6
*ARCH 2003	Architecture and Society (H,I)	3	*ARCH 2263	Building Systems and Materials	3
CHEM 1314	General Chemistry (N,L)	4	*ENGS 2113	Statics	3
*ELECT 3--3	General Education Elective (S)	3	*ELECT ---4	Basic Science Elective (N,L)	4
Second year (fall)		16	Second year (spring)		16
*ARCH 3116	Architectural Design Studio IV	6	ARCH 3243	Structures: Analysis I	3
*ARCH 3323	Structures: Steel I	3	*ARCH 3223	Structures: Timbers	3
*ARCH 3134	EC: Thermal Systems/Life Safety	4	*ARCH 3233	E. C.: Acoustics and Lighting	3
ENGS 2143	Strength of Materials	4	*ARCH 3453	Computer-Aided Design/ Analysis	3
			MATH 2155	Calculus II (A)	5
Third year (fall)		16	Third year (spring)		17
ARCH 4144	Structures: Steel II	4	ARCH 4443	Structures: Analysis II	3
*ARCH 4123	Structures: Concrete I	3	ARCH 4243	Structures: Foundations for Buildings	3
ENGSC 2123	Elementary Dynamics	3	*ARCH ---3	Architectural History/Theory Elective	3
MATH 3013	Linear Algebra	3	MATH 2233	Differential Equations	3
PHYS 2114	General Physics (N,L)	4	ENGSC 2213	Thermodynamics	3
Fourth year (fall)		17	Fourth year (spring)		15
*ARCH 5119	Architectural Design and Development	9	ARCH 5244	Structures: Concrete II	4
ARCH 5143	Structures: Special Loadings	3	*ARCH ---3	Architectural History/Theory Elective	3
*ARCH 5193	Management of Architectural Practice	3	CIVEN 4711	Basics Soils Testing Laboratory	1
			ENGSC 3233	Fluid Mechanics	3
			ENGSC 2613	Introduction to Electrical Science	3
			*ELECT ---3	Directed Elective	3
Fifth year (fall)		15	Fifth year (spring)		17
			Total		160

Both the architectural engineer and the architect must possess the rational and logical skills of convergent thinking, and the imaginative and intuitive skills of divergent thinking patterns in order to successfully respond to an architectural problem. The process of design and analysis relies upon convergent and divergent thinking skills, which is probably what makes it so challenging and satisfying to practice.² In our curriculum, we attempt to address the development of both skills, throughout the entirety of the program.

As architectural engineering and architectural design students enter the School of Architecture at Oklahoma State University, they are faced with the task of approaching a design problem in the studio that is open-ended and subjective in nature. Today's engineer needs to have the mindsets of artist, detective, judge, and producer during the creative problem solving process.³ For many students, this can cause a kind of culture shock, when they realize that there is always more than one "right answer". Because beginning students have limited experience with the creative act of design, five years ago we created the course titled "Introduction to Architecture" to help ease the students' transition into the design studio. This beginning studio course was specifically developed to introduce freshman students to the fundamental concepts and ideas

involved in the creation of Architecture, and the non-linear problem solving that is a part of our creative professions.

In our “Introduction to Architecture” course and all of the following architectural design studios, architectural engineering and architectural design students are not separated by major, in order to encourage a sense of mutual understanding within our studio culture. The belief of our school aligns with Mario Salvadori’s proclamation: “The architectural engineer and the architect must strive, by all means at their disposal, toward a better understanding and a more fruitful collaboration”.⁴ The focus of this shared beginning course is to provide an orientation for students considering either architectural engineering or architectural design as a professional career. Thus, the course endeavors to introduce students to the required educational processes and career opportunities available in either discipline. The development of graphic skills – both drawing and model-building, is also an emphasis of the course. Most importantly, however, the course asks students to *start thinking like designers* at the very beginning of their career.

The relative success of an architect or architectural engineer relies upon his or her ability to address design problems and communicate ideas, usually through drawings. Drawing is an evolutionary cycle involving our brains, our eyes, our hands and our interpretations of visual images.⁵ Typically, the graphic skills of the freshman students are very modest. In our course, we address the skills of freehand sketching and basic graphic techniques in order to build confidence within our beginning students. We start with a drawing emulation exercise illustrating fundamental graphic techniques, and then introduce the students to the basic concepts involved with drawing in perspective (Figure 1). Following these exercises in freehand drawings, the students are asked to use perspective sketches as tools to record and analyze the fundamental design elements and concepts exhibited in the buildings they experience (Figure 2).

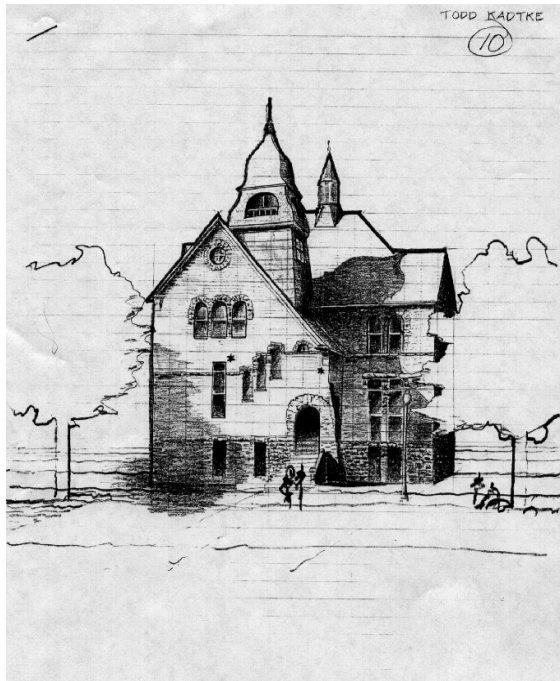


Figure 1: Perspective Drawing

Of great importance is that the student recognize the basic elements of architectural form and space, understand how they can be manipulated in the development of a design concept, and realize their visual implications in the implementation of a design solution.⁶ In a series of open-ended assignments, students are asked to evaluate the architecture they experience daily, using the vocabulary of a designer, and documenting their experiences in both written and graphic forms. This group of exercises has been titled the “Looking at Architecture” series. In these exercises, the students are asked to locate three existing spaces that have the individual qualities of anticipation, transition, and gathering. Once the student determines that a space creates a mood of anticipation, transition, or gathering, then they are asked to document the attributes of the space which create that sense (Figure 3). These attributes could include the physical shape of the space, the sequential experience of the space, the position of focal points within the space, the surface characters, the colors, or the lighting. Upon the completion of this analysis and documentation for each space, the students are also given the challenge of creating abstract three-dimensional constructs of these spaces, while considering the tectonic and aesthetic issues of form, space and order (Figure 4).

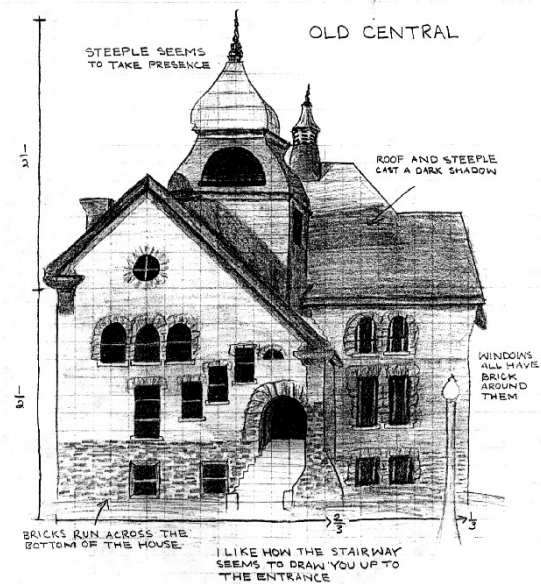


Figure 2: Analytical Drawing

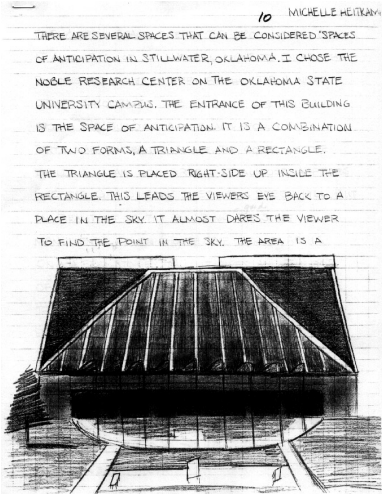


Figure 3: Documentation

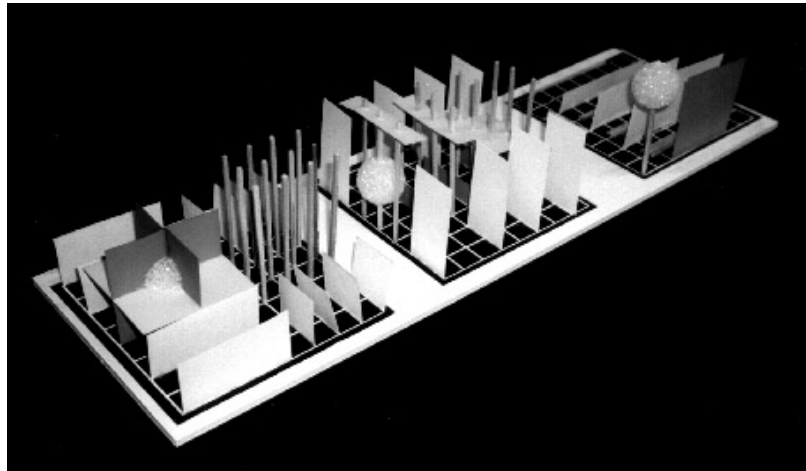


Figure 4: Abstract Compositions

Following these skills development and experiential assignments, the students are challenged with two design problems; one that is focused in scope, and one that is open to personal interpretation. The first design project is centered on the design of a small object – a clock tower - using a standard set of materials to create a finished model. Each student is given the same set of shapes to utilize in their design, with the requirement that the integrity of the shapes must remain. Using the limited materials palette, the students experiment with issues of structure and aesthetics in a conceptual way (Figure 5). The final design project of the semester is truly open-ended; the students are simply asked to design an imaginative object and/or space. The basic materials are provided, but the students can manipulate them in any way that reinforces their idea or concept. The design solution may or may not be overtly architectural in nature, however the goal is to allow the students the opportunity to explore their own creative impulses while considering issues of form, space and order (Figure 6).

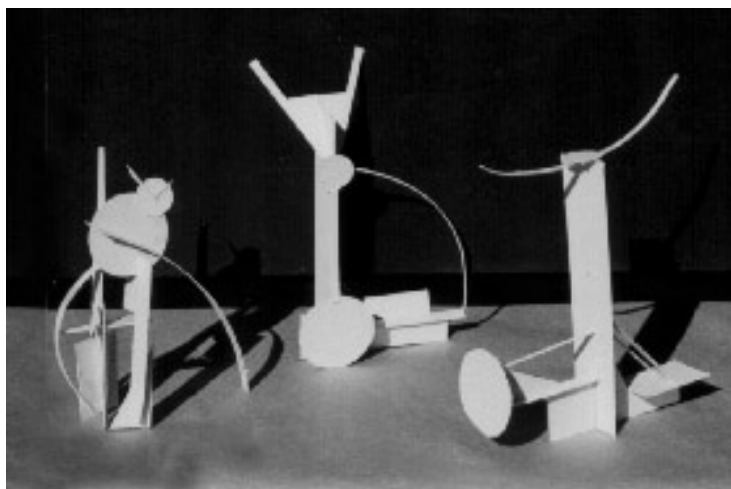


Figure 5: Design Problem

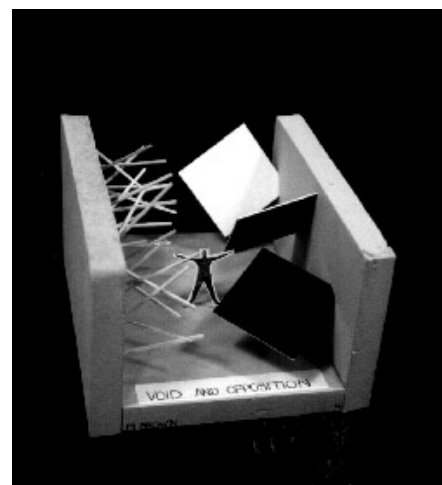


Figure 6: Design Problem

All design work is conducted within an open studio setting within a limited time, and the work is displayed publicly in our gallery upon completion. Examples of excellent homework

responses are also posted. This system allows students to learn from each other while doing, and gives them the opportunity to evaluate their results against the results of their peers at the end of each assignment or project.

To allow the students to learn about the exciting work that a professional architect or architectural engineer engages in, the students conduct a library research project to document the work of an important architect or architectural engineer. On a more personal level, the students are also afforded the opportunity to meet with a practicing professional from Oklahoma City or Tulsa. In this meeting, the students uncover the day to day challenges and rewards of a career in architecture from one who is doing it “in the real world”. In a related exercise, the students tour a local construction site and meet with the construction manager. And finally, to familiarize the students with the process required to become a licensed engineer or architect, our student advisors hold an evening seminar explaining the curriculum, and the internship and examination processes.

The architectural engineering student at OSU is first introduced to the fundamental concepts and ideas underlying the creation of architecture in the Introduction to Architecture course. These concepts are further developed in the following four Architectural Design studios. The engineering design experience is developed and integrated into the curriculum in the material specific courses of Timbers, Steel and Concrete, concurrent with courses in Structural Analysis. The basic concept in each course is to introduce the necessary science and then provide a correlating design experience. The last two years of study are focused on design problems with direct application to professional practice. The overall building design process and the integration of the many factors affecting design are the primary focus of the second courses in Steel and Concrete Design. Both of these courses contain open-ended comprehensive structural and building design problems. The Architectural Design and Development course in the fifth year is a comprehensive building design course which allows the students to fully integrate their skills in architectural design with their abilities in the technical aspects of creating architecture.

The Architectural Engineering program at Oklahoma State University has a primary objective of preparing students for a rewarding and creative practice in the profession of architectural engineering. The curriculum, from the first semester to the last, has been designed to achieve this objective. The success of the program is measured in part by the fact that graduates are highly valued and highly successful in practice. Graduates have an excellent placement rate and typically receive several job offers in the course of their post-graduation job search. The OSU graduates in Architectural Engineering comprise approximately 37% of the architectural engineering work force in Tulsa and Oklahoma City. Their success is evident in the fact that over 60% of the principals and 40% of the associates in these firms are OSU Architectural Engineering graduates.⁷ Because the program is relatively small, we maintain close contact with many of our graduates and most of the employers of our graduates. This informal communication is important in that it keeps us very much in tune to the needs of the profession and to whether or not we are meeting our objective of preparing our architectural engineering graduates for the design and analysis of structures in professional practice. Formal communication is maintained through the school’s Professional Advisory Committee, alumni surveys and student juries in the comprehensive Architectural Design and Development course.

It is clear that in order to create the safe and economical design of structural systems used in buildings the architectural engineer requires a working knowledge of the mechanics of those materials commonly used for building structures, including steel, timber and reinforced concrete. But, as Fazlur Khan stated, “The technical man mustn’t be lost in his own technology... I think that the best structural solutions emerge from a conceptual approach to a problem.”⁸ An education in conceptual design and architectural aesthetics is also crucial for the success of an architectural engineer. We believe that a first semester introduction to the process of design, as a shared experience for our beginning architecture and architectural engineering students, is a fundamental element of both our degree programs. Guiding our beginning students into the unknown frontier of non-linear thinking allows them to realize in the first semester of their studies the creative potential inherent in the professions of architecture and architectural engineering.

¹ The primary focus of Architectural Engineering at the Oklahoma State University School of Architecture is on structural design and analysis of buildings.

² Lawson, Brian. How Designers Think. Cambridge, Great Britain: The University Press, 1991. 96-107.

³ Lumsdaine, Edward, Monika Lumsdaine, and William Shelnett. “Integrating Creative Problem Solving and Engineering Design”. Proceedings of the 1999 ASEE Annual Conference (Charlotte).

⁴ Salvadori, Mario. Structure in Architecture. Englewood Cliffs, NJ: Prentice-Hall, Inc, 1963. 359-61.

⁵ Hanks, Kurt and Larry Belliston. Draw! A Visual Approach to Thinking, Learning and Communicating. Los Altos, CA: Crisp Publications, Inc., 1992. 5-31.

⁶ Ching, Francis D.K. Architecture: Form, Space & Order. New York, NY: Van Nostrand Reinhold, 1984. 10-11.

⁷ O’Hara, Steven E. Survey of Architecture/Engineering and Consulting Structural Engineering firms in Tulsa and Oklahoma City, Oklahoma, November 1999.

⁸ “Profile: Fazlur Khan”. Mimar 4, April-June 1982: 35.

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Suzanne Bilbeisi, an associate professor of architecture, is the principal instructor and coordinator of the “Introduction to Architecture” course. She also teaches architectural history, and design in the studios at all levels of the curriculum. Professor Bilbeisi is a licensed architect in the states of Pennsylvania and Oklahoma, and principal of Bilbeisi Architects.

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