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# IMPLEMENTING HANDS-ON TINY HOUSE DESIGN AND CONSTRUCTION FOR BUILDING SCIENCE AND ARCHITECTURE STUDENTS



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## **Implementing Hands-On Tiny House Design and Construction for Building Science and Architecture Students**

### **Synopsis:**

An elective course was offered in Spring, 2018 at Auburn University titled “Special Problems-Tiny Houses.” This course met for 2.5 hours, once a week and incorporated lecture, research, hands-on construction activities, and a field trip centered around tiny home design and construction. Enrollment in the Spring, 2018 course consisted of 11 architecture students and 3 building construction students. Results of a survey administered at the end of the course indicated that hands-on construction activities were the most effective component of the course. Though the results are representative of the entire population of the course, they may not be statistically sound due to the small survey population. Future research will seek to administer this survey to future classes in order to increase the survey population.

# **Implementing Hands-On Tiny House Design and Construction for Building Science and Architecture Students**

## **Introduction and Background**

Many Construction Management (CM) courses utilize hands-on exercises to reinforce concepts. These exercises have been effective at reinforcing various CM principles (Collins and Redden, 2017; Sattineni and Williams, 2008; Mills et al., 2010) while proving enjoyable for students (Stein and Gotts, 2001). Additionally, collaboration skills are important for architecture, engineering, and construction graduates. Research indicates that collaboration between multidisciplinary teams is becoming standard practice in the architecture, engineering, and construction (AEC) industry but educational models have been slow to adjust (O'Brien et al., 2003). An elective course at Auburn University has been developed to increase interdisciplinary collaboration between architecture and building construction students. A pilot course was taught in Fall 2017 and adjustments were made based on student feedback before the course was taught again in Spring 2018.

## **Literature Review**

Hands-on projects are effective in teaching and reinforcing Science Technology Engineering and Mathematics (STEM) principles. Many university courses in STEM programs, particularly in Construction Management (CM) programs, utilize experiential learning, hands-on activities or lab exercises to supplement various courses. Hands-on class or lab sections are typically where construction students first learn construction concepts through experiential learning (Glick et al., 2010) which provide students with a more intuitive sense for potential construction issues (Hubbard and Hubbard, 2009). Additionally, hands-on activities have proven effective at teaching and reinforcing learning outcomes for construction students. Collins and Redden (2017) describes a hand-on exercise completed in an construction management estimating course. Statistical analysis of pre and post-exercise surveys showed that completion of the exercise itself (including post-exercise analysis with the students) facilitated the achievement of course objectives, and assisted students in understanding where deficiencies existed in their estimating abilities. Other studies (Sattineni and Williams, 2008; Mills et al., 2010) also suggest that the best way to deliver theoretical and practical knowledge needed for construction and project management graduates is through hands-on exercises. Not surprisingly, the literature also suggests that construction students tend to prefer hands-on activities over traditional lecture classes. Stein and Gotts (2001) surveyed seventy-three undergraduate CM students at a Midwestern university to evaluate preferred student learning environments, among other variables. Students were asked to rank a series of statements on a Likert scale of 1-5, with 1 representing strongly agree and 5 representing strongly disagree. A vast majority of the respondents (97.2%) strongly agreed or agreed with the statement that read, "I enjoy hands-on lab work as a means to learning in construction management courses."

Many programs and colleges afford the opportunity for collaboration between students in related fields but not all programs take advantage of this opportunity. Collaboration skills are especially important for architecture, engineering, and construction graduates. The construction industry is one that is collaborative in nature and individual workers need to learn how to collaborate (Creasey, 2013). O'Brien et al. (2003) notes that collaboration between geographically distributed, multidisciplinary teams is becoming standard practice in the architecture, engineering, and construction (AEC) industry but educational models in AEC have been slow to adjust to this rapid shift in project organization. Most students in these fields spend the majority of their college years working on individual projects that do not build teamwork or communication skills (O'Brien et al., 2003). Collaboration between architecture and construction students could take many forms from a single lab exercise to an entire class. Incorporating a collaborative hands-on elective class into a building construction and/or architecture curriculum could prove beneficial on many levels.

### **Course Details**

An elective course titled BSCI 4960/5960: "Special Problems in Construction" was taught in the Fall Semester, 2017, at Auburn University. Though the course was open to students across campus and publicized to building construction and architecture students, final enrollment of the course consisted of 29 building construction students. An unofficial survey was given to the Fall 2017 students to gather feedback and make improvements to course which was offered again in Spring 2018. The most notable change or improvement made based on student feedback and instructor perception was class size. A cap of 15 students was placed on the Spring 2018 class to ensure students could work on the project simultaneously without crowding each other.

The Spring 2018 course consisted of 11 architecture students and 3 building construction students. This course met for 2.5 hours a day, one day a week, and incorporated instructor lectures, guest lectures, research and reading assignments, design activities, hands-on construction activities, and a field trip to the Georgia Tiny House Festival in Atlanta, Georgia. Additionally, the OSHA 10-hr course was taught for the students enrolled who did not previously hold a 10-hr or 30-hr OSHA card.

### **Objectives and Methodology**

The objectives of this research were:

- Evaluate student perceived effectiveness of the following activities, exercises, and components of the course using a combination of Likert scale and open-ended response for each:
  - a. Construction processes and procedures
  - b. Architecture and design
  - c. Tiny homes and the tiny home movement

- Evaluate student perceived relative effectiveness of specific activities, exercises, and components of the course by ranking them in order of most effective to least effective.
- Evaluate if the multidisciplinary component of the class (i.e. mixed Architecture and Building Construction enrollment) enhanced the student experience.
- Document improvements that could be made to the course.

A survey was administered on the last day of class in the Spring 2018 course to evaluate student perceived effectiveness of the course in reinforcing multiple design and construction concepts through the various activities, exercises, and other components of the course. The survey is included in Appendix A for reference. The research presented herein refers to data collected from the Spring 2018 course. Table 1 provides the primary course objectives and activities along with a description of each.

Table 1: Course Objectives and Activities with Description

Course Objectives/Activities	Description of Assignment or Activity
Hands-on Construction Exercises	Interior and Exterior Construction of a Tiny House on Wheels
Daily Safety Meetings & Reports	Safety Meetings and Reports on Pertinent Activities and Risks
Daily Progress (Instructional) Videos	You-Tube Videos Summarizing Activities Completed each Day
Class Summary/Reflection Papers	Personal Reflections of Daily Activities (what you did/what you learned)
Creating Individual Floor Plans	Creating a Floor Plan Based on Specific Design Constraints (8'x18' Length)
Comparing Floor Plans to Select a Final Design	Working in Groups to Collectively Recommend the "Best" Floor Plan
Creating a 3D Model of your chosen Design	Using Revit or Sketchup Software to Model the Group's Final Plan
Paired Research and Presentations on Tiny House Design	Based on Internet Sources and Book "Tiny House Design..." -Morrison
Guest Speaker on Tiny House Design	Seminar on Design and Construction from Local Tiny House Expert
Field Trip to XX Tiny House Festival	Day Long Field Trip with Corresponding Assignment and Reflection Paper

Though the results of this survey are representative of the entire population of the course, they may not be statistically sound due to the small survey population. In order to achieve more sound results, students enrolled in future offerings of this class will need to complete the same survey.

## Results and Discussion

A total of 14 surveys were collected and evaluated which represents 100% of the students who completed the course. This included 11 architecture and 3 building construction students, all of which were undergraduate students in their respective majors. Survey results were transcribed from hard copy to Microsoft Excel in order to more easily group and process the data. Surveys were anonymous and students were given the opportunity to answer as many or as few questions as they wished, or to not take the survey at all. Though anonymous, the first question of the survey asked the students to identify their major (Architecture or Building Science) by circling the corresponding choice. This allowed for further analysis of the results by major where beneficial.

## Construction Processes and Procedures

Question 2 analyzed the effectiveness of the course in contributing to student knowledge of construction processes and procedures by rating the following components on a scale of 1-5, with 5 being the most effective (corresponding to the answer choice "A Great Deal") and 1 being

the least effective (corresponding to the answer choice “Not at All”): hands-on construction exercises, daily safety meetings & reports, daily progress (instructional) videos, class summary/reflection papers. Figure 1 shows the distribution of ratings for each of these activities.

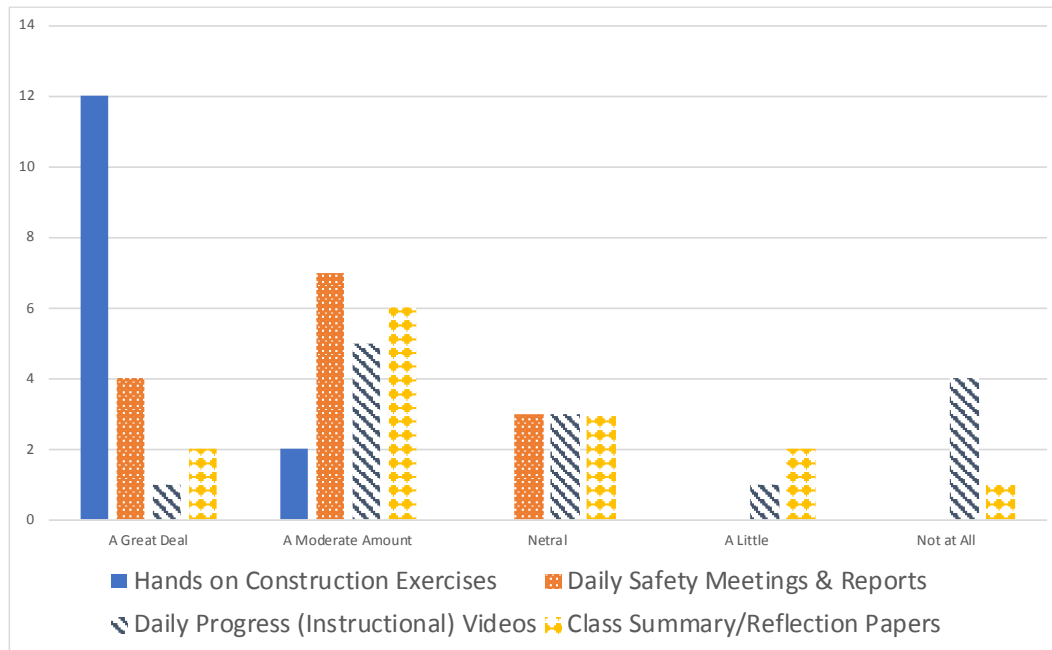


Figure 1: Frequency Response to Survey Question 2 – Construction Activities

Figure 1 shows that 12 out of 14 respondents indicated that hands-on construction exercises increased their knowledge of construction activities “A Great Deal”, while the remaining 2 respondents selected “A Moderate Amount” for this item. Daily safety meetings and reports received ratings ranging from “A Great Deal” to “Neutral” while responses for the remaining categories of daily progress (instructional) videos and class summary/reflection papers were scattered but lower ranking than the other activities in this question.

### Architecture and Design Processes

Question 4 analyzed the effectiveness of the course in contributing to student knowledge of architecture and design processes by rating the following components on a scale of 1-5 with 5 being the most effective (corresponding to the answer choice “A Great Deal”) and 1 being the least effective (corresponding to the answer choice “Not at All”): creating individual floor plans, comparing floor plans to select a final design, and creating a 3D model of the chosen design. Figure 2 shows the distribution of ratings for each of these activities.

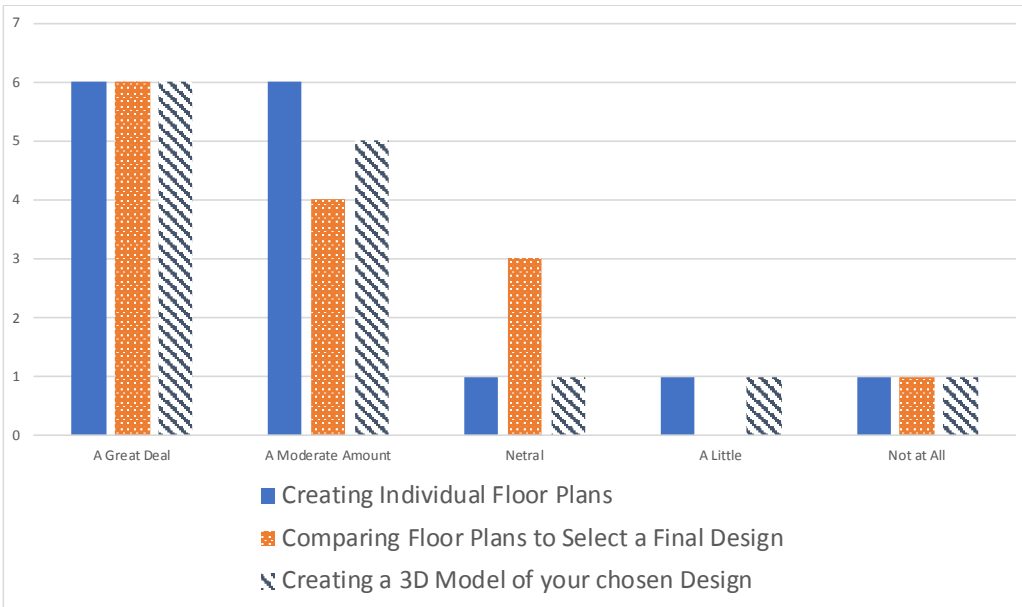


Figure 2: Frequency Response to Survey Question 4 – Design Activities

As shown in Figure 2, the majority of survey takers, 12 out of 14, stated that creating individual floor plans contributed to their knowledge of architecture and design “A Great Deal” or “A Moderate Amount.” Additionally, 10 out of 14 respondents and 11 out of 14 respondents gave the highest two ratings to the “comparing floor plans to select a final design” and “creating a 3D model of your chosen design” activities, respectively. The survey results corresponding to this series of questions indicates that, in general, the three design activities included in Figure 2 were effective at contributing to student knowledge of architecture and design processes.

**Tiny homes and the Tiny Home Movement**

Question 6 analyzed the effectiveness of the course in contributing to student knowledge of tiny homes and the tiny home movement by rating the following components on a scale of 1-5, with 5 being the most effective (corresponding to the answer choice “A Great Deal”) and 1 being the least effective (corresponding to the answer choice “Not at All”): paired research and presentations on tiny house design considerations, guest speaker on tiny house, and field trip to Georgia Tiny House Festival. Figure 3 shows the distribution of ratings for each of these activities.

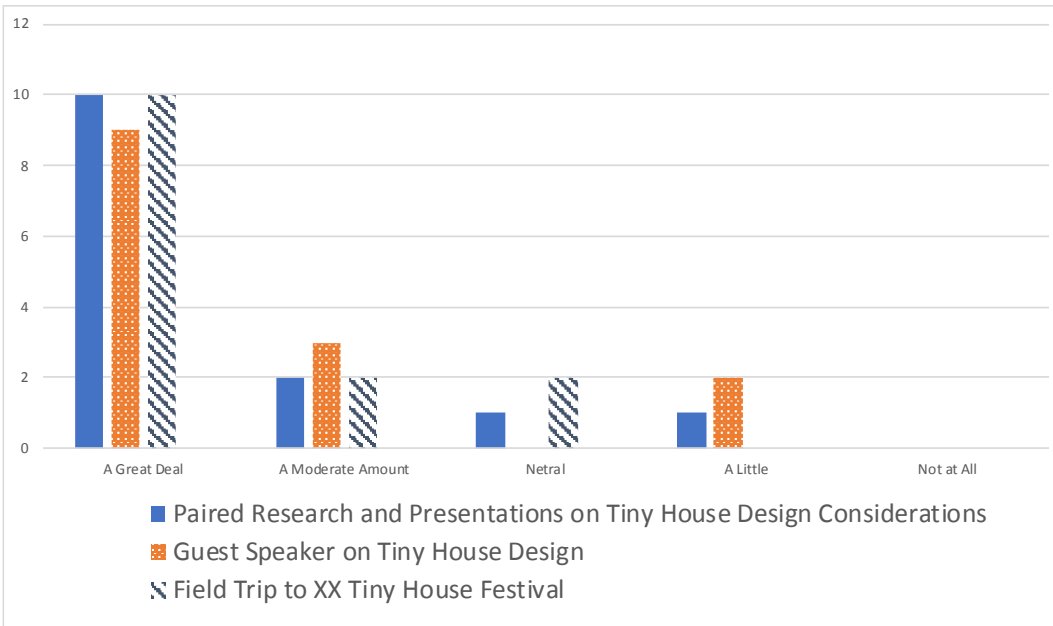


Figure 3: Frequency Response to Survey Question 6 – Tiny House Activities

As shown in Figure 3, results of the survey questions which focused on student knowledge of tiny homes and the tiny home movement were positive overall. Twelve out of 14 survey takers responded “A Great Deal” or “A Moderate Amount” when asked how paired research presentations on tiny house design considerations, guest speaker on tiny house design, and field trip to Georgia Tiny House Festival contributed to their knowledge of tiny homes and the tiny home movement.

### Activity Ranking

Question 8 of the survey asked students to rank 11 activities (10 of which are shown in Table 1 and 1 which was not completed) in order of their overall effectiveness at enhancing your knowledge of construction processes and procedures, architecture and design processes, tiny homes, and the tiny home movement. Rank them in order from 1 to 11, with 1 being the most effective activity and 11 being the least effective activity. The most notable outcome of this question was the overwhelmingly positive response to “hands-on construction activities,” with 13 of the 14 students surveyed ranking this as the number 1 activity. In general, “daily progress (instructional) videos” and “class summary/reflection papers” were the lowest ranked activities among students.

### Multidisciplinary Evaluation

One of the objectives of this research was to evaluate if the multidisciplinary component of the class (i.e. mixed Architecture and Building Construction enrollment) enhanced the student experience. Question 10 of the survey asked students to rate their agreement with the following statement from on a scale of 1-5, with 5 representing “Strongly Agree” and 1 representing “Strongly Disagree: “Taking this class with students from another discipline (i.e. architecture or building science) enhanced my learning experience.” Figure 4 provides the response frequency to this question organized by major.



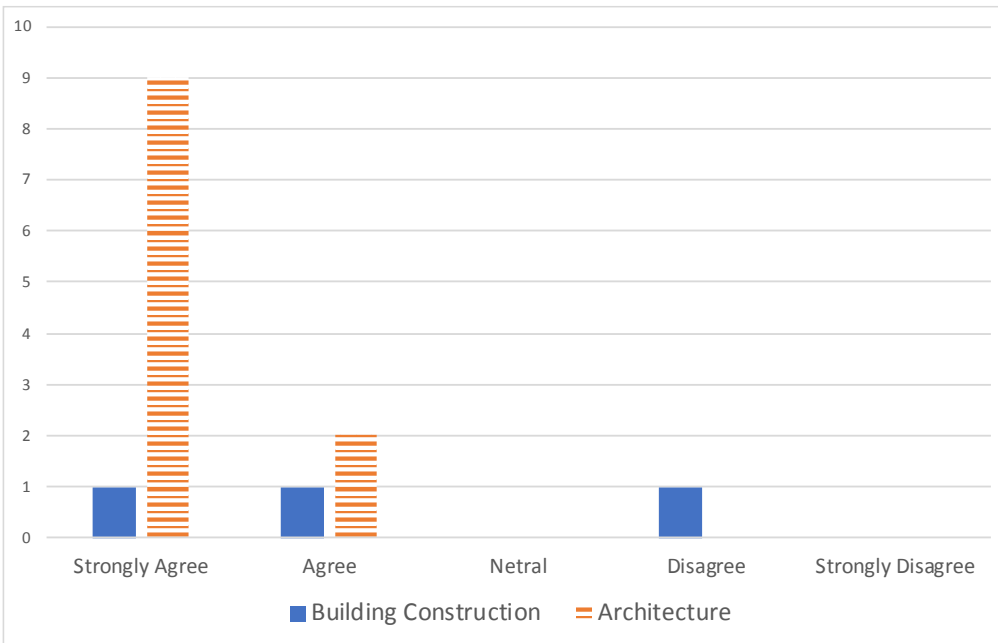


Figure 4: Frequency Response to Survey Question 10 Grouped by Major

As indicated in Figure 4, all 11 architecture students participating in the course indicated that taking the course with building science students enhanced their learning experience. Similarly, 2 of the 3 building science students indicated that taking the course with architecture students enhanced their learning experience. In total, only 1 student surveyed disagreed with the statement posed in survey question 10.

### Potential Course Improvements

Question 9 of the survey asked students to recommend improvements to their low ranking activities in Question 8. The overwhelming majority of the comments took the form of reducing or eliminating the weekly videos and reflection papers. This makes sense as the lowest ranked activities were “daily progress (instructional) videos” and “class summary/reflection papers.” One student indicated that more guest speakers would be beneficial and that paired research was preferred over individual. These comments can be used to implement changes and improve future offerings of this elective.

### Conclusions and Recommendations

Eleven architecture and 3 building construction students participating in the elective course BSCI 4960/5960: Special Problems in Construction at Auburn University during the Spring 2018 participated in a survey to assess the effectiveness of the course at enhancing student knowledge of construction processes and procedures, architecture and design, and tiny homes/tiny home movement. The survey also evaluated the multidisciplinary component of the class and solicited recommendations to improvements for future offerings of the course. The students surveyed overwhelmingly cited the hands-on construction exercises as the most effective activity or

component of the course. The majority of students cited “daily progress (instructional) videos” and “class summary/reflection papers” as the lowest-ranking, and least effective activities.

One obvious drawback to the study is the relatively small survey size. Though the results are representative of the entire population of the course, they may not be statistically sound due to the small survey population. Future research will seek to administer this survey to future classes in order to increase the survey population.

## **References**

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**Appendix A: Survey Administered to BSCI 4960/5960: Special Problems in Construction**

BSCI 4960/5960: Special Problems in Construction – Tiny Houses Survey

1. What is your major course of study? (Please circle your answer) BSCI/ARCH

2. Rate how the following components of the class contributed to your knowledge of construction processes and procedures: (please circle your answers)

	A Great Deal	A Moderate Amount	Neutral	A Little	Not at All
Hands-on Construction Exercises	5	4	3	2	1
Daily Safety Meetings & Reports	5	4	3	2	1
Daily Progress (Instructional) Videos	5	4	3	2	1
Class Summary/Reflection Papers	5	4	3	2	1

3. In what ways did the items in Question 2 enhance to your knowledge of construction processes and procedures? Please be specific.

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4. Rate how the following components of the class contributed to your knowledge of architecture and design processes: (please circle your answers)

	A Great Deal	A Moderate Amount	Neutral	A Little	Not at All
Creating Individual Floor Plans	5	4	3	2	1
Comparing Floor Plans to Select a Final Design	5	4	3	2	1
Creating a 3D Model of your chosen Design	5	4	3	2	1

5. In what ways did the items in Question 4 enhance your knowledge of architecture and design processes? Please be specific.

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6. Rate how the following components of the class contributed to your knowledge of tiny homes and the tiny home movement: (please circle your answers)

	A Great Deal	A Moderate Amount	Neutral	A Little	Not at All
Paired Research and Presentations on Tiny House Design Considerations	5	4	3	2	1
Guest Speaker on Tiny House Design	5	4	3	2	1
Field Trip to GA Tiny House Festival	5	4	3	2	1
Individual Research Project on Tiny House Topics	5	4	3	2	1

7. In what ways did the items in Question 6 enhance your knowledge of tiny homes and the tiny home movement?

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8. Please rank the following activities from the previous questions in order of their overall effectiveness at enhancing your knowledge of construction processes and procedures, architecture and design processes, tiny homes, and the tiny home movement. Rank them in order from 1 to 11, with 1 being the most effective activity and 11 being the least effective activity. (Please write the ranking in the blank provided to the right of each activity)

Class Activity	Ranking
Hands-on Construction Exercises	
Daily Safety Meetings & Reports	
Daily Progress (Instructional) Videos	
Class Summary/Reflection Papers	
Creating Individual Floor Plans	
Comparing Floor Plans to Select a Final Design	
Creating a 3D Model of your chosen Design	
Paired Research and Presentations on Tiny House Design Considerations	
Guest Speaker on Tiny House Design	
Field Trip to GA Tiny House Festival	
Individual Research Project on Tiny House Topics	

9. What are your recommendations for improving the low ranking activities in Question 8?

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10. Rate your agreement with the following statement: (please circle your answer)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Taking this class with students from another discipline (i.e. architecture or building science) enhanced my learning experience.	5	4	3	2	1

11. Rate your agreement with the following statements: (please circle your answers)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I would recommend this class to a friend.	5	4	3	2	1
Given the opportunity to work on a new tiny house project, I would take this class again.	5	4	3	2	1