

## **WIP: Enhancing Freshman Seminars With Themes: An Architectural Engineering Approach**

### **Dr. Ryan Solnosky P.E., Pennsylvania State University**

Ryan Solnosky is an Associate Teaching Professor in the Department of Architectural Engineering at The Pennsylvania State University at University Park. Dr. Solnosky has taught courses for Architectural Engineering, Civil Engineering, and Pre-Major Freshman in Engineering. He received his integrated Bachelor of Architectural Engineering/Master of Architectural Engineering (BAE/MAE), and PhD. degrees in architectural engineering from The Pennsylvania State University. Dr. Solnosky is also a licensed Professional Engineer in PA. Ryan's research interests include: integrated structural design methodologies and processes; Innovative methods for enhancing engineering education; and high performing wall enclosures. These three areas look towards the next generation of building engineering, including how systems are selected, configured and designed.

### **Prof. M. Kevin Parfitt, Pennsylvania State University**

M. Kevin Parfitt is an award winning teacher in the Department of Architectural Engineering at Penn State. He has over 38 years experience teaching courses ranging from Freshman Seminar to the 5th-Year Senior Thesis (Capstone experience). He is also the AE faculty coordinator for the annual AE Career Fair and student placement related activities. Creating a link between his courses and industry experts and mentors is one of his signature activities.

### **Dr. Sez Atamturktur Ph.D., Pennsylvania State University**

Dr. Sez Atamturktur is the Harry and Arlene Schell Professor and Department Head of Architectural Engineering at The Pennsylvania State University. Previously, she served as Associate Vice President for Research Development and Provost's Distinguished Professor at Clemson University. Dr. Atamturktur's research, which focuses on uncertainty quantification in scientific computing, has been documented in over 100 peer-reviewed publications in some of the finest engineering science journals and proceedings. Dr. Atamturktur's research has received funding from several federal agencies including the National Science Foundation, the U.S. Department of Energy, the Department of the Interior, the Department of Transportation, the Department of Education, and the Los Alamos National Laboratory, as well as industry organizations and partners, such as the National Masonry Concrete Association and Nucor. She served as the director of the National Science Foundation-funded Tigers ADVANCE project, which focuses on improving the status of women and minority faculty at Clemson. Previously, Dr. Atamturktur was the director of the National Science Foundation-funded National Research Traineeship project at Clemson, with funding for over 30 doctoral students and a goal of initiating a new degree program on scientific computing and data analytics for resilient infrastructure systems. In addition, Dr. Atamturktur was the director of two separate Department of Education-funded Graduate Assistantships in Areas of National Need projects that each provided funding for 10 doctoral students. Dr. Atamturktur served as one of the four co-directors of Clemson's Center of Excellence in Next Generation Computing and Creativity. Prior to joining Clemson University, Dr. Atamturktur served as an LTV technical staff member at Los Alamos National Laboratory.

### **Prof. Moses Ling P.E., Pennsylvania State University**

# **Work in Progress: Enhancing Freshman Seminars with Themes: An Architectural Engineering Approach**

## **Abstract**

This article presents the development, implementation, and early results of a revitalization effort for engineering first-year seminar (FYS) classes offered by the Architectural Engineering (AE) Department at The Pennsylvania State University. At our university, based on a faculty senate resolution, all students must take a 1-credit FYS in their first year. FYS courses at Penn State are intended to help students develop good study habits; introduce students to Penn State and their intended major of study; and help them develop relationships with faculty and other students, especially those in their freshman peer group. For the past decade, the AE department has offered two sections of FYS every Fall semester. This course offered a somewhat traditional passive classroom environment and was not always very successful in meeting our goals and assisting with student retention in the program. Topical content was very traditional and centered around very standard and generic lessons regarding what the AE profession does. Course material was inconsistent and varied between sections based on the discipline of the course instructor. Instructors without industry experience or multidisciplinary backgrounds sometimes struggled to provide a comprehensive view of AE to the students, which resulted in widely varying student satisfaction ratings.

In Fall 2019, the AE Department initiated an effort to revitalize the FYS course to be more current in its topical coverage, active and engaging in its content delivery while at the same time maintaining standard university educational goals and requirements for first year students. Further, this new initiative was formulated to ensure consistency of goals and objectives between various sections of the same course without necessarily providing an exact duplicate of content. In other words, basic requirements were specified to ensure students experienced a consistent educational outcome regardless of the course instructor, but each section or instructor was given freedom to introduce or host special topics or “mini-themes” to add interest, take advantage of current events or emerging industry topics and to better align with the instructor’s background and experience.

## **Introduction**

First-year seminar (FYS) courses at Penn State University are intended to help students develop university level study habits; introduce students to Penn State’s campus and their intended major of study; acquaint students with learning resources; and familiarize students to the university community and help them develop relations with faculty and other students. The FYS offered by Penn State’s Architectural Engineering (AE) Department, has the potential to help engineering students build interest in AE and encourage them to pursue careers dedicated to engineering better buildings. Beyond career selection and regardless of which discipline the engineering student decides to major in, any College of Engineering student in AE 124 would benefit from gaining an appreciation of the role buildings play in improving the human condition and orienting them toward engineering for long-term positive societal benefit.

The revitalization efforts focused around three basic groups or modules of materials. The first is aligning the content and materials to support the university requirements of ethics, academic and personal success, and work habits while in college. The second focus is on helping

students develop the social support networks by connecting to faculty, to other students and with the physical campus itself. The third is providing an exposure to the AE major (including curriculum) and the profession by relaying what their career opportunities and focus could be through themed mini-experiences, hands on when possible (e.g., construction robotics, why buildings fail?, etc.). The outcomes to date which are discussed in this paper revolve around two primary categories. The first is how the FYS was structured to align with the university requirements for a FYS course while tying in customized or active learning to create central AE themes both individually in a section and in cross connecting multiple sections when appropriate. The second point of discussion centers on current documented trends in student perceptions of the course to date. Topics such as: site tours of campus construction projects, campus scavenger hunts, themed hands on activities, and strategies for academic and career planning will be used to highlight student engagement and course improvements.

### **Summary of Related Literature**

A consistent factor that influences learning is the powerful impact of engagement, defined as the level at which students invest physical, psychological, emotional, and intellectual energy in educationally related activities [1]. Successful engagement early in a student's course of study is critical as early engagement is sometimes insufficient at large universities, where students do not normally feel "belonged" early due to large class sizes or lack of interaction among students for a variety of reasons [2]. FYS classes have a statistically significant and positive influence on retention and subsequent achievement [3]. A way to start to cultivate this engagement and sense of belonging is through FYS style classes [4]. FYS courses are often viewed as a way to increase students' faculty and peer interactions and academic engagement [5]. Padgett et al. [6] further found that FYS can cultivate lifelong learning and an increase in an individual's desire to engage and seek out areas of interest. Porter and Swing [7] made a case for support of FYS as valued instructional vehicles for cultivating intellectual developmental objectives for undergraduates. Additionally, Pascarella and Terenzini [3] found that FYS contributed significantly to increasing persistence and retention among students.

To assist in keeping students engaged and avoiding passive lecture settings, a variety of active learning education theories are possible fits for FYS. A possible learning theory relevant to FYS is Kolb's model [8]. Specifically for FYS, Kolb's concrete experience and active experimentation stages are best suited [9]. Keeping within Kolb's theory, and to promote active lecturing, engaging activities were implemented from various active learning domains. These activities took the form of brainstorming, case study reflections, scavenger hunts, think-pair shares, etc. We also wish to maintain and build a sense of community within the students that leads to social networking development [10]. Within this social knowledge network, as soon as students begin to interact, they change one another's perspective and context. The strength of these types of social systems is in their ability to enable creativity and adaptability as new experiences are created [11]. An additional aspect of grouping distinct requirements to experiences that are required of our FYS, scenario-based learning provides an avenue to organize our lectures around key concepts or "big ideas" that exposes students to AE concepts within a relevant theme [12,13]. Cech [14] found that when modules are structured correctly, students engage more deeply in the content in a way that advances their skills at a faster rate. In light of these demonstrated traits in literature as shown to be successful in other FYS and freshman courses,

active learning strategies will be coupled with scenario- or module-based learning in the proposed AE FYS development.

### **Freshman Seminar Objectives at the Institution and Department Level**

At Penn State, the requirement for the university to have all students participate in a First-Year Seminar (FYS) was established in 1998. The Faculty Senate established the FYS with the thinking that the University “needed to do a better job of engaging our incoming students, quickly and deliberately, in the educational enterprise.” In addition to institution level requirements, the department looked at what they wanted to achieve within permitted boundaries in terms of showcasing the AE major and career paths. As such, two goals and six objectives were established that AE FYS courses needed to achieve to satisfy both institutional and department.

#### **Institution Goals:**

1. Engage students in learning and orient them to the scholarly community from the outset of their undergraduate studies in a way that will bridge to later experiences in their chosen majors, and
2. Facilitate students’ adjustment to the high expectations, demanding workload, increased liberties, and other aspects of the transition to college life.

#### **Merged Institution and Department Objectives:**

1. To introduce students to university study and cultivate best practices for success,
2. To introduce students to Penn State as an academic community and their responsibilities,
3. To acquaint students with the learning tools and resources available,
4. To provide an opportunity for students to develop relationships with full-time faculty and other students in an academic area of interest to them,
5. To excite students about the building industry with its vague coverage of field and emerging trends, and
6. To expose students to the various career paths and options within AE that they may want to focus on.

### **Development of the AE FYS Framework**

Using the field of architectural engineering as a central point to leverage collaboration, a revitalization of the AE FYS to meet both university and department goals was possible. The new FYS structure established a new responsive, replicable, and theoretically-informed approach by following the guidelines listed below:

1. Meet the goals put forth by the faculty senate for the FYS experience in preparing students for university study;
2. Establish shared learning objectives across all sections of AE FYS that effectively reflect architectural engineering career and professional development opportunities for current and future generations of students;
3. Provide a common core across AE FYS offerings, ensuring consistency in the way students are introduced to the architectural engineering discipline;
4. Establish a mechanism through which structured, yet customizable, learning modules can be developed and incorporated by AE faculty; and

5. Develop a set of shared programmatic and curricular deployment and evaluation guidelines with associated instruments.

Through active learning strategies, AE's FYS was structured to engage students and orient them to the AE department and university community, all while facilitating students' adjustment to the high expectations, demanding workload, and other aspects of the transition to college life. Three distinct modules of the FYS course were developed to meet all the objectives. They are:

- **Building Technical Content Module:** AE common technical areas and interdisciplinary integration to showcase the major.
- **Building Professional Module:** Building careers (AE curriculum; career fair); building students (goal setting, ethics, and time management/study habits); building campus connections (connecting with students and faculty).
- **Building Interest Module:** Engaging AE focused themes and mini-themes that permits a deeper exploration into areas of AE.

Each of these three modules can be tied to university requirements. The formulation is described in the following sub-sections of this paper. For all AE FYS sections, the proposed curriculum must include all three of these modules, each accounting for approximately 1/3<sup>rd</sup> (5 weeks) of the semester. There does exist some overlap and dual-purpose content across modules depending on the theme and the particular lesson. Each of these three core modules have active learning content that goes beyond in-class lecturing. As noted, while module content is grouped together here, some topics may be mixed (in their order) to maximize events, have dual-purpose applications across categories, and utilize other opportunities on campus.

#### *Technical Content Module*

This module's intent is to provide an overview technical based introduction to each of the four AE sub-disciplines (e.g., mechanical, lighting/electrical, structural, and construction) as well as the many sub-disciplines (acoustics, energy, real estate, forensics etc.). Based on content, Objectives 2 and 4 are primarily satisfied in this module. For Objective 4, students begin to learn about disciplines, faculty expertise, and industry opportunities. With Objective 2, the focus is on the part of introducing the curriculum and field of study. Discussions focus on integration and the interdependencies between them (and the reality that they cannot be isolated in their design and construction activities). The truly interdisciplinary nature of the AE discipline is reinforced with a review of the Architectural Engineering Institute (AEI) International Design Competition teams' presentations. To fully immerse students in the building industry and provide an active learning component, one or more site tours of an actual active construction site is provided (usually including a lecture on the project by the industry professionals involved) that is located on or adjacent to campus.

#### *Building Professional Module*

In the in the Professional Module, AE students will be guided through lectures and activities on: career success including professional development and career options; academic success and connections with campus. Objectives 2 and 4 have some overlap contributions here.

This module includes resume preparation, professional social media (i.e. LinkedIn networking), and interview skills. Discussions related to effectively navigating career fairs, attending actual career fairs when feasible, and internship interviews, are included. University Objectives 1 and 5 focusing on study, learning tools and resources are met in this module. To achieve this, discussions, case studies and activities on academic integrity, effective studying strategies, and extracurricular best practices will be presented. For Objective 3, a portion of this module walks students through planning their academic experience and curriculum needs by looking at how classes flow, pre-requisites, scheduling opportunities for minor, certificates, and study abroad. Another attribute that is built into this module is developing students' mindsets and work attitudes toward the time intensive, team-driven, and demanding higher education environment in which Penn State AE students immerse themselves. Students also explore the degree program by attending a major night evening social where students and clubs talk as well as a faculty spotlight night where faculty showcase research and their specialty interest areas.

### *Building Interest Module*

To engage the students in an AE experience that is a subset of the major or an emerging industry topic, a themed approach and experience was conceived such that students are able to gain exposure to engaging, innovative, and relatable aspects of AE before any technical classes in the major were undertaken. Themes were defined to be building industry focused and worked towards engagement and excitement for freshman while also providing a snapshot into what an AE career is to aid in making their major selection. An intent of this module is retention and engagement but also is directed at discovery since AE is not a well-exposed program to freshman within the College. Hands-on creative learning was required as a desirable component in developing these engagement themes. Themes and mini-themes to date have included:

- Stadium design
- AE applications of 3D printing
- Construction robotics
- Lego architecture
- Engineering a campus: Penn State Buildings (The campus is your lab)
- Greatest Building Failures of All Time (forensics)
- Extreme Buildings: Designing the seemingly Impossible

### **Pilot Delivery To-Date**

The Pilot AE FYS delivery started in Fall 2019 and is continuing through Spring 2021. In each given academic year, seven sections were offered, 5 in the fall and 2 in the spring. The 5-2 split is based on the timeframe that best fits with engineering student scheduling who are required to take a FYS course. In the 2019-2020 offering, a total of 142 students were enrolled. The largest section had 25 students while the smallest had 22. In the 2020-2021 offering, a total of 152 students were enrolled. The largest section had 23 students while the smallest had 12.

In Year 1 of the pilot (2019-2020), each of the course sections taught each of the three modules in a somewhat self-contained fashion by moving from one topic to the next, although as previously noted there are topical overlaps and some lessons such as field trips and lab experiments were woven into available facility schedules. All topics in Year 1 remained with the AE focus. In Year 2, due to COVID limiting hand-on learning and due to mixed mode, the three

modules were more interwoven with one another mixing the content from class to class to provide a less segmented feel. This was partially due to student feedback but also worked well with the series of guest lecturers each section implemented.

In adopting the themed approach, the following themes were tried the first year: stadium design (1 sect.), AE applications of 3D printing (1 sect.), construction robotics (1 sect.), Lego architecture (1 sect.), and Greatest Building Failures of All Time (1 sect.). In continuing the themed approach, the following themes were tried the second year: Engineering a campus: Penn State buildings (3 sect.), Greatest Building Failures of All Time (2 sect.), and Extreme Buildings: Designing the seemingly Impossible (2 sect.). Themed experiences remained in Year 2, but they were much more integrated with the other topics for flow, continuity and student interest. For example, the faculty would make an assignment as an offshoot of a guest speaker lecture on The Future of Sports Facilities with an assignment or discussion of a non-traditional career path demonstrated by the speaker. Instead of researching random firms and developing connections at career fairs, students would link theme guest speakers and their companies or their interest in one of the mini themes in these career connection talks to better reinforce the experience.

### **COVID Impacts**

COVID posed limitations on 2020-2021 plans for active hands-on building, testing, and student tour visits to active construction sites and a full group tour to Frank Lloyd Wright's Fallingwater. Spring 2020 students seemed to like the content in Year 1 (even during shutdown) but were disappointed when the hands-on building site tours (scheduled for after spring break) were canceled due to University and State Government mandates and requirements. Social distancing and safety concerns effectively prohibited group-based lab builds and testing as they required close proximity construction tasks in somewhat limited physical spaces. In addition, site tours were planned for campus buildings under construction but had been halted by the University's risk management and legal teams. Most events were not eliminated from the course but were either altered or reasonable alternatives were implemented. In working with industry firms and AE alumni, we were able to provide virtual tours and site visits to round out those topics. Faculty are trying "just-in-time" modifications to give the most meaningful experience. A positive outcome, resulting from more virtual guest speakers and faculty spotlight connections that worked well with the integration and innovation theme topics, resulted in successful course offerings which was confirmed by student ratings and feedback.

### **Student and Faculty Perceptions to Date**

During Year 1 and 2, student surveys in the form of end-of-year course evaluations were distributed to the students to complete. The anonymous volunteer data was collected with open-ended free responses. These responses along with faculty debriefing sessions notes have been summarized and presented here. Perceptions to date based on student feedback indicate that we are on the right track by using case study / industry-based themes and mini themes.

Casual observations by faculty are showing that students do not seem to be overly attached to a particular theme topic other than it is related to Architectural Engineering practice. The themes make them feel that they are getting a "course in their major" during their freshman year compared to a heavy slate of math, physics, chemistry where there is only one other engineering course. It appears that any theme related to the building industry is new and informative to the students if well managed. Tying the themes back to what a student might do in

practice is important to the students. New and emerging topics need to be reinforced in the class and introducing industry practitioners who bring in case studies on related topics and practice areas is proving successful. Supplementing the themes with hands-on activities is very well received although due to COVID much of this was replaced by virtual activities. A caution of the hands-on activities is time management and student skills. An example with the 3D printing modules was that the builds themselves take considerable time on the machines and that students were not familiar with the software and needed training that wasn't anticipated. Another example was in the forensics theme, students built wood trusses. Faculty initially assumed more students were familiar with basic wood shop skills (like using tools) from Middle and High School settings but about 50% never had that exposure. Just-in-time modifications with Teaching Assistant (TA) support aiding in educating those practices were needed.

In Fall 2020, one section of AE 124 was designated as remote only for students who were not on campus. The same instructor taught a second mixed-mode section for on-campus students. Unfortunately, the number of students impacted by the pandemic, either directly or indirectly, made it necessary to hold all but one class remotely as well. Even so, the student evaluation of teaching effectiveness (SRTE) indicated up to a one-point variant between on-campus and at-home students, from 7/7 to 6/7. The only significant difference between the two sections is the ability for students to visit the building site independently, most likely in groups. At-home students were provided photos of the buildings to replicate the experience. The open-ended questions confirmed this out as well. One student wrote "the only change would be to visit the new and old buildings on campus". The student comments reinforced the notion that first-year students long for connection with faculty, students and campus.

Another observation was the need to clarify some basic concepts. Alumni and professional presentations were sometimes at a level above the comprehension of a recent high-school graduate. After an initial period, guest speakers were specifically guided on this fact in terms of their use of terminology and making sure that ample time was provided for clarification questions from the students. In addition, the instructors must be mindful to help translate the concepts for first-year students' consumption. Creating a balance between gaining basic understanding and realizing the depth of expertise involved is a delicate and necessary task. These opportunities may promote self-directed learning and significantly stimulate curiosity. Relative to this discussion, it was found that on certain topics, a good approach was to provide a degree of self-study or topic introduction prior to the guest speaker. For example, a self-study module on the history of high-rise buildings was provided before a guest speaker provided a case study of "super slender" buildings in New York City.

### **Next Steps and Future Work**

Knowing the current success of the re-envisioned AE 124 FYS course, the next steps are twofold. The first is to continue to refine the hands on aspect of FYS and how to best structure those activities as we only had one semester to pilot those before COVID and there was varying amounts of success. Concurrently with this step, we have standardized the material development but have yet to test its success in faculty handover for other faculty to adopt. For the second component of continued work, we have collected other pre- and post- data relative to student interests in AE and their understanding of what is AE. We plan to review this data more comprehensively determine the impact that the FYS had on solidifying an understanding of what AE is but also their interest level in AE and how the course played a role in their interests.



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