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Applied Experiential Learning: Benefiting First Year Students and Co-op Employers with Student Developed Lesson Plans

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Eric completed three co-ops with local site design firms, gaining experience while still in school. His academic coursework and job experience equipped him with the technical skills essential for engineers, while his tutoring roles helped him develop effective teaching strategies and communication skills. These experiences not only strengthened his technical foundation but also prepared him to effectively teach the content to others.

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Sherin Ashraf-Hanna, her family moved to the US when she was only 12 years old to provide Sherin and her siblings opportunities that would be unavailable back home. Sherin inherited her parents' hard-working mentality, earning her Bachelor of Science in civil engineering from York College. She currently working at ECS as a staff project manager. Sherin also took advantage of many extracurricular opportunities while completing her degree. She was involved in the ASCE regional competitions, a stream health research team and an independent study. Furthermore, she completed three co-ops and two internships with geotechnical and construction management companies. With Sherin's vast experience in both industry and academia and her unique background, Sherin provides exemplary problem-solving abilities and inspiring creativity skills.

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Paul Ackerman is an Associate Professor of Civil Engineering at York College of Pennsylvania (YCP). Paul received a BS in civil engineering from Virginia Military Institute in 1993, an MSCE specializing in Geoenvironmental Engineering from West Virginia University in 1995, and a PhD specializing in Construction Engineering and Management from Virginia Tech in 2014.

A registered professional engineer in Virginia since 1999, Paul has over 20 years of engineering and project management experience with a large variety of local, state, and federal projects. In addition to teaching civil engineering courses, Paul has assisted with engineering service projects in the United States, Uganda, Bolivia, and Guatemala.

Applied Experiential Learning: Benefiting First Year Students and Co-op Employers with Student Developed Lesson Plans

This paper discusses the methodology and results of utilizing students' experiential learning from co-ops to develop lesson plans that better meet industry expectations for future co-op students while also meeting the course and student outcomes. Engineering students at York College of Pennsylvania (YCP) are required to partake in at least two co-op experiences. The first required co-op is during the summer, after the completion of the students' second academic year. Many students select a co-op which involves land development or stormwater management and to prepare students for this field, first year civil engineering students take a civil site design course that includes twelve weeks of surveying laboratory, where students gain familiarization with field surveying tasks and utilizing Autodesk® Civil 3D®. With the increase in the size and complexity in Autodesk® Civil 3D® Fundamentals software tutorial, course evaluations showed a decline in student self-efficacy. The 2024 tutorial is now just under 1000 pages, 18 chapters in length. Students commented that the Civil 3D® tutorial was overwhelming due to the abundance of tasks required for each chapter and that the tasks outlined in the tutorials were too advanced for an entry level Civil 3D® user. In addition, students noted even when they completed the tutorial, they were not confident in their ability in using the program outside of the course. Students also had a difficult time relating the tasks in the assignments to real-world applications.

To improve student-efficacy in Civil 3D® and prepare future students for site design related co-ops, two senior students proposed an independent study to develop new projectized laboratory modules that faculty could incorporate in the civil engineering site design course. Both students had completed twelve months of co-ops and developed laboratory modules based on their experiential learning acquired during these co-ops. Industry co-op partners were also interviewed to collaborate and verify the learning objectives which included:

- Planning, collecting, surveying, and transferring spatial data from on campus locations
- Formatting spatial data for importing into Civil 3D® program
- Gaining experience with Autodesk® Civil 3D®
- Gaining design and presentation skills focusing on the use of survey equipment with Civil 3D®Software

In addition to improving Civil 3D® familiarization with students, another objective of this research was to improve engagement and interest by developing laboratory modules that utilize sites on campus that students are familiar with. An unrealized benefit of improved student self-efficacy was the increase in student interest in pursuing co-ops with civil engineering firms that utilize Civil 3D®. The methodology of this paper could be easily modified to be utilized by other institutions with similar programs.

Background

The civil engineering site design (site design) class is a required course for first year civil engineering majors and is the first class they take inside of the civil engineering department during the 4-year curriculum. The course consists of three 50-minute classroom lessons and one 165-minute laboratory lesson per week over a 14-week semester. This course becomes the students first impression of evaluating the department's competence and character. The course strives to provide fundamental experiences such as site analysis, surveying tasks, and Autodesk® Civil 3D® (Civil 3D®) skills [1]. Currently, portions of the class do not serve students well. These learning modules are confusing and complicated. Compounding this issue is the annual increase in the size of Autodesk's Civil 3D® Fundamentals tutorial book. When the site design course was first developed in 2019, the Civil 3D® tutorial book was 658 pages and 12 chapters in length [2]. The 2024 tutorial has now grown to 986 pages, 18 chapters in length [3]. As first year students navigate the challenges of college life, implementing an effective lesson method can assist in facing challenges in time management [4], anxiety, and their overall wellbeing [5]. However, not having a structured lesson approach can lead to students feeling overwhelmed and helpless. As a result, students may turn to external resources such as ChatGPT, Chegg and online search engines. These programs can be effective as a supplemental tool for learning but should not be the primary source of information for a college student, especially when dealing with new software tutorials [6]. The site civil laboratory course is failing to provide sufficient guidance trying to navigate through the software tutorial and forces students to lean heavily on external resources to learn the material in the short amount of time provided. To instill confidence in students regarding the entire civil engineering department and more specifically the site design course, a redevelopment of the underperforming laboratory lesson modules was initiated.

Student Course Evaluations and Survey Results

The civil engineering site design curriculum lessons identified for redevelopment consisted of Civil 3D® lessons and field surveying lessons. Prior to any alterations to the current curriculum, the research team, which consisted of two senior civil engineering students and a faculty advisor, analyzed the course evaluations from the past 4 years. Although overall rating from the 2021 to 2024 course evaluations ranged from 4.0 to 4.9, on a 5-point Likert scale, 31% of 51 students surveyed listed Civil 3D® when asked "which aspect of the course were least valuable" [7]. Students felt that the Civil 3D® modules were confusing, lengthy and unengaging. A sample of students' comments when asked what aspect of the course was least valuable are as follows:

- "The civil 3D work was sometimes so complex that I did not learn from those"
- "The Civil 3D labs were not very in depth and did not really help with learning"
- "I didn't learn much in Civil 3D. I definitely think we could use more-depth training with the program"
- "Skimming over the Civil 3D book, not really learning much do to the large chapters"

Regarding the field surveying labs, the survey data showed a positive experience with 88.9% of the 51 students surveyed commenting about the field and survey equipment labs when asked "Which aspects of the course were most valuable" [7]. The field surveying lab lesson objectives include:

- Measure horizontal distances with a standard engineer's tape and with pacing techniques
- Conceive and run a level loop using an automatic level and level rod
- Perform resection station setup with total station and survey existing infrastructure
- Export PNEZD data to a standard txt. document

The field lab covering these learning objectives appears to be functioning well based on student course evaluations; the research team determined that revising the field lab lessons was not necessary.

However, since the course survey is typically completed before students start their co-op experience, a new survey was conducted with current seniors, who completed the site design course as well as two co-op experiences. Although only one cohort could be surveyed at this time, the results verify the problem of lack of preparation students feel in regard to the Civil 3D® aspects of the site design course that did not prepare them well for their co-op employment. The survey indicates that students who completed the site design course and two co-op employment assignments felt that the course hardly prepared them or somewhat all respondents fell in between hardly and somewhat prepared for their co-ops in the site design discipline, as shown in Figure 1 [8].

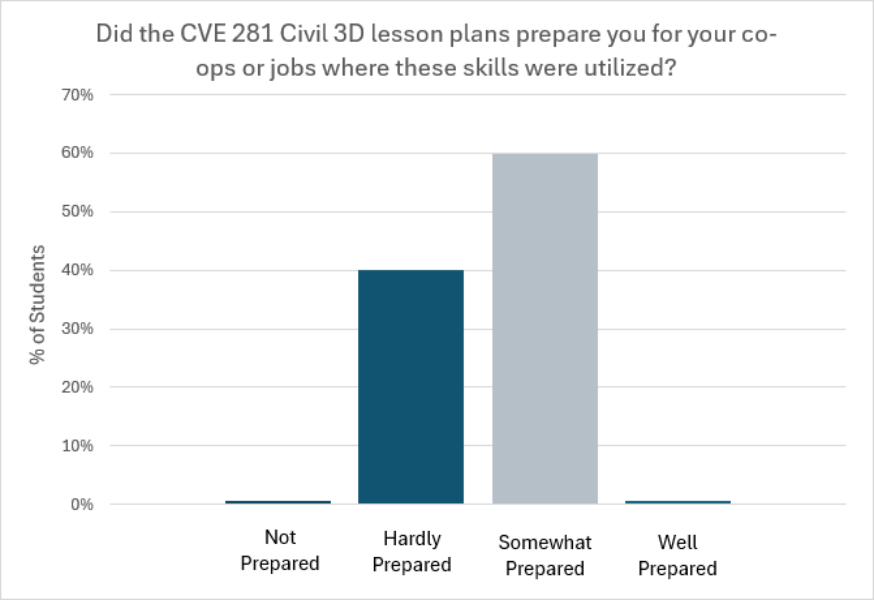

Figure 1: Results of question 6 in the senior student survey evaluating readiness for co-op roles

Co-op Employer Interviews

Civil Engineering students at YCP are required to complete at least two co-op employment assignments. The first co-op opportunity typically occurs the summer after students complete their sophomore year, for a duration of 12 weeks. The second co-op occurs during the spring semester of a student's junior year, for a minimum duration of 16 weeks. The students may extend their spring co-op through the summer of their junior year. However, extending the co-op or seeking a third co-op with a different company during the junior summer is optional [9]. This co-op schedule provides students with the opportunity to gain 7 to 11 months of civil engineering work experience. During the co-op, the students' faculty advisor meets with the co-op employer supervisor to complete a student evaluation. These meetings provide an opportunity to interview employers to discuss not only what areas the student can improve in but also what areas the college's civil engineering program can improve on. Although the employer co-op evaluation results are overwhelmingly positive, the personal interview with employers allows faculty an opportunity to gain a unique perspective of civil engineering employer needs and trends. One significant trend is that civil design and site design firms are requiring recently hired graduates to be more proficient in computer aided drafting [10]. ABET requirements leave little room to increase the curriculum to meet ever increasing industry demands. Employers and instructors agree that in regard to computer aided drafting, integrating software programs with current curriculum lessons to allow students to not necessarily gain expertise but familiarization may be a winning strategy for all civil engineering stakeholders. However, institutions have been struggling with this logistical time crunch to meet changing industry demand for decades [11]. On the other hand, student attitudes about co-op opportunities are significantly positive. Students value co-ops due to the opportunity to gain career experience and develop networking skills to increase their chances of finding full time employment after graduation [12]. As a result, the ability to redesign course lessons to allow students to gain skills and knowledge to be more competitive for co-op opportunities should also improve student self-efficacy.

Course Redevelopment Objectives

York College engineering courses typically get reviewed and experience minor revisions on a routine basis but the strength in the redesign for the site design course was a focus on utilizing senior civil engineering students' co-op experience in developing and implementing significant review and revisions in the civil site design curriculum. The senior students leading this effort have a combined 20 months of co-op experience in the civil engineering site design profession with several different employers. Therefore, these students had recent exposure in both industry and academia which enabled the research team to develop lesson plans from the students' perspective based on co-op experience and mentorship from civil engineering practitioners currently working in the industry. The practitioners complemented the senior students well, providing insight into the skills expected from co-op students. In addition, these engineers also worked with the department instructors to make sure the instructors understood current entry level work demands and required skills. The senior civil engineering students along with the

instructors, and practitioners formed an ideal, intellectually diverse group capable of producing high quality lesson plans that engaged students to provide relevant skills to best prepare for the upcoming co-op search in the site design and surveyor discipline fields.

Autodesk® Civil 3D® Lab Lesson 1

As mentioned earlier, the Civil 3D® lessons were determined to be the priority objective for the course redevelopment. Civil 3D® provides users with many tools which automate the design, drafting, and reporting of projects. Some common features which civil engineers may use include pipe networks, pressure networks, grading optimization and corridors. These features can be complemented by labels, tables and graphs to give designers the desired aesthetic format on their plans. These Civil 3D® commands are a complex web of different styles and properties and take time to master. There was not enough time to cover these complex topics in the civil site design laboratory curriculum, however the simple building blocks which are fundamental to any advanced feature are a natural starting point for any new CAD user and is manageable to learn in one semester which is why the research team's first Civil 3D® lesson objective was to simply teach how to draft and format lines/polylines, hatch patterns, and text boxes.

The first CAD lesson in the site design course begins with instructions on drafting a polyline. The students are instructed to trace a set of markers which were placed in the lesson plan CAD file in preparation for this exercise. Figure 2 displays the path students are instructed to trace. An individual Civil 3D® template file was prepared for each lesson to eliminate unnecessary layers, styles and objects which would distract from what the lesson is teaching. The Autodesk® Civil 3D® 2024 fundamentals tutorial uses drawing (dwg.) files downloaded with the program during installation. The Civil 3D® template file labeled 'Intro 1' contains 148 layers while the revised YCP template file only has 11 layers.

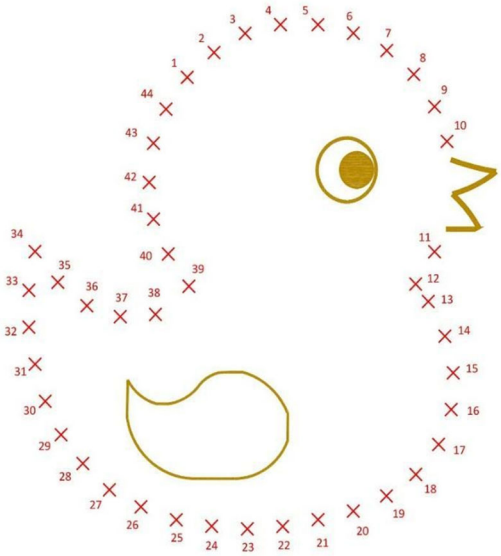

Figure 2: Civil 3D® snapshot displaying CAD lab 1, task 1

The completed sketch is intended to resemble a cartoon duck. An overarching objective for the design team was to make learning Civil 3D® more interactive and enjoyable. Having the students trace a simple cartoon duck is one example of implementing some lively elements into the lesson plans which increases student engagement and retention during the lessons. The independent study team also created very user friendly and easy to follow instruction manuals to direct students on how to complete the task. These manuals are concise and provide sufficient guidance to complete the lessons without overwhelming students. After all steps in the instructions for task 1 are completed, the result should look similar to Figure 3.

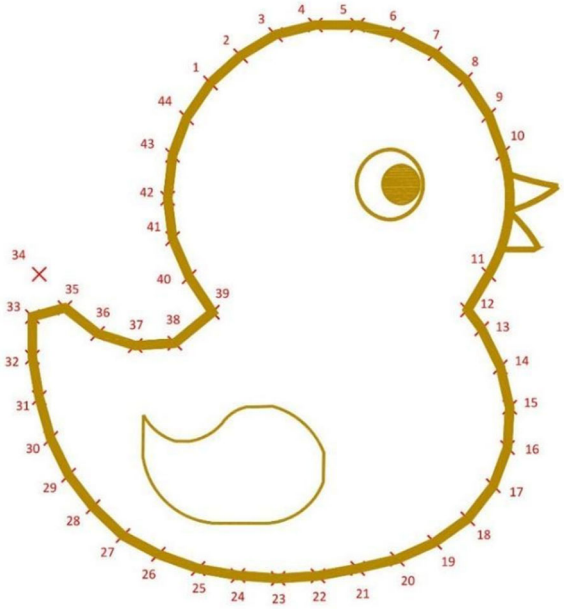

Figure 3: Civil 3D® snapshot displaying completed CAD lab 1, task 1

The curriculum for the course has very limited time for CAD lessons and therefore these lessons must be concise and meaningful. This quick exercise teaches much more than just drawing a polyline. The lesson discusses how to edit polylines to add arches and how to remove nodes. It also explains how to set objects to the correct layer and how that updates the appearance of the object. Finally, the task explains some style choices the user has such as global width and linetype scale.

The next task in this first lab explains the basic application of hatch patterns to enhance the aesthetic of engineering plans. This task guides students to hatch a dwelling, driveway, stream and road and explains stylistic options which alter the appearance of the hatch such as the pattern, scale, color and rotation. Figure 4 displays the completed task 2.

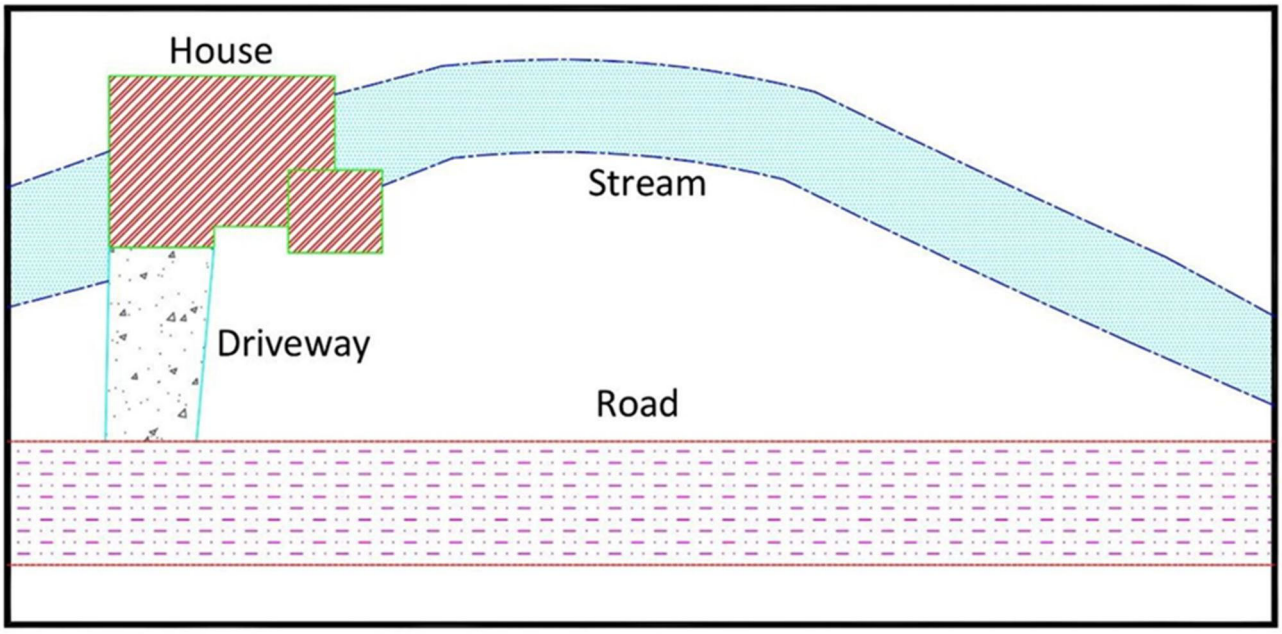

Figure 4: Civil 3D® snapshot displaying completed CAD lab 1, task 2

With lines and hatches covered, the final basic skill to learn is adding text to projects which task 3 explores. Civil 3D® text options and the importance of labeling features on a plan are critical for plans to be accurate and clear. The task guides students to create text boxes to label common features such as a house, road and stream. The task also outlines some options in the text editor tab if changes to the text font, size, rotation, and color are desired. The lesson plans created encourage students to explore different style options so while Figure 5 displays the completed task 3 for lesson 1, students can employ their creativity to make additional changes within a reasonable standard of deviation.

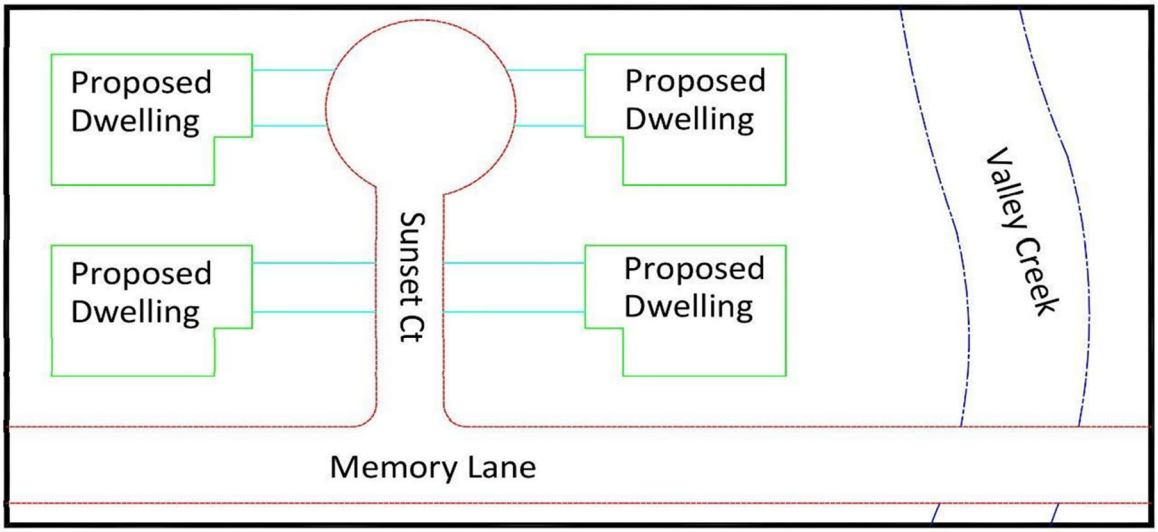

Figure 5: Civil 3D® snapshot displaying completed CAD lab 1, task 3

The final task instructs students to use any aerial imagery software and their field observations to sketch the Civil Engineering Building on campus along with the surrounding infrastructure such as the sidewalks and roads. The class is held in this building so this lesson helps introduce a real-world application into the curriculum where students are familiar with the features they are drawing. This task is not sharply defined and while Figure 6 is the example solution in the grading key, there is a level of freedom for students to draw these features how they best see fit.

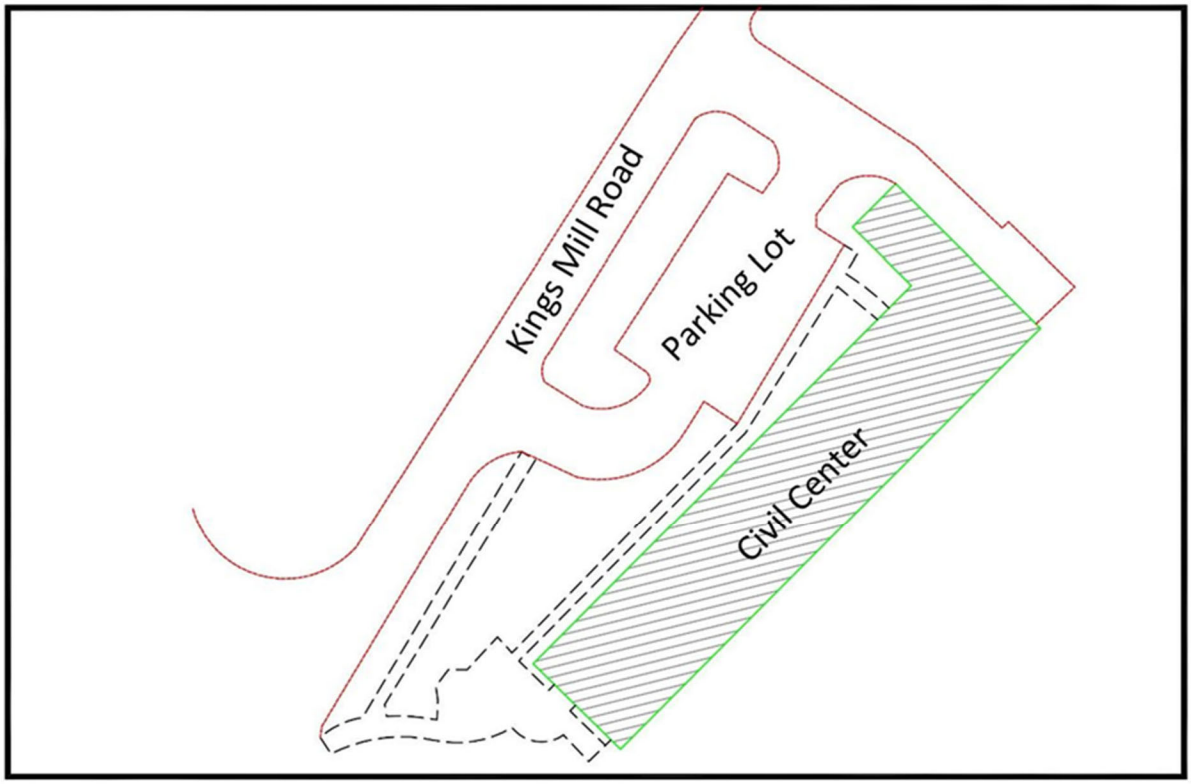

Figure 6: Solution to final task CAD Lab 1

To complete this task, students will rely on skills built earlier in the lesson plan which is why these first 3 tasks ultimately serve as a prelude to the final task. The research team examined the standard Autodesk® Civil 3D® Fundamentals software tutorial and noticed their tutorials typically are stand alone and provide specific instructions for every step. Both methods have their advantages, but the research team is confident that having a cumulative learning approach will increase retention of the lesson content. All the lesson plans in this course redesign build off each other which challenges students to apply previously learned skills. The final task also requires students to use their observation skills when sketching the existing features. The lab is held in the building they are sketching so students get to visualize what infrastructure, which they are familiar with, looks like on engineering drawings. This improves the student's ability to conceptualize how the developed world appears on paper; a benefit which Autodesk® standard tutorials cannot replicate.

Autodesk® Civil 3D® Lab Lesson 2

The next lesson was heavily inspired by the industry partners interviewed for this curriculum redesign. Many commented that an introductory task which was typically delegated to co-op students was the drafting of property deeds. The industry firms give this assignment to new CAD users to help ease them into the Civil 3D® program and introduce some of its capabilities. The research team agrees with the industry partners on the importance of deed drafting and thus created a fictional deed which describes a parcel of land. The deed contains 27 lines of bearing and distance data which represent the parcel boundary. Students are instructed to plot the property boundary and label the linework and the property title information. This lesson also involves basic sheet setup for presentation of the recently plotted deed which includes a north arrow, scale bar, legend and a title block. The template file uses an 11'x17' sheet, as shown in Figure 7, but this sheet becomes very crowded with all the labels, text, and linework drafted on the plan. This congestion was fully intentional to allow students the opportunity to improve the aesthetic of the plan by pulling out text leaders and rearranging text blocks. Typical engineering plans are packed with information that needs to be scaled and repositioned to communicate the information clearly. Having students learn to take a problem-solving approach when improving the clarity of a plan is a valuable skill, best improved through practice.

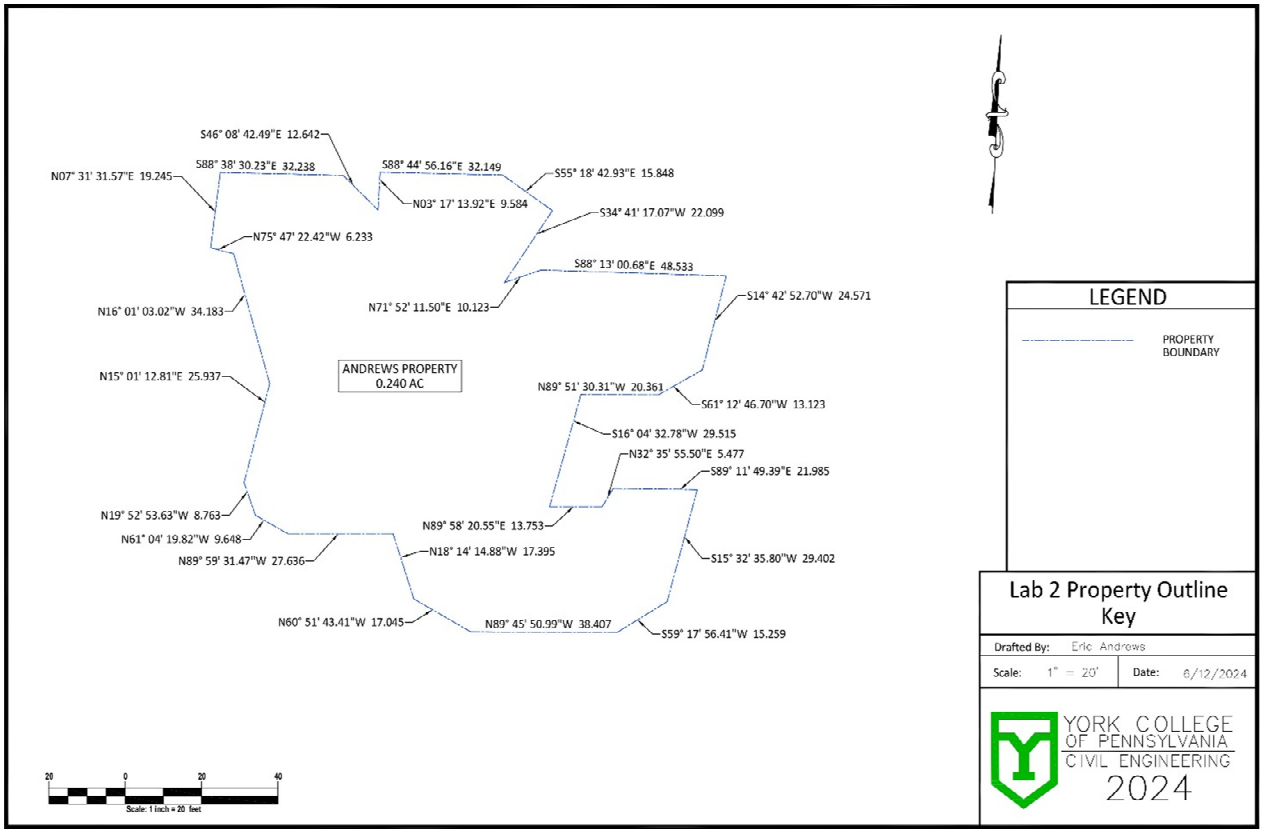

Figure 7: 11" x 17" sheet displaying completed CAD lesson 2

Autodesk® Civil 3D® Lab Lesson 3

The third lab designed by the research team deals with the creation and editing of a Civil 3D® surface. The lab begins with a simple text document which contains field data in PNEZD format. Students can use commands within Civil 3D® to import these points into the model space of the template file. After the points are properly imported, the instructions outline several tasks and features which engineering firms frequently utilize. The first step is to exclude points which do not belong in the surface creation. Points such as pipe inverts which are below existing grade and property corners which do not contain any elevation data will be ignored. This can be achieved by creating a unique point group for the surface where students can exclude the points mentioned above. The surface can now be created, however there are still several discrepancies to resolve. Figure 8 displays a screenshot from the CAD file, and it is important to highlight areas where contours are being inaccurately drawn which are occurring due to offsite benchmarks used during the survey station setup.

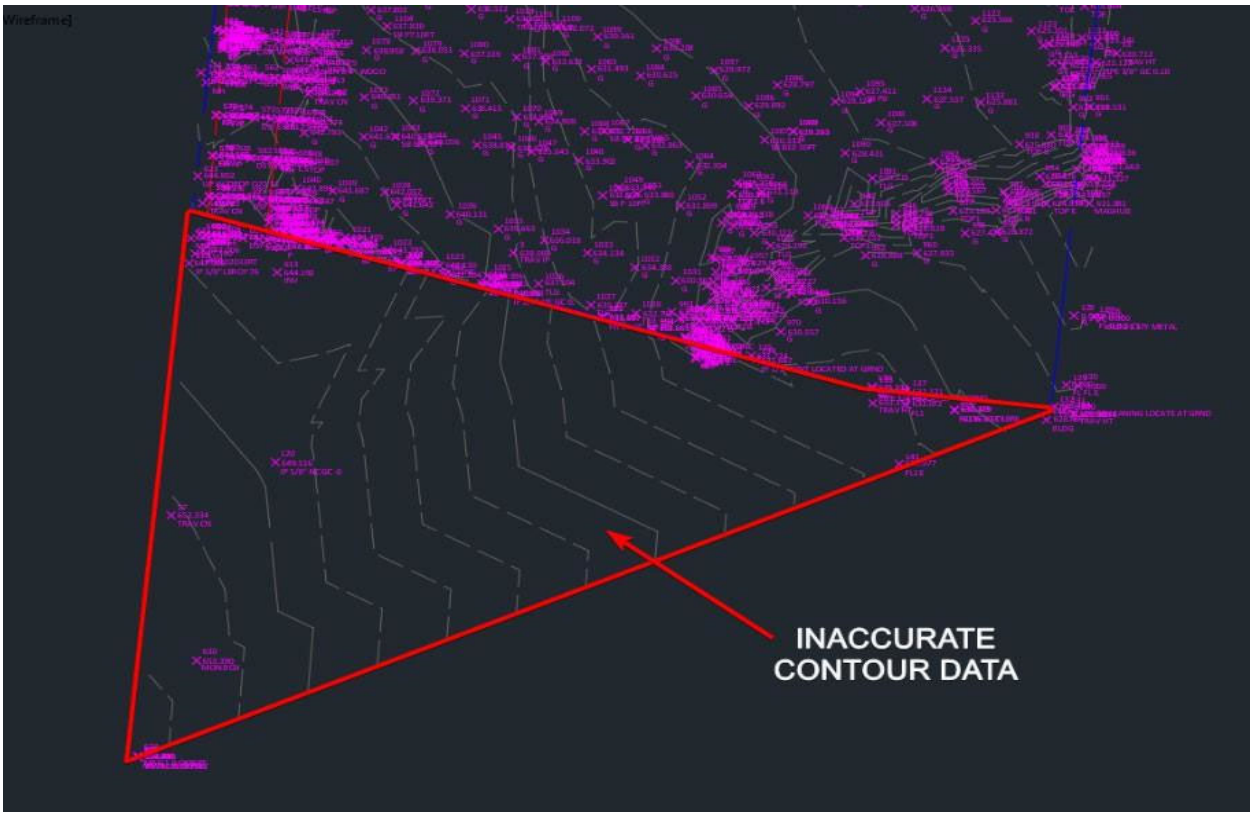

Figure 8: Civil 3D® snapshot displaying CAD lab 3

The lesson manual instructs setting a surface boundary which will exclude contours from being created outside the subject property. The initial surface creation will provide surface data for areas where there is not enough survey data to accurately describe that area. This region must be excluded from the surface to ensure the surface only describes areas where there is a justifiable quantity of data.

The remaining steps improve the aesthetics of the surface and provide information pertinent to site designs. This includes hiding contours inside existing buildings, displaying the elevation data on contour lines and shading steep slopes. The surface and some adjoining linework can now be labeled and plotted on a sheet using a viewport. The instructions call for a viewport scale of 1” = 60’ which will require a rotated polygonal viewport to fit everything on the sheet without conflicting with the title block and legend. The research team from experience understands packing everything on one sheet neatly is a skill and providing students with a slightly challenging sheet setup better prepares these students for future CAD work. Figure 9 outlines one possible solution to the lesson plan.

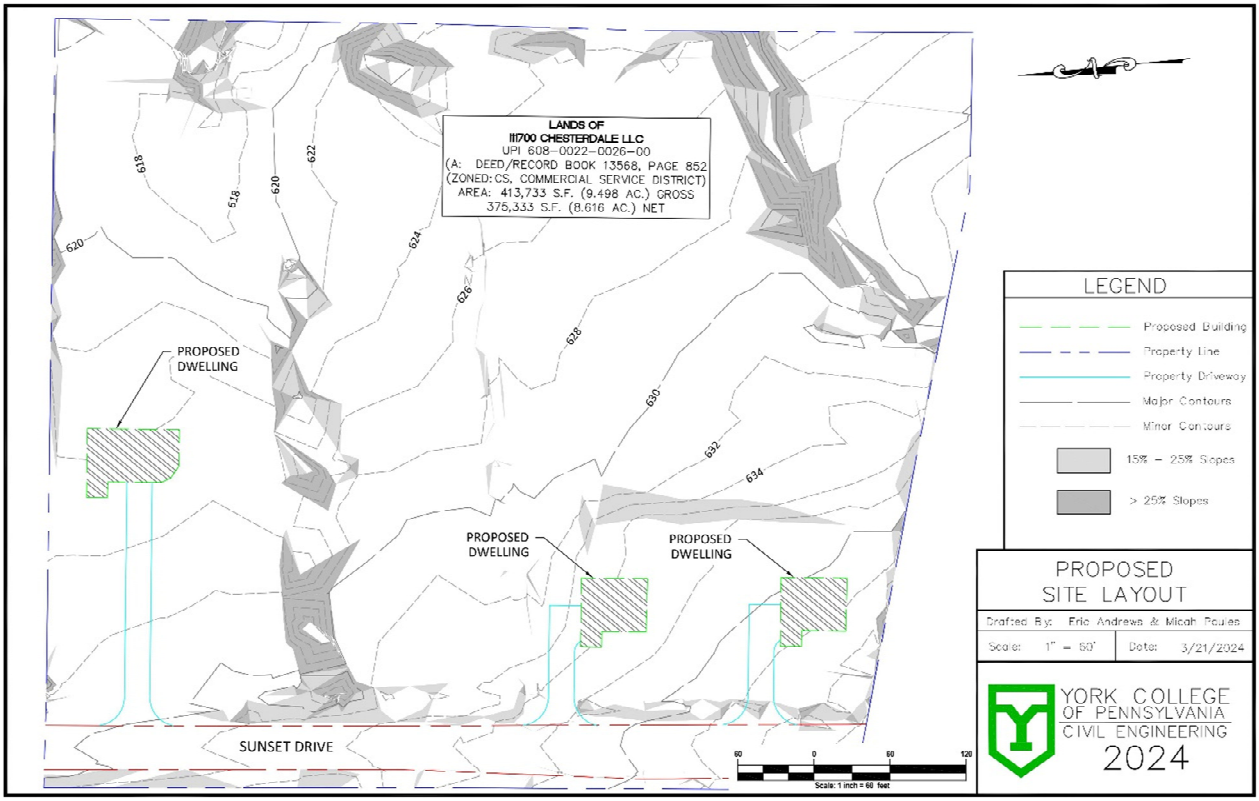

Figure 9: 11” x 17” sheet displaying completed CAD lesson 3

Autodesk® Civil 3D® Lab Lesson 4

While a few of our Civil 3D® labs are standalone, half of them incorporate data collected from the field labs in the curriculum. This helps the students understand the connection surveyors and engineers have and it incorporates local areas so students can visualize what real infrastructure looks like on two dimensional plans. Students who graduate with a bachelor’s in science of civil engineering typically do not enter the surveyor profession but many engineering roles will require their staff to be familiar with the fundamentals of surveying. With this objective in mind, our next lesson builds upon a field lab in the earlier weeks of the semester. The field lab instructs students to gather elevation data for a stream crossing using standard survey equipment. The Civil 3D® lesson plan takes this data and instructs students to import the points into the template

drawing file. A basic surface can be created using these points and students are instructed to import an aerial image and sketch the buildings and roads in the surrounding area. Figure 10 displays the surface creation and the linework drafted from the aerial imagery.

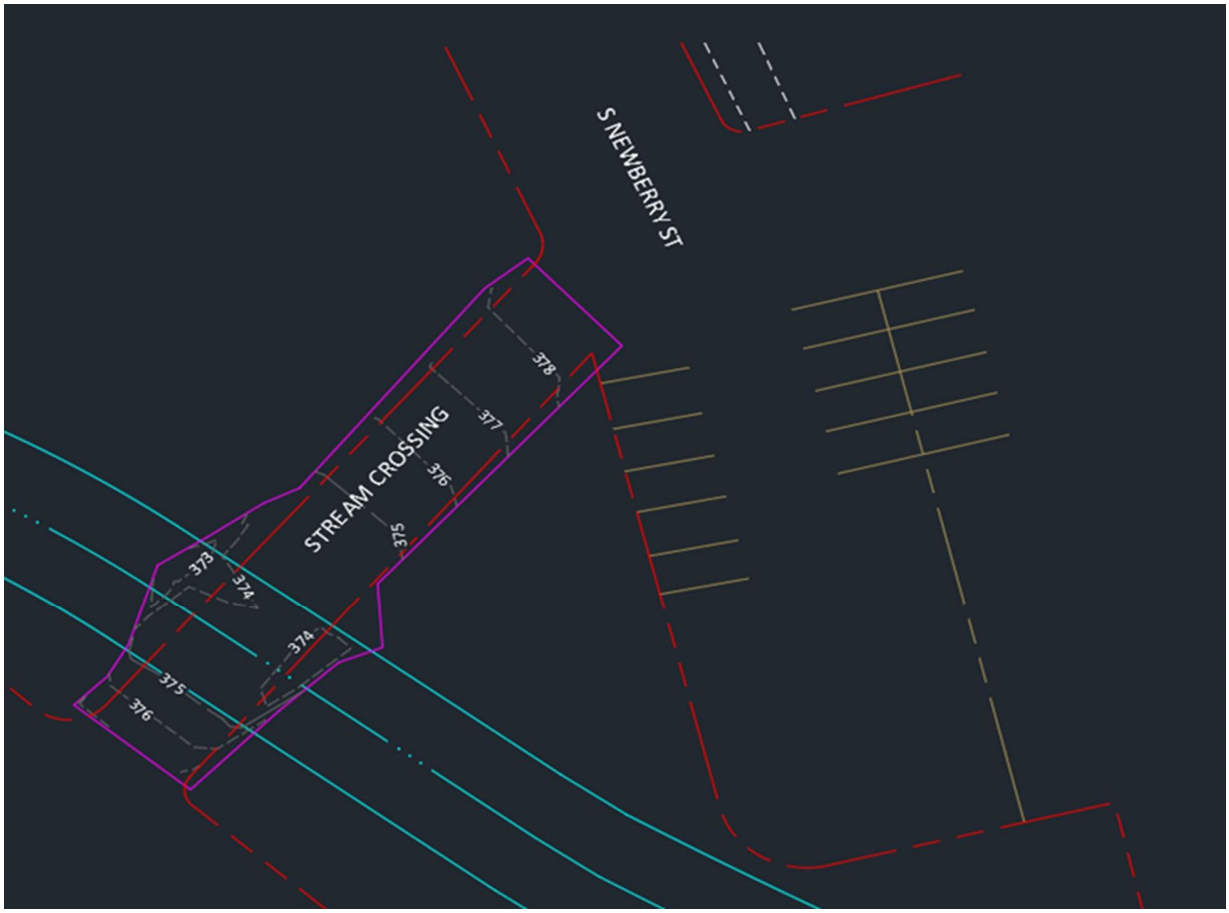

Figure 10: Civil 3D® snapshot displaying completed CAD lab 4

The next step is to draft an alignment on the centerline of the stream crossing. Alignments are foundational for many advanced CAD tools and while there isn't enough class time to cover these tools, the research team determined alignments were a crucial topic to briefly introduce. A profile view can be created using the alignment's stationing and this profile view can display the existing ground elevations and the road profile along the alignment. The final step in the instruction manual is to set up a sheet with a plan and profile view of the stream crossing; the student's submission should closely resemble Figure 11.

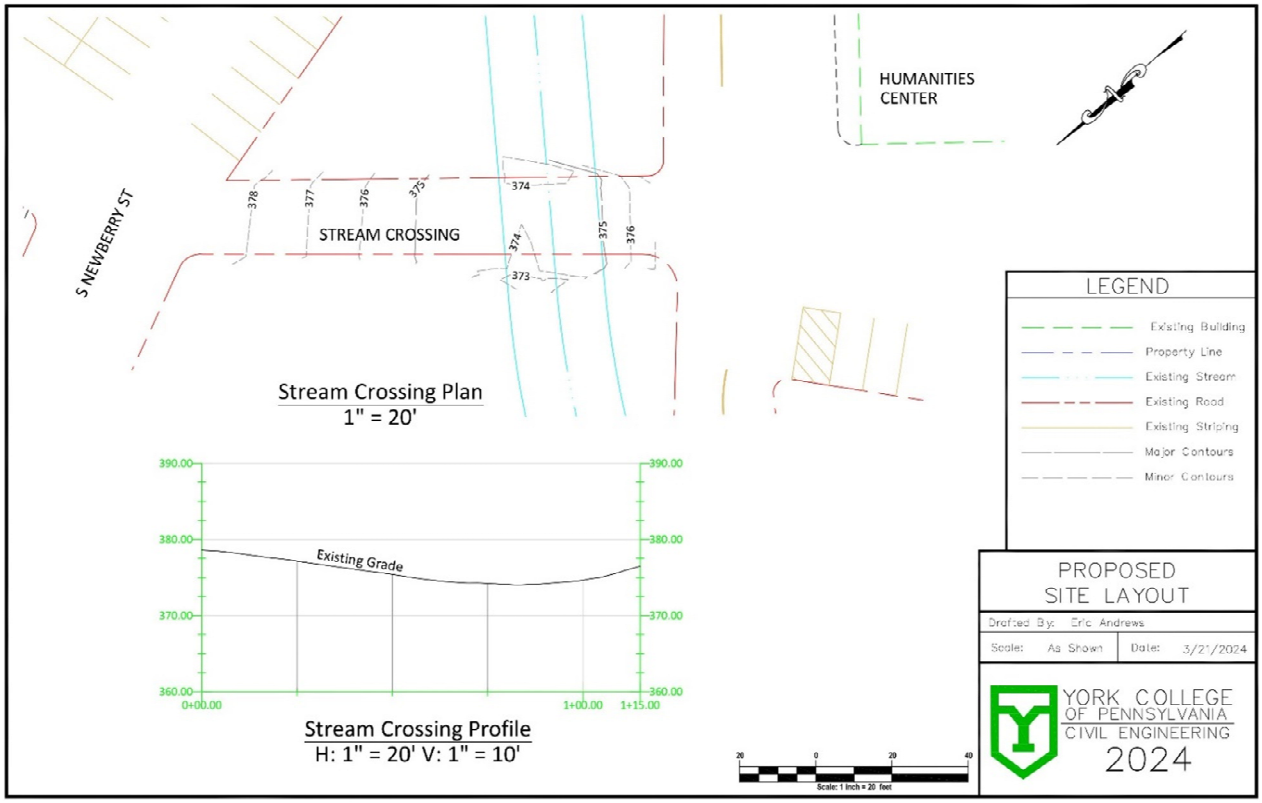

Figure 11: 11" x 17" sheet displaying completed CAD lesson 4

Site Design Lab Final Project

The final project in the site design curriculum combines skills learned from the surveying and Civil 3D® labs to challenge students with the task of completing a topographic map from scratch. This requires students to complete a station setup with nearby benchmarks and survey the existing infrastructure in the area of interest. After the field portion of this lab is complete the students then take their recently gathered survey data and import those points into Civil 3D®. All the CAD steps in the manual are skills built earlier in the semester, and this is intentional to give students practice which increases content retention. The tasks in this assignment include creating a surface, drafting existing features and completing a standard sheet setup. The lab manual doesn't spend time detailing the specifics because students at this stage of the curriculum are expected to exhibit a high level of independence when completing these basic CAD tasks. Figure 12 displays the completed topographic map project.

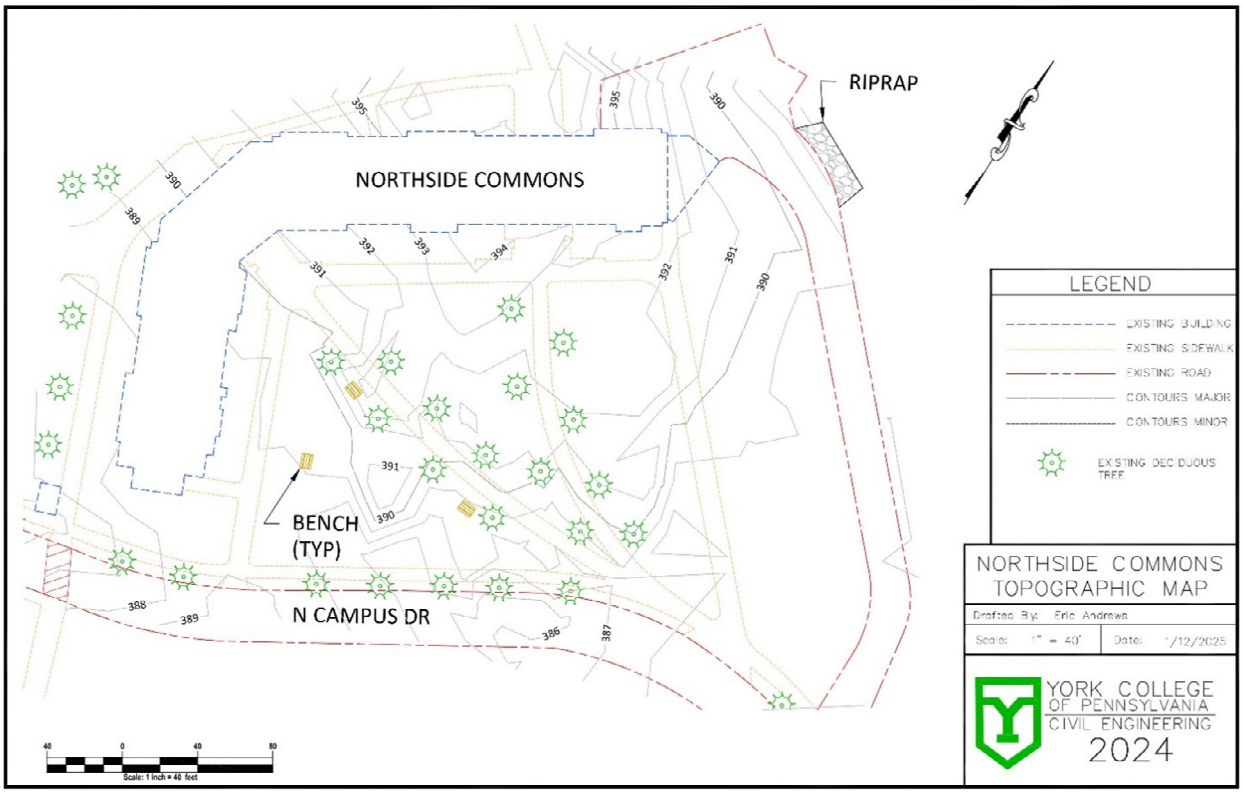

Figure 12: 11" x 17" sheet displaying completed final project

The final project also includes a presentation where students will outline the process, they followed to create their topographic map. The presentation aspect is crucial to the curriculum because performing and explaining a task are two different skills. All the lesson plans prior to the final project solely focus on the ability to follow a lab manual and complete the lesson, which is valuable, but it would be a disservice to not include some communication practice into the final project. The ability to explain the process requires a higher degree of competency in the subject matter than just completing the task and students can deepen their surveying and Civil 3D® skills with presentation skills.

Student Evaluations Following Curriculum Revisions

The revamped lesson plans were implemented for the 2025 Spring semester and student feedback indicates an overwhelmingly positive response to the new lessons. The lesson plans were developed so students could complete them each within in one lab period which has a duration of 2 hours and 45 minutes. All the students completed the lessons in approximately within 2 hours. Out of the 21 students surveyed, 20 reported the lesson plans felt 'very meaningful and all survey respondents indicated high content retention. The survey asked respondent to "please describe your experience with the CAD lessons plans [8]. A sample of the students' answers is as follows:

- “I enjoyed the CAD lessons and plans. Over all it was a fun class and I learned a lot.”
- “They make it a lot simpler than a textbook and very easy to follow and understand the basic components of civil 3D, saved me a lot of time and headaches trying to figure it all out.”
- “The lessons were very intuitive and fun to do. They were not extremely long which enabled me to stayed focused and it felt like I was learning something as opposed to completing a task. I had always wanted to learn AutoCAD and with my background in basic/non-Civil CAD, the experience was a good one with many similarities but also many learning moments.”

The students were also asked if these new lesson plans were interesting and engaging and a vast majority rated the curriculum as engaging. Figure 13 summarized those results.

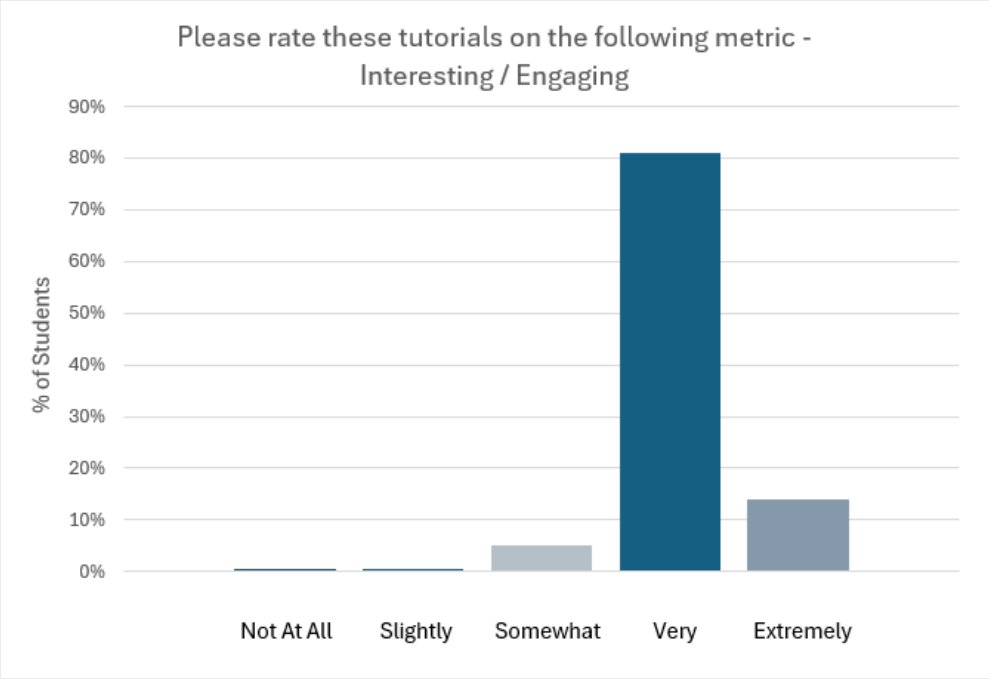

Figure 13: Results of Question 4 from the Analysis of Student Feedback After Curriculum Enhancements

The final question in the survey prompts respondents to explain any complexities with the new lesson plans. Students reported some of the lesson plans should include more visuals to make the instructions clearer. Multiple students also commented they were confused on the function of Civil 3D® layers and more clarification could be helpful. This feedback will be addressed by a future, student-led independent study team. This approach creates an efficient iteration process to improve the lesson plans and meet student needs.

Continuous Improvement Plan and Future Assessment

Although the civil engineering site design course and laboratory is not one of the courses selected by faculty for the department's ABET Continuous Improvement Plan the student outcomes (SOs) the course does meet supports the foundation of student knowledge and skill for assessment of these SOs in follow on courses that are directly assessed for ABET. In addition, the faculty members teaching the course do assesses the following SOs for their own course self-improvement goals which was the significant factor in developing new lesson plans for the laboratory component of the course [12]. Specifically, the civil engineering site design course allows students to gain the ability to meet the following SOs:

> SO 1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics. Although the Civil 3D® tasks my not meet the definition of a "complex" problem, the students learn to apply the basic principles of trigonometry, formulate a plan to collect data, and apply this data to create a topographic site plan for a future engineering project.
>
> SO 3. an ability to communicate effectively with a range of audiences. For the site design lab final project, students are required to present the means, methods, and results of the project to fellow students, faculty, and alumni of the program. This does not meet ABET's definition of a "range of audiences" since the audience is mostly civil engineering students and civil engineers. However, it is a good first step towards this outcome. Follow on courses in the program will build upon this with the end result being the students communicating effectively with a range of audiences to include engineers, non-engineers, clients, local and international community members.
>
> SO 5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives. Although the students individually work on the Civil3D® lab lessons, they are required to work and present as a team for the site design lab final project. Similar to the programs assessment of other SOs, students learn and develop the ability to meet SO 5 in several classes, with the civil engineering site course being the second time students meet this outcome.
>
> SO 7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. Although a significant number of students are becoming familiar with CAD in high school, the redesigned lab lessons introduce students to survey equipment, data collection, and analyzing strategies to build on their familiarization with CAD systems and apply this new knowledge in an experiential and projectized method in civil engineering site design.

As mentioned, the civil engineering site design course is not utilized in the programs direct assessment of ABET SOs. However, SOs 1, 3, 5, and 7 are directly assessed by faculty to continue self-improvement and student self-efficacy objectives [13]. Future assessment of the course continues to include indirect data from the student course evaluations. However, the civil engineering program also collects indirect data from co-op employer evaluation surveys. As a

result, a question rating the proficiency of student knowledge with AutoCAD programs and site design concepts will be added to the employer evaluation survey.

Conclusion

The presentation of the final project is scheduled for the last day of the semester and concludes the site design course. With the class redesign finalized, the research team successfully addressed student feedback and developed lesson plans to enhance learning experiences for first year civil engineering students. The research team was composed of senior students who provided recent and relevant experiential learning insight from co-op employment and a department instructor who was also a student advisor who interviewed over 20 civil engineering employers. The team's combined knowledge was essential in analyzing student feedback, employer demands, and ABET requirements to find a sustainable solution to improve student engagement and proficiency in the site design course.

In addition to the anticipated student benefits of this course redesign. The instructor acquired a current perspective that allowed them to benefit from student acquired co-op experience. The senior students gained college course credits for their independent study and professional teaching skills to include lesson development and planning. Additionally, industry professionals stand to gain from exposing their future co-op students to real-world experiences prior to the internship; making these students ready and more proficient when they arrive at the co-op. Students who are also inspired to become professors had a real opportunity to explore the workings of education and the pedagogical process of lesson planning.

The redeveloped lessons were implemented in the course curriculum in the spring of 2025. The research team will continue to collect data from future freshmen students to evaluate the effectiveness of the new lesson plans and the research team is confident the data will continue to show an increase in Civil 3D® competency and co-op readiness. A future goal is to expand this methodology to all applicable courses inside the civil engineering department; ultimately preparing students for success in any civil engineering field they decide to pursue.

The work outlined in this paper is specifically for the site design course at YCP but can be easily applied to Civil 3D® courses at other institutions. The authors have developed a shared Dropbox folder which includes the first 3 Civil 3D® labs so other instructors may utilize them for their own course needs.
https://www.dropbox.com/scl/fo/z33p70rbnpf3gi6wac6vr/AO61FmyasiSMKe337fgm0dc?rlkey=77y6crpbbj7dyjwfdsthluiut&st=0apd0w6t&dl=0

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