

The History of the Architectural Engineering Program at — and its Impact on Engineering Education

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Abstract: This article is currently a work in progress (WIP). Historically, the construction of buildings has relied on the contributions of architects and multiple branches of engineering, such as mechanical, civil and electrical. In the early nineteenth century, as cities began to grow in the US, the need for specialized areas combining architecture and engineering became necessary. To fulfil this need, in 1908, the first Architectural Engineering (AE) program was established at Oklahoma State University (OSU). During the initial years, the AE program included the first two years, which were common to all engineering fields, followed by a diversion for the remainder of the AE program. Subsequently, in 1922, the curricula were separated for the architecture and AE programs, without a year in common. The program's history also reflects important milestones in access and participation, including the 1915 graduation of the first woman in AE at OSU, who also became the School of Engineering's first female graduate. Over the years, the AE program has greatly contributed to producing several architectural engineers who have either served in the industry or pursued a graduate program elsewhere. The current AE program involves 4.5 years of study, including taking courses in art, history, studio courses and engineering, with several required and elective courses. Furthermore, the number of students, including both men and women, graduating from the AE program has increased since its inception in 1908. To assess the importance of the AE program and its contribution to the scientific community and society at large, the authors conducted two separate surveys consisting of multiple-choice questions. The first survey was sent to current students enrolled in the AE program at the School of Architecture (SOA), while the second survey was sent to former graduates of the AE program. The surveys were conducted using Qualtrics software, utilizing the anonymized function of the software to seek honest opinions without obtaining and retaining personal information from the respondents. Results from the surveys showed a strong interest in learning about the AE program's history, in addition to suggestions provided by respondents to further improve the AE program at the SOA. As cities continue to expand and design practice prioritizes structural performance and energy efficiency, architectural engineering education must keep pace with evolving standards. This paper reexamines the history of OSU's Architectural Engineering program, tracing its development and proposing forward-looking changes.

Keywords: Architectural Engineering; Survey; Education; Building; Energy efficiency.

1. Introduction

Architectural Engineering (AE) combines several fields, including architecture, building science, structural engineering, energy modeling, plumbing, acoustics, and sustainable building design [1]. There are several AE programs across the US and other parts of the world offering undergraduate and graduate programs [2]. In some countries, such as in Canada, AE is also called building engineering. The AE program at OSU has existed since 1908, with graduates serving the architectural, engineering, and construction (AEC) industry. The objective of this paper is to revisit the history of the AE program since its inception and assess the various stages of development. In addition, two separate surveys consisting of multiple-choice questions for current AE students and

alumni were conducted. Results show that although most current and past students at the School of Architecture's AE program had limited knowledge of the program's history, they had a strong interest in learning about it, besides having positive views about the AE program. This paper provides a detailed overview of the AE program at OSU, discussing the various stages of development of the program and results from student surveys. In addition, future work focused on improving the AE program and raising students' awareness of its history is discussed.

2. AE programs in the US and other countries

There are several schools in the US and across the world that offer programs in AE [3]. In some countries, such as in Canada, these programs are also called building engineering. Table 1 presents a summary of a few universities around the world having AE programs or their equivalent. This table is not a comprehensive list and does not include details about the AE program at OSU which will be discussed in detail in the following section. Most AE programs offered by universities include undergraduate and graduate degrees, with some (e.g., Penn State) also offering certificate programs in AE. In general, most AE programs typically include courses in structural design, building science, materials, sustainable design, architecture, and design studios. It is worth noting that the AE program at OSU is time-honored (established in 1908), like the AE program at Penn State University (established in 1910 – see Table 1). The following section describes the history of the AE program at OSU.

3. History of the AE program at OSU

This section provides an overview of the AE program's history, followed by recent developments.

3.1. Initial stages of development

The architectural engineering program at OSU began in 1908 through the efforts of Professor W.A. Etherton [4]. Initially, the program shared the first two years with other engineering fields, before diverging from the others, but mostly included courses in civil engineering from the structural area. In 1915, a separate curriculum in architecture and architectural engineering was established, each a 4-year degree program.



Figure 1. Picture of Maude Spear, the first female graduate in AE from OSU (image from [4])

Table 1. AE programs at various universities

Name of University	Location	Salient features of the program
California Polytechnic State University	San Luis Obispo, CA, USA	- The AE department was first created in 1946 and has maintained accreditation since 1974. - AE program offers a 4-year undergraduate degree, with a possibility to complete a master's degree with AE specialization
Kansas State University	Manhattan, KS, USA	- AE program focused on electrical, Mechanical and structural systems. - offers B.S./M.S. programs and an accelerated B.S. and M.S. degree. - M.S. degree includes 30 credit hours of graduate level research/course work.
Pennsylvania State University	University Park, PA, USA	- AE program includes undergraduate and graduate degrees. - Offers certificate in residential construction. - founded in 1910 and is ABET accredited.
Texas A&M University	College Station, TX, USA	- offers an undergraduate program with the option of choosing between mechanical systems or structural systems - includes 128 semester credit hours, combining courses in civil, mechanical, electrical, and architectural engineering.
University of Nebraska-Lincoln	Omaha, NE, USA	- provides an accelerated 5-year program to complete undergraduate and MS degrees. - Undergraduate programs in AE specialize in Structural systems, Mechanical systems and acoustics, Lighting and electrical systems.
University of Texas at Austin	Austin, TX, USA	- undergraduate program includes 64 hours of core courses - topics of study include engineering science, structural design, indoor air quality and sustainable building systems, among others
University of Arizona	Tuscon, AZ, USA	- offers a 4-year undergraduate program in architectural engineering. - Courses combine civil, structural, electrical and mechanical engineering, architectural theory, history and design
Illinois Institute of Technology	Chicago, IL, USA	- includes ABET accredited undergraduate (B.Eng), graduate (M.Eng/M.S. and PhD) and certificate programs. 4-year undergraduate program with focus on building systems engineering, construction and engineering management and structural engineering.
University of Wyoming	Laramie, WY, USA	- provides an ABET accredited undergraduate degree in architectural engineering requiring 120 credits, 42 of which are upper division. - provides a path for PE licensure
Worcester Polytechnic Institute	Worcester, MA, USA	- AE undergraduate program includes coursework in Architectural Design, Principles of HVAC Design, Energy Simulation, and Building Envelope Design. - Degree is also offered online.
Concordia University	Montreal, QC, Canada	- The program is called building engineering and includes undergraduate (B.Eng.) and graduate (M.Eng/MS and PhD) degrees. - Some of the coursework for the B.Eng. program include Acoustics and lighting, building science, fire and smoke control, indoor air quality, thermal analysis and various structural engineering courses.
University of Waterloo	Waterloo, ON, Canada	- undergraduate program in architectural engineering includes courses on structural analysis, energy and sustainability, solid mechanics and design and communication. - undergraduate degree focused on building structures and building systems. - includes undergraduate and graduate degrees.

University of Liverpool	Liverpool, England, UK	• The program is called architectural engineering and includes a 3-year B.Eng. degree or 4-year integrated M.Eng. degree. • includes the possibility to spend a summer or a year abroad as part of the study program • coursework on HVAC design, acoustics and lighting and various topics on structural engineering.
TU Delft	Delft, Netherlands	• Includes a MSc program in architectural engineering. • Focus areas include circularity, climate design, digital manufacturing, product design, material research, structural mechanics and computational modeling.
The University of Melbourne	Melbourne, Australia	• Includes undergraduate and graduate programs in architectural engineering • Studio based course, structural design and building science courses are part of the curriculum
Politecnico di Milano	Milan, Italy	• Offers a 2-year MSc program in architectural engineering • Some of the courses include Building Physics, Structural Design, History of Architecture, Building Renovation, Building Materials, Integrated Project Management and Sustainable Building Technologies.

Although most graduates in architectural engineering at the time were men, Maude Spear (Figure 1) was the first female graduate in 1915, an important milestone that marks early progress toward broadening access and representation in the program and helps ensure that the program's history reflects the contributions of all its graduates.

In 1917, under the direction of Professor J.J. Patterson, a common curriculum for both architecture and architectural engineering programs was formed, with bifurcation at the sophomore year. However, in 1922, the curricula of architecture and architectural engineering programs differed, with no common year. It is worth mentioning that in 1914, the first two years of the program were common to all engineering fields, before branching into civil, architectural, mechanical, and electrical engineering.

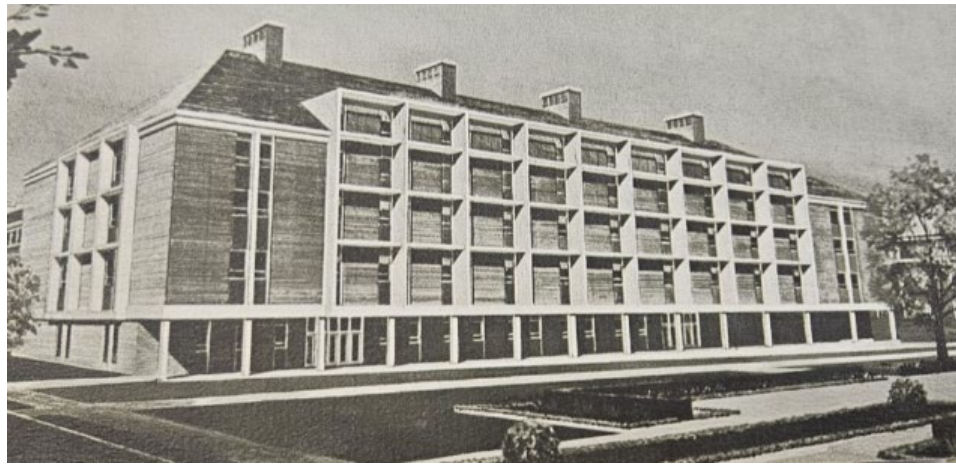
In 1970, the building that was originally constructed as a gymnasium and in support of the Reserve Officers Training Corps (ROTC), was reassigned to the school of architecture (SOA), with renovations being completed in 2009. The SOA also houses a library named after John Cunningham, who worked at OSU as a faculty for 39 years. From 2007 to 2009 the SOA had temporary studios located inside the Advanced Technology Research Center (ATRC) – a separate building near the SOA's current location. The AE program at OSU was first accredited by the Accreditation Board for Engineering and Technology (ABET) in October 1986, with its next accreditation visit in 2027. The undergraduate program in architecture has been accredited by the National Architectural Accrediting Board (NAAB) since 1951. Currently, the SOA has an undergraduate program in architecture, architectural design studies and architectural engineering (AE). The five-year NAAB-accredited Bachelor of Architecture degree allows graduating students to become licensed architects. Minors are available in the subjects of architecture and entrepreneurship, design, and history and theory. The undergraduate degree in AE is a 4.5-year ABET accredited program that allows students to choose between structural design and construction management. The AE curriculum includes courses in engineering and studio-based courses. The SOA also offers a 12-credit hour graduate certificate in integrative design of the building envelope.

3.2. Construction of the Engineering Building and development of the AE curriculum

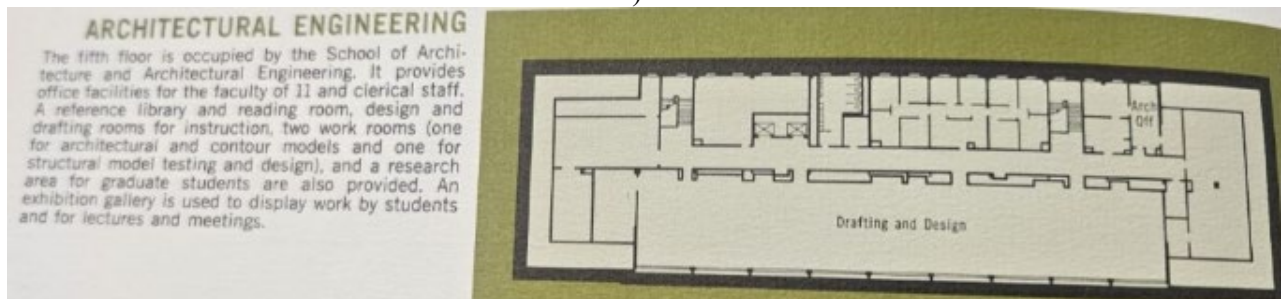
In 1912, all engineering fields, including civil, mechanical, architectural, and electrical engineering, were housed in the newly constructed engineering building containing classrooms, laboratories, and drafting rooms, whose construction was supervised by the then school of architecture head, Professor Etherton (Figure 2).



Figure 2. A mechanical drawing class being held in one of the rooms in the engineering building (image from [4])



a)



b)

Figure 3. Images of : a) Engineering North building at OSU; b) Architectural engineering department located on the 5th floor

In 1915, the engineering society was divided into four areas – civil, mechanical, architectural and electrical engineering. Figure 3 shows the engineering north building which housed the school of architecture on the fifth floor. An image showing the requirements of the architectural engineering undergraduate degree in 1971 is shown in Figure 4. In 1981, a proposal was developed and implemented thereafter, to reduce the duration of the architectural engineering program from 6 years to 5 years (Figure 5). This was found to be efficient and cost effective for architectural engineering graduates at OSU.

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Figure 4. Curriculum of AE at OSU in 1971

ARCHITECTURAL ENGINEERING ENVIRONMENTAL CONTROL			
Subject Area	Existing 6 Year	Proposed 5 Year	Comment
Design	36	34	Decrease of 2
Environmental Control	38	24	Decrease of 14
Structures	12	16	Increase of 4
Theory	14	15	Increase of 1
*Professional Electives	18	0-9	Decrease of 9-18
Art	6	3	Decrease of 3
Hum/Soc/Eng	21	15	Decrease of 6
Physical Sciences	16	16	---
Mathematics	13	13	---
**Controlled Electives	0	9-0	Increase of 9-0
Engineering Science	15	15	---
Other	3	3	---
	192	163	Decrease of 29

Figure 5. Proposed change to the duration of the architectural engineering program at OSU in 1981 [image from OSU's proposal to reorganize the architectural engineering program, published in 1981]

3.3. Recent developments in the Architectural Engineering program

More recently, the number of AE student enrollments has steadily increased at OSU (Figure 6). In 2025, there were 119 students in Spring compared to 100 in 2018 (19% increase). A slight decrease in enrollment in 2020 and 2021 is attributed to the Covid pandemic. Currently, 5 out of the 19 faculty members at the School of Architecture at SOA are AE faculty. Also, the 4.5-year undergraduate program in AE can be pursued with a focus on construction management (Figure 7) or structures (Figure 8). A wide range of required and elective courses are available for both specializations. For instance, the construction management specialization includes several elective courses such as: Estimating, Management of Architectural Practice and Project Engineering and Management. The structures focus includes electives such as prestressed concrete, advanced strength of materials and Steel III. Some of these electives are offered at the SOA, while some are offered by the School of Civil and Environmental Engineering. As the SOA has constantly grown through increased student enrolment and recent faculty recruitment, the number and variety of courses offered within the AE program has also increased. For instance, very recently a course on façade design was introduced, which has been well received by students of architecture and AE. With a gradual push for sustainable buildings, façade design is gaining importance in practice, as an emerging area within AE. This new course incorporates structural engineering and building science concepts applied to façade design, that an AE graduate can apply in practice. Similarly, a course on structural loadings is a recent addition for AE students at the SOA. Although most courses are offered by the school of architecture, a few courses are offered by other departments within the University. The courses include both classroom and studio-based learning, with many courses shared with students of architecture.

Enrollment Trends: Spring Semesters

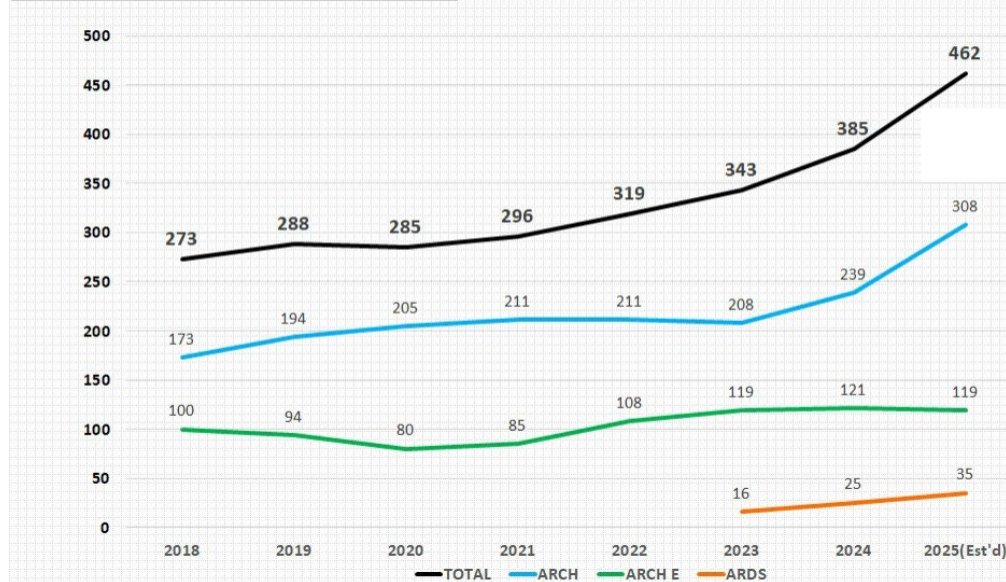


Figure 6. Recent enrollment trends in architectural engineering (ARCH E), architecture (ARCH) and architectural design studies (ARDS) in Spring semesters at OSU

Therefore, to summarize, the Architectural Engineering program at OSU:

- was established in 1908 through the efforts of Professor W.A. Etherton.
- had its first female graduate, Maude Spear in 1915, when most graduates at the time were male.
- under the direction of Professor J.J. Patterson, consisted of a common curriculum for both architecture and AE programs in 1917.
- had separate curricula for Architecture and AE, with no shared year remaining by 1922.
- was housed on the 5th floor of the Engineering North building, whose construction was supervised by Professor W.A. Etherton.
- reduced the duration of the AE program from 6 to 5 years in 1981.

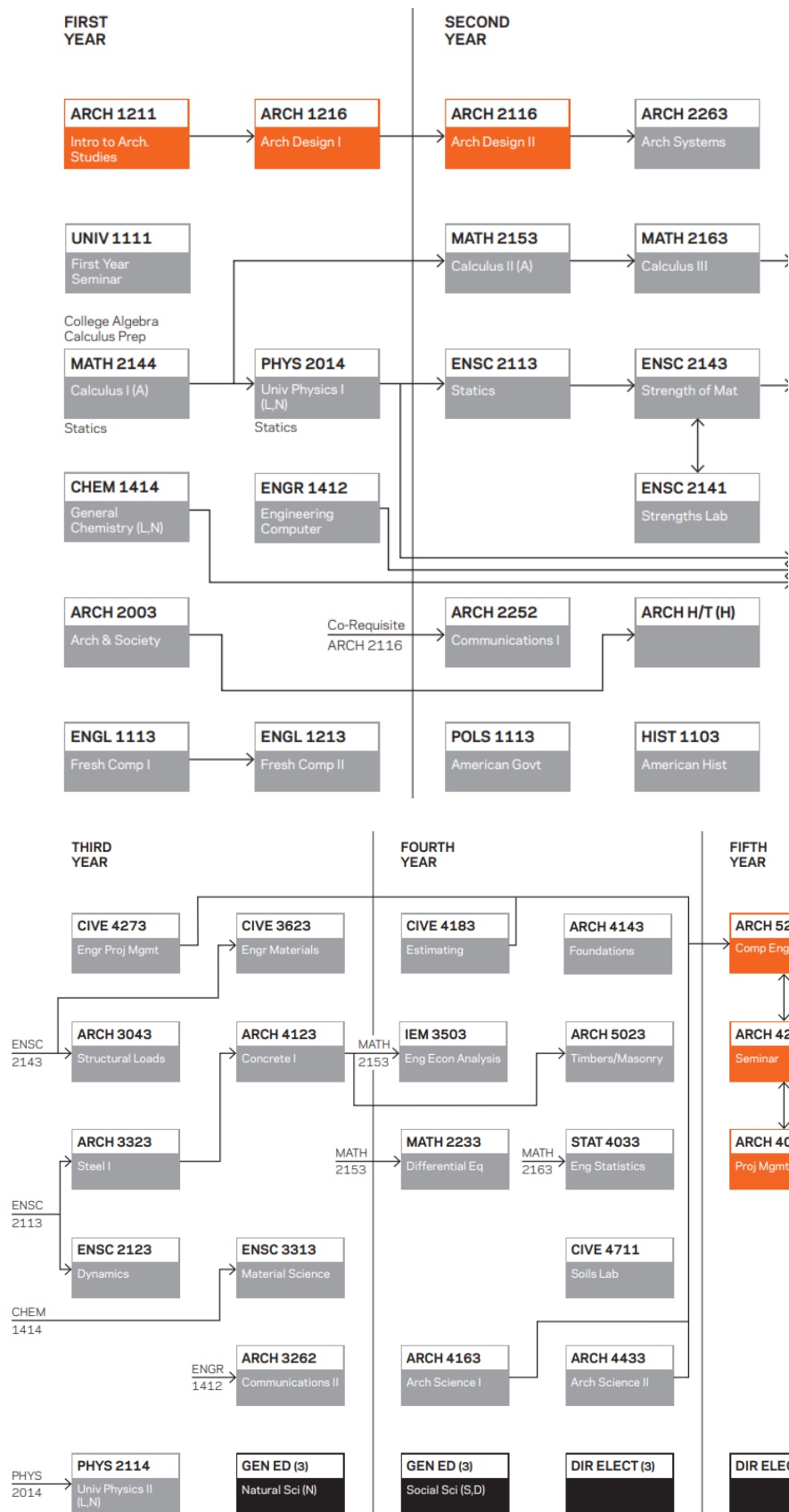


Figure 7. Undergraduate degree in AE focused on construction project management at SOA

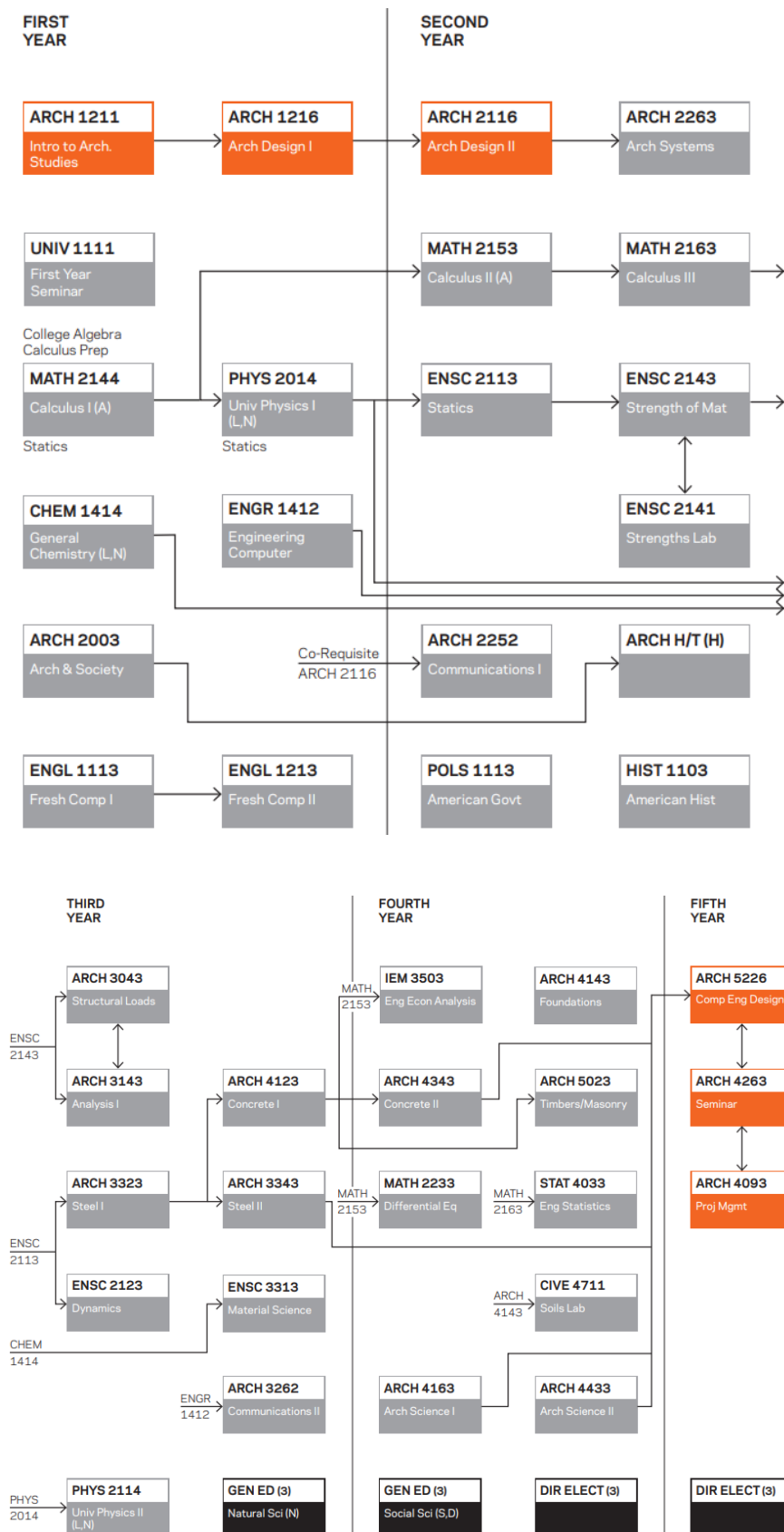


Figure 8. List of courses for the undergraduate degree in AE focused on Structures at SOA

4. Results and Discussion

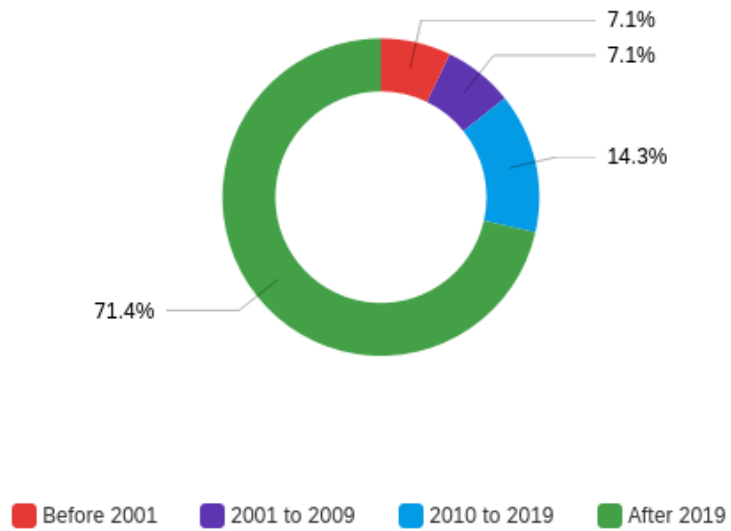
Results are presented in the form of pie charts, based on the responses received from the respondents as shown in Figures 9 and 10.

4.1. Responses from SOA's AE alumni

Figure 9 presents survey responses from 15 AE alumni, comprising 8 multiple-choice questions and an open-ended question. Typically, AE students graduate in Fall and Spring every year. For instance, since Fall 2015, 149 AE students graduated from the SOA, which is not a large number of students in the last 11 years, compared to other disciplines such as civil or mechanical engineering at OSU. Due to the difficulty in establishing contacts with AE alumni who are mostly working in the industry, only 15 respondents completed the survey. However, the authors will continue to reach out to alumni to obtain their feedback through the Qualtrics survey. Despite fewer respondents, the results provide an overview of their interest in the history of the AE program, besides offering suggestions on future improvement to the program as discussed further. The survey was conducted using the anonymized function of 'Qualtrics' software, without seeking personal information of each respondent to obtain unbiased responses. It must be mentioned that 3 out of the 15 responses were from faculty members at the SOA who are alumni of the AE program. The remaining 12 respondents are alumni currently serving the industry. Results show that most respondents (71.4%) were recent graduates (after 2019) of the AE program (Figure 9(a)), with most respondents focused on structures (Figure 9(b)). Although 64.3 % of the respondents were familiar with the history of the AE program (Figure 9(c)), most of them (78.6%) were interested in learning more about the program's history (Figure 9(g)) which is encouraging. The AE graduates acknowledged the program's contribution in enhancing student education (Figure 9(e)), in addition to observing changes in the program's curriculum in the recent times (Figure 9(d)). These positive changes, in addition to being part of student groups at OSU (Figure 9(h)) have clearly benefited students, faculty, industry and the community, as indicated by 64.3% of the respondents (Figure 9(f)). Student groups refer to several organizations run by students at OSU, where students get to establish professional connections and serve the community. The SOA supports a robust ecosystem of student organizations, including campus chapters of the Architectural Engineering Institute (AEI), the American Institute of Architecture Students (AIAS), and the National Organization of Minority Architecture Students (NOMAS). In addition, the school has established two signature student-led initiatives: Architecture Students Teaching Elementary Kids (ASTEK) and The Almighty She, supporting women in the design fields.

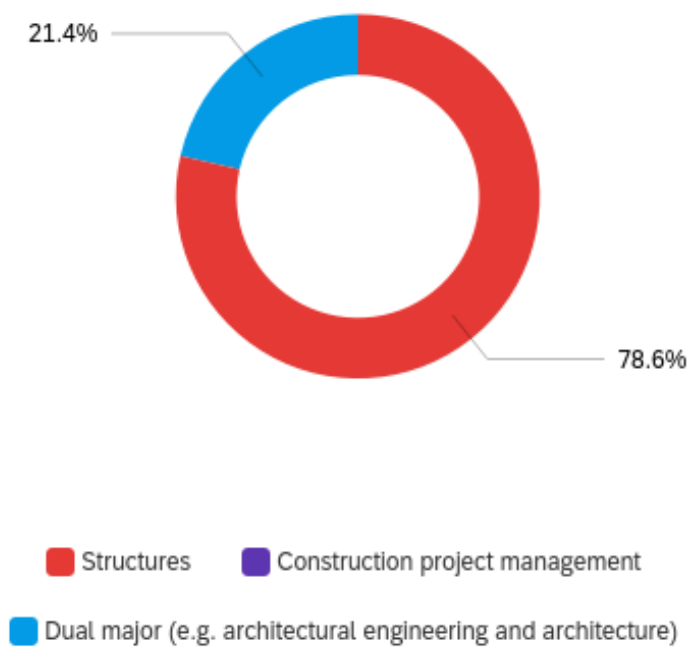
Although, future improvements are needed as indicated by some respondents who felt the need to have prior training in crafting, which would greatly assist with studio courses. Clearly, the results indicate that the AE program has evolved over time, providing high-quality student education and contributing to society. To learn more about the views of current AE students on the history of the AE program, a similar survey was conducted as discussed in the following section.

Q1 - What year did you graduate with an undergraduate degree in architectural engineering from OSU?



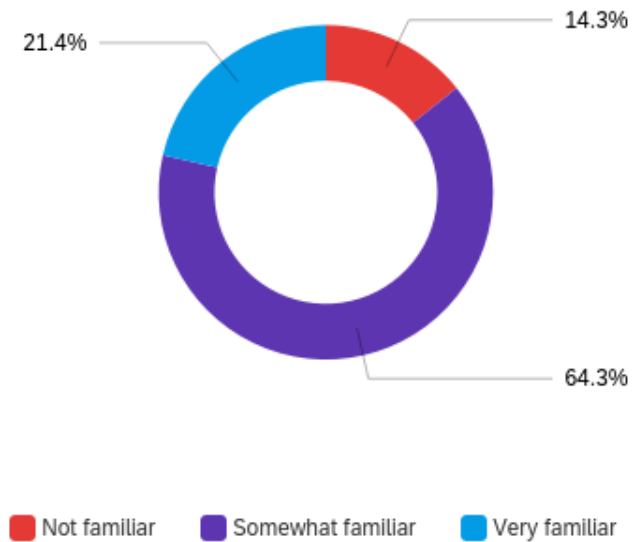
a)

Q2 - What was your area of focus within the program?



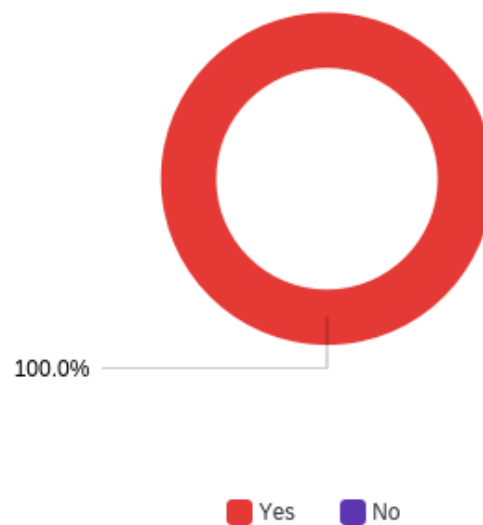
b)

Q3 - Were you familiar with the history of the architectural engineering program at OSU while you were a student?



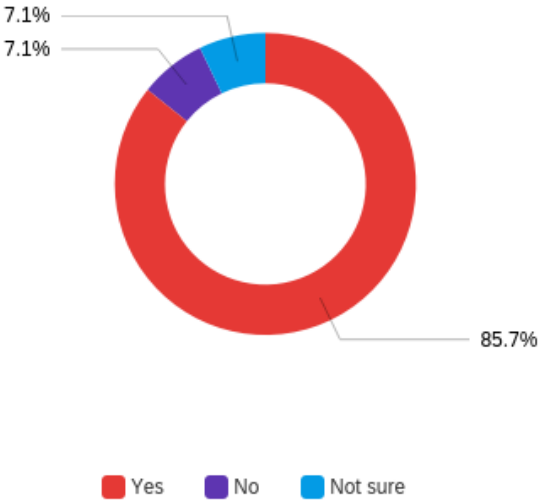
c)

Q4 - Since you graduated with an undergraduate degree in architectural engineering, have you observed any changes in program curriculum or leadership within the SOA?



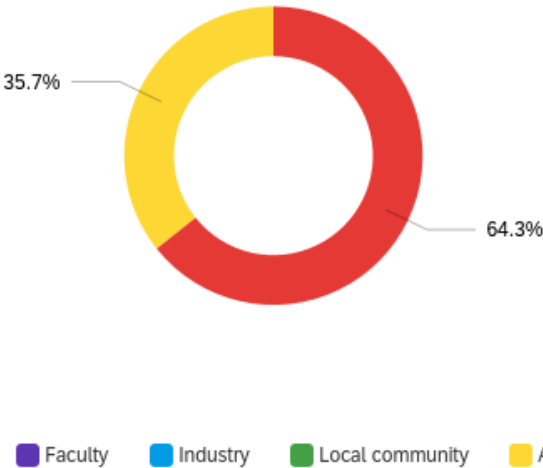
d)

Q5 - Do you think over the years, the architectural engineering program at the SOA has enhanced student learning in addition to establishing industry connections?



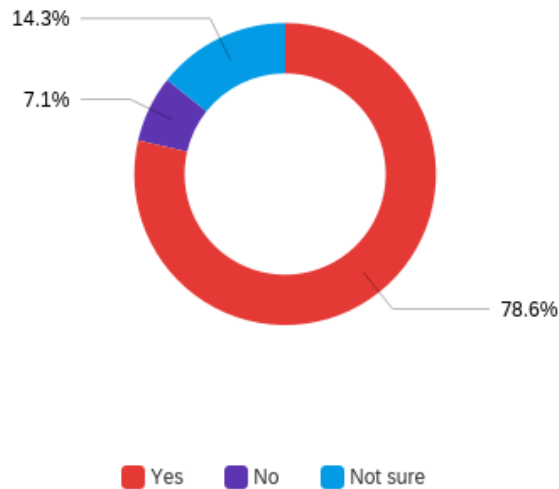
e)

Q6 - In your opinion, who has benefited the most from the architectural engineering program at OSU?



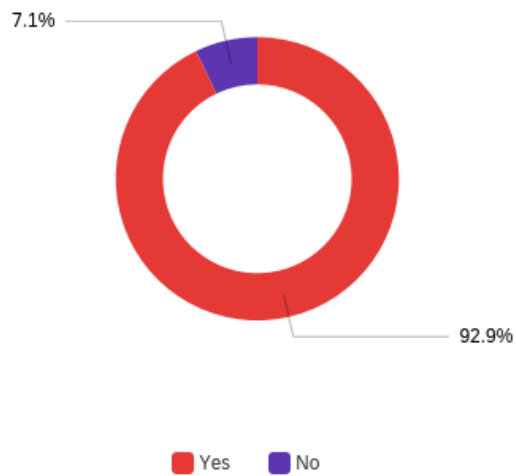
f)

Q7 - As an OSU alumni, are you interested in learning more about the history of the architectural engineering program at the SOA?



g)

Q8 - While you were a student at OSU, did you participate in any events/activities held within the SOA or participate in any student groups?



h)

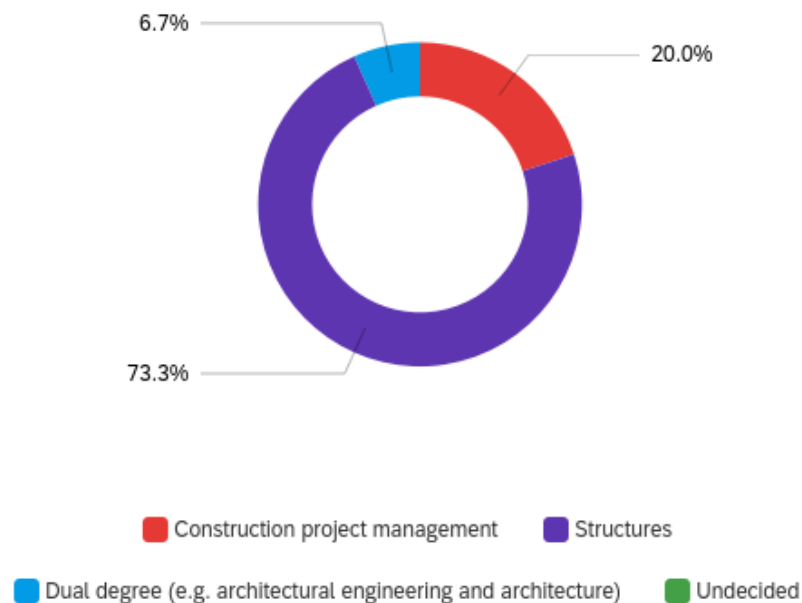
Figure 9. Survey responses from 15 OSU alumni.

4.2. Responses from current AE students

Responses were obtained from 45 current AE students at OSU. As shown in Figure 10(a), most respondents are currently pursuing their undergraduate degrees in architectural engineering with a focus on structures (73.3%), and about 6.7% of current student respondents are enrolled in a dual-

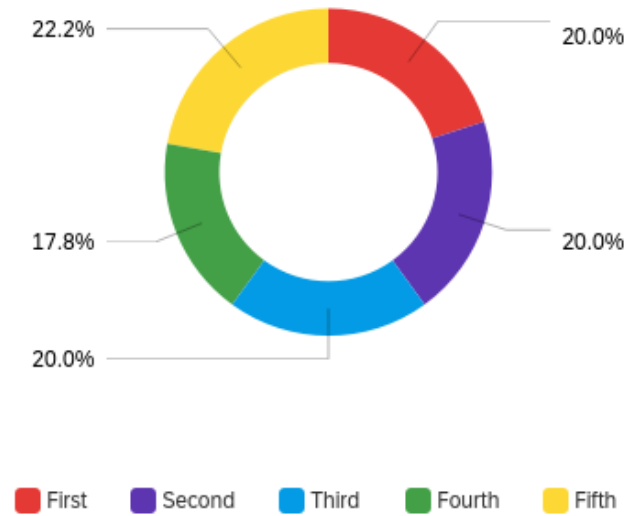
degree program (AE and architecture). While the students were found to be in different years of the AE program (Figure 10(b)), most of them (36.9%) had taken required and elective courses from the school of architecture and other departments (Figure 10(c)). This shows that current AE students are always willing to expand their knowledge beyond courses offered at the School of Architecture. Interestingly, the university website is an important source of information about the AE program for most respondents (Figure 10 (d)). While most students observed changes to the AE program over the years (Figure 10(f)), besides acknowledging the enhancement of their technical knowledge to benefit many (Figure 10(g)(h)), only 42.2% of them were somewhat familiar with the history of the AE program (Figure 10(e)). Therefore, 82.2% of the students expressed the need to learn more about the AE program (Figure 10(i)), mostly through visual tools and social media content (Figure 10(j)). Similar to the alumni, current students have also been part of several student groups (Figure 10(k)). The current students also suggested that a new course or a short seminar that includes the history of the AE program would be very helpful to learn more about the program's history.

Q1 - For the undergraduate degree, which option have you chosen?



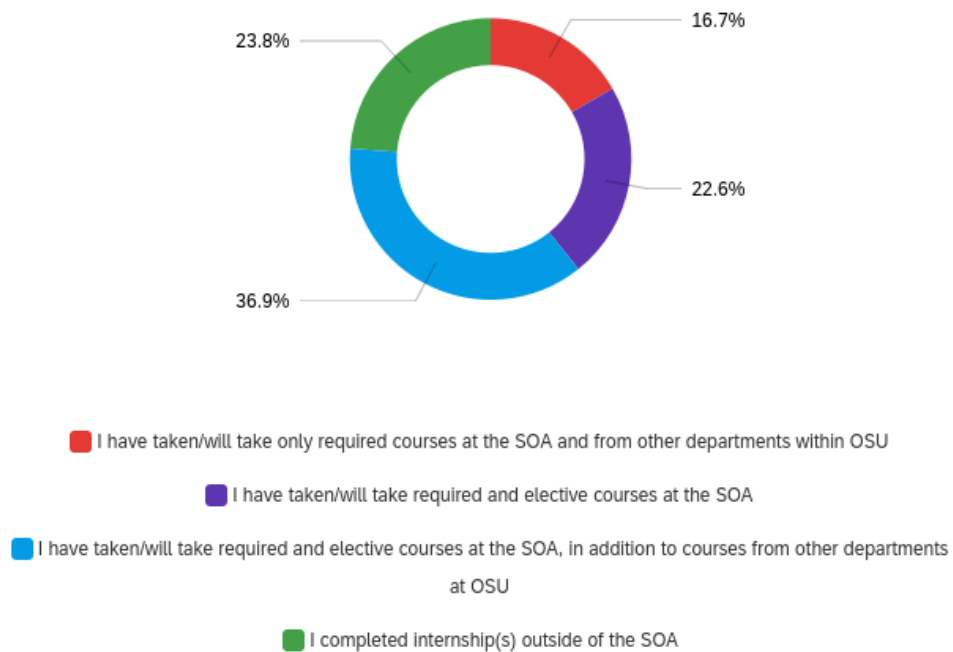
a)

Q2 - Which curriculum year are you within the program at the School of Architecture?



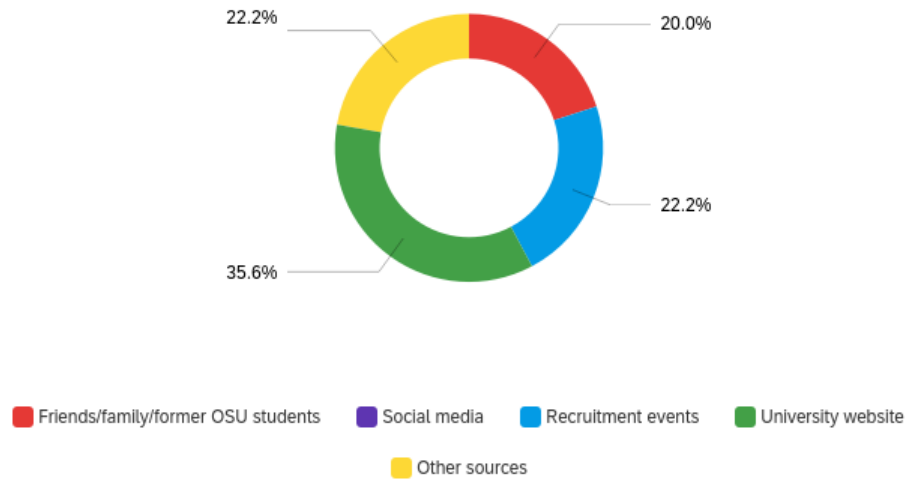
b)

Q3 - Which of the following best describes you (choose multiple options if needed).



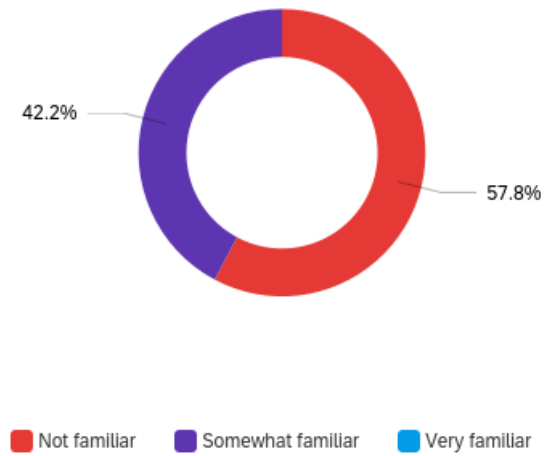
c)

Q4 - How did you first get to know about the undergraduate program in architectural engineering at OSU?



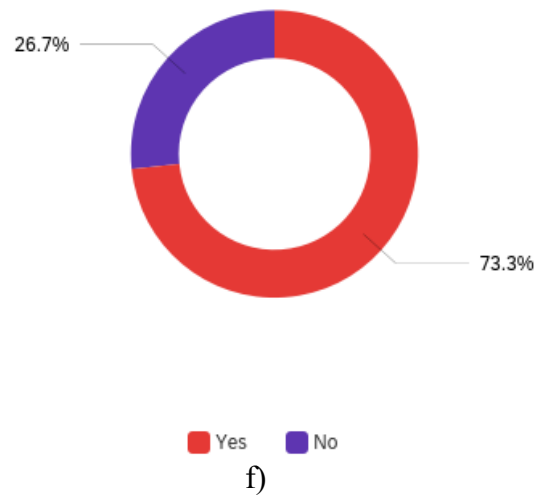
d)

Q5 - How familiar are you with the history of the architectural engineering program at OSU?

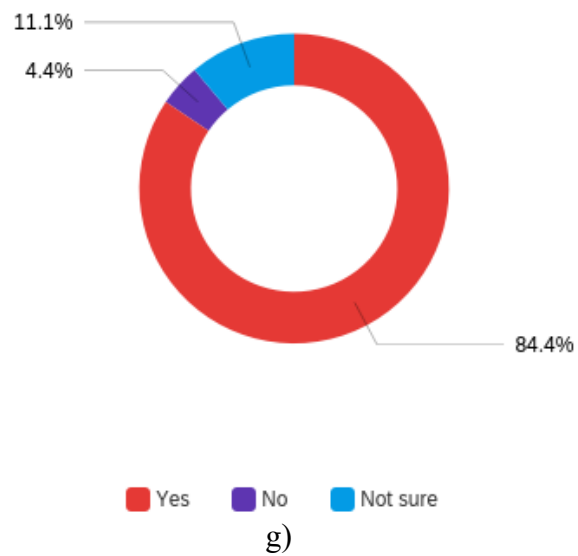


e)

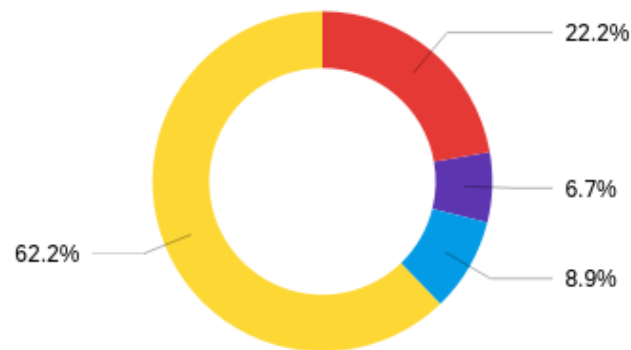
Q6 - So far, during your time as a student, have you observed any changes in program curriculum or leadership within the SOA?



Q7 - Do you think over the years, the architectural engineering program at the SOA has greatly enhanced your knowledge in this area?



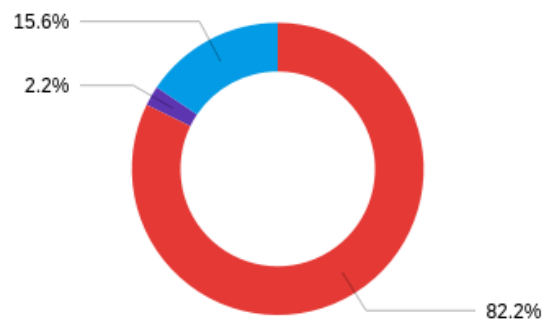
Q8 - In your opinion, who has benefited the most from the architectural engineering program at OSU?



Students Faculty Industry Local community All the above

h)

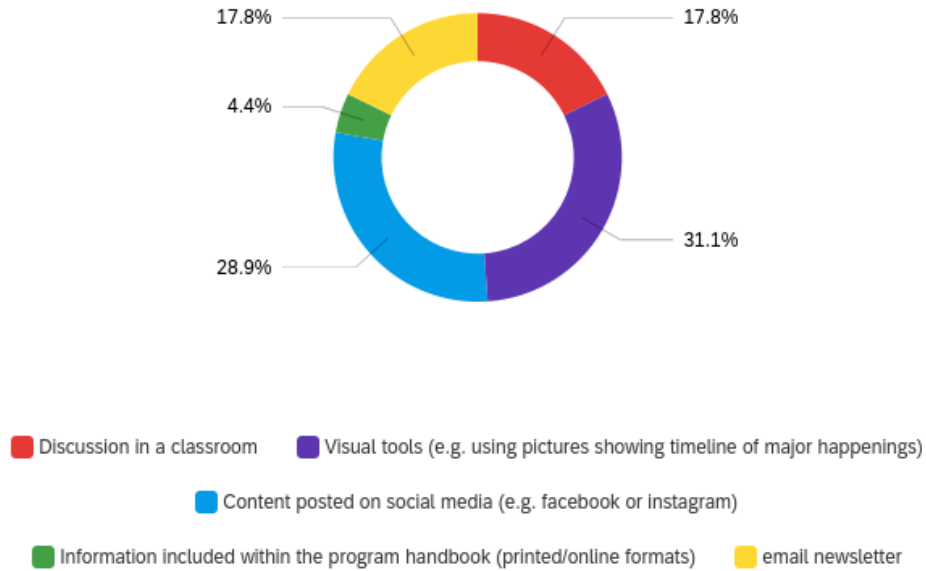
Q9 - Are you interested in learning more about the architectural engineering program at the SOA?



Yes No Not sure

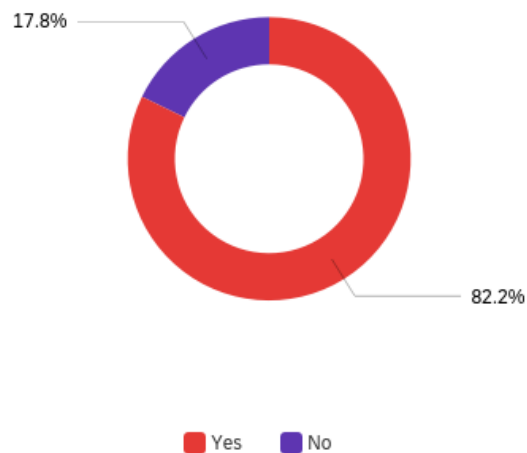
i)

Q10 - How would you like to learn about the history of the architectural engineering program at the SOA?



j)

Q11 - Did you participate in any events/activities held within the SOA or participate in any student groups?



k)

Figure 10. Survey results from 45 students currently enrolled in the AE program.

4.3. Further Discussion of survey results

The results of the surveys indicate a lack of knowledge about the AE program's history, despite strong interest in learning more about it. The AE program has been a tremendous contributor to

both current and past students through the variety of courses, interactions with industry professionals, and participation in educational events. Results show that content pertaining to the AE programs history posted on social media can reach a larger audience, allowing more prospective students to join the program. The knowledge of the history of the AE program at OSU helps understand the challenges faced by AE graduates and allows for future improvements and inclusion of new courses. Since its inception in 1908, the AE program has come a long way. Future work is underway to further improve the AE program and raise awareness of its origins, as discussed further.

4.4. Impact on Engineering Education and Scope for Future Work

The AE program has had a tremendous impact on engineering education. Graduates of the AE program:

- serve the AEC industry as engineers or project managers,
- comprise 4 out of the 5 faculty members at the School of Architecture,
- participate in national competitions such as Solar Decathlon,
- regularly present at symposiums within and outside of OSU,
- have used their connections to inspire other high school students to pursue a career in AE.

Based on the responses from the surveys, future work will:

- consist of providing more insight into the AE programs during visits by high school students wishing to pursue a degree in AE,
- consist of developing a short seminar for new undergraduate students in AE, to learn more about the program's history,
- focus on educating students on the AE program's history through social media content and email newsletters,
- include additional elective courses within the AE program,
- include additional training to improve crafting skills for AE students pursuing studio courses.

5. Conclusions

This paper traced the evolution of the Architectural Engineering (AE) program at OSU from its founding in 1908 to its current form. In its earliest period, AE students completed a shared foundational sequence before moving into AE-specific study, and by 1922 the AE and Architecture curricula had fully diverged. The program's history also reflects important milestones in access and participation, including the 1915 graduation of the first woman in AE at OSU, who also became the OSU School of Engineering's first female graduate. Today, the program spans 4.5 years and blends engineering coursework with studio, art, and history requirements, and the number of graduates has steadily grown over time. Survey responses from both current students and alumni indicate that the program has been academically and professionally beneficial, while also revealing strong interest in learning more about its history; future efforts will focus on creating seminar programming on program heritage and using feedback to guide continued curriculum improvement.

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- [2] Hajra, B., Phillips, J. J. (2024). Developing and introducing a new course on building façade design. In *June 2024 ASEE Annual Conference & Exposition, Portland, Oregon, USA*.
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