Letter of Transmittal

NAU Pottery Ramada Capstone Team

NAU Civil and Environmental Engineering Department

Samantha Ray, Kayla Cross, Madison Kaltschnee, and Luis Corral

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05/05/2020

Jason Hess

NAU Ceramics Department

1919 S Lone Tree Rd

Flagstaff, AZ 86001

Dear Mr. Hess,

Attached below is our final project proposal directed to NAUs' Ceramics Department. The purpose of the proposal is to analyze the project in terms of research and design. The project will produce final plan sets for the proposed ramada. Testing and calculations will begin 08/24/2020 and the final plan set, proposal, and presentation will be completed by 12/08/2020. Please let us know if you have any questions.

Sincerely,

NAU Pottery Ramada Capstone Team

Civil and Environmental Engineering, NAU

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FRAMEWORK ENGINEERING

Project Proposal
CENE 476 Capstone
NAU Pottery Ramada

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Final Version

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List of Abbreviations

Northern Arizona University (NAU)
The National Oceanic and Atmospheric Administration (NOAA)
The American Society for Testing and Materials (ASTM)
The American Society of Civil Engineers (ASCE)

1.0 Project Understanding

1.1 Project Purpose

Northern Arizona University's ceramics department is equipped with a large amount of tools and resources that help students create art. They have large kilns to aid in the process of creating ceramic sculptures. Students use the kilns throughout the year to create their ceramic art. One of the kilns that is used for constant firing does not have a roof to protect it from rain, snow, or sunshine. The goal of this project is to design a ramada that allows students to have overhead protection from inclement weather when they are using the kiln to fire their ceramic projects. With no protection over the kiln, the wood that is stockpiled for fuel can become wet. Before the wood is used for fuel it must be dried. The new ramada will be large enough to keep the wood dry when storing it next to the kiln, keep the kiln and students dry, as well as direct water runoff away from the kiln and its surrounding areas.

1.2 Project Background

The site is located at 1919 S Lone Tree Rd, Flagstaff, AZ 86001, which is on Northern Arizona University's campus. Flagstaff Arizona lies within the bounds of Coconino County. Coconino County lies in Northwestern Arizona Between Mohave County and the Navajo Reservation. Flagstaff is positioned in South Central Coconino County and can be seen in Figure 1-1. Flagstaff is 66 square miles housing Northern Arizona University's (NAU) main campus. NAU campus lies in Central Flagstaff, directly south of downtown Flagstaff. The project vicinity can be seen in Figure 1-2 shown by the red box. The Ramada will be constructed over the kiln shown in yellow located on the aerial photo of the NAU Ceramics Complex, Figure 1-3.

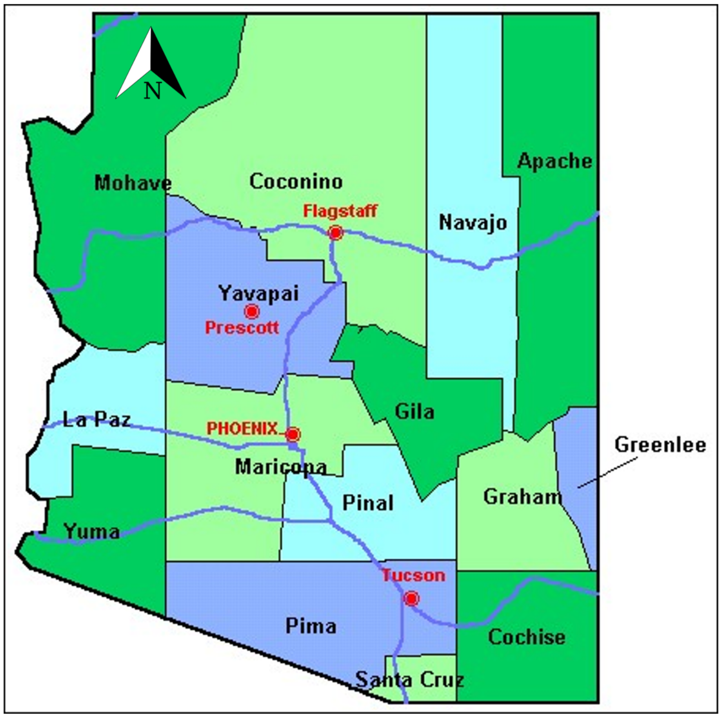

Figure 1-1: Location of Coconino County Within Arizona [1]

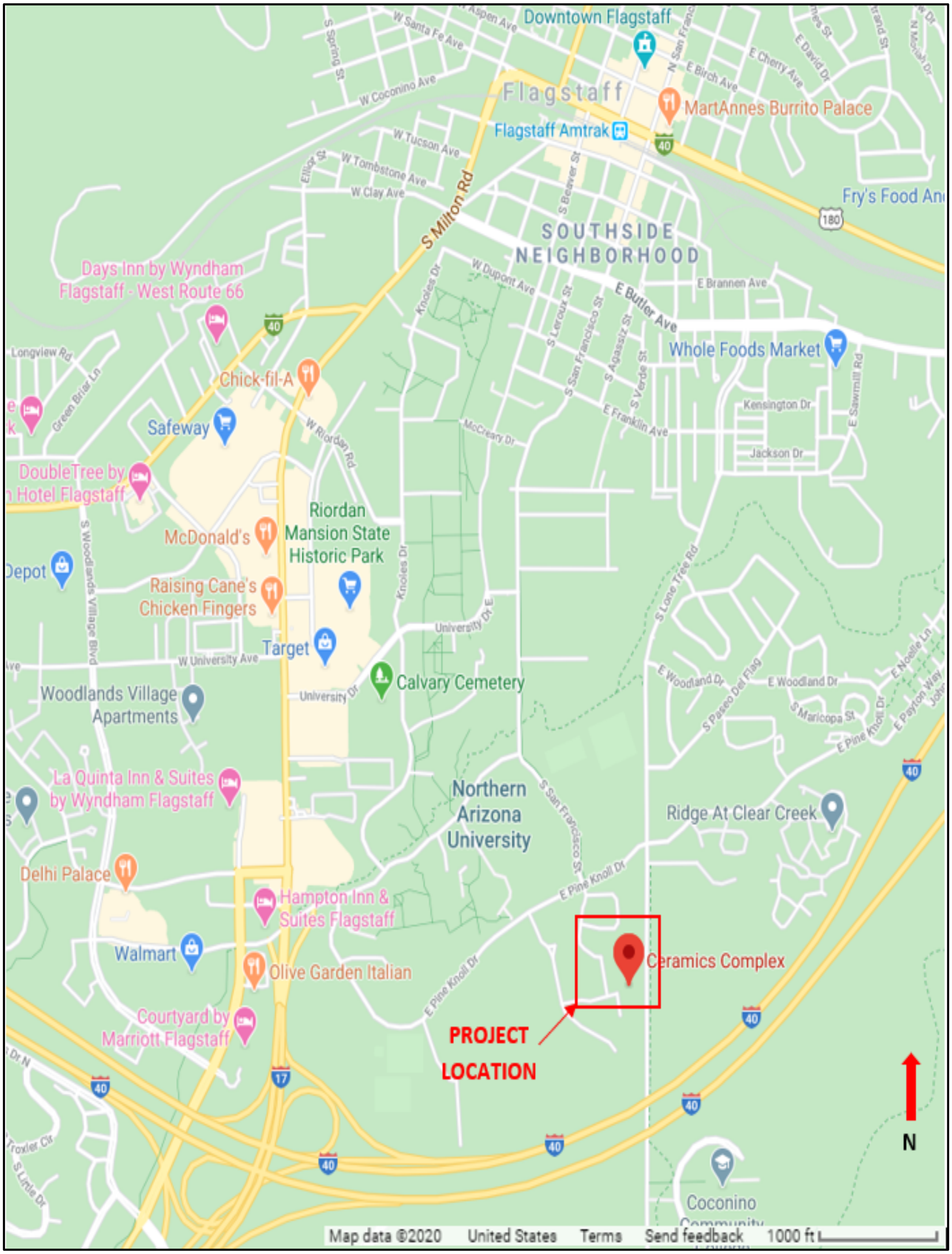

Figure 1-2: Project Vicinity Map [2]

Figure 1-3: Project Site at NAU Ceramics Department [2]

Figures 1-4 and 1-5 show two different views of the kiln to be covered. The kiln is approximately 8'(H) x 18' (L) with a chimney extending about 3-4 feet above the top of the kiln.

Figure 1-4: Side View of the Kiln Looking West

Figure 1-5: Front View of the Kiln Looking North

As seen above in Figures 1-3, 1-4, and 1-5, the site has a relatively natural terrain. The location of the proposed ramada is located on a slope of an estimated 1:4. Additionally, the proposed ramada will be within 5 feet of an existing ramada. There are numerous trees in the area that are within 10 feet of the proposed ramada.

1.3 Technical Considerations

The client has requested the ramada function as a shelter for users during storms, as well as a covered space to keep firing wood dry. Based on our initial site visit there will be multiple site constraints as well as existing issues that need to be considered.

The current site gradation allows water from storms to run down the slope and into the existing ramada that is in front of the uncovered kiln. To provide a functional solution, it is recommended to perform a hydrologic study to assess drainage, a geotechnical investigation, and a site survey.

Performing a drainage analysis provides the basis for implementing and locating adequate storm drainage structures and components within the project area. The drainage analysis will also determine whether the proposed ramada design will influence the existing drainage pattern of the area.

A geotechnical investigation is advised to classify in-situ soils, which determine the amount of clay on site. Clayey soil can prevent drainage and cause footings and foundations to sink and move from their constructed spot. A soil classification will provide the necessary information to design and construct the footings and drainage plan for the ramada.

A site survey is necessary to determine the boundaries and elevations of existing structures to ensure the ramada does not encroach on other structures, making them unusable. The site survey also provides elevations for creating a topographic map, determining in-situ grade, and information to calculate a cut/fill report.

A structural analysis is necessary in order to determine if the ramada can withstand various loads due to safety concerns of those who use the ramada. The analysis will provide information on the sizes of certain components of the structure such as column thickness.

Slab/footing analysis will be conducted. The allowable soil bearing pressure of the soil will be found through soil testing and compared to Flagstaff's minimum allowable soil bearing pressure. Foundation analysis will provide bearing pressures that will be compared to Flagstaff's minimum allowable soil bearing pressure to determine whether native soil is adequate or whether engineered fill will be required. The dimensions of the slab/footing can be expanded to alleviate pressure if need be.

All the above testing and structural analysis will provide adequate knowledge to allow the NAU Pottery Ramada Capstone team to complete the design for the proposed ramada.

1.4 Potential Challenges

As with many projects, challenges will arise during each phase of the project. A few challenges that can be encountered during the projects design phase are limited space, weather, and access to resources. The space surrounding the kiln is very limited. There are multiple structures such as existing ramadas and other kilns surrounding the kiln site that cannot be moved. Other kilns and existing ramadas are within 10 feet of the kiln, therefore restricting the ramada design to fit within a small area. There are also trees near the kiln site that the client would like to preserve for aesthetic purposes. Figure 1-6 shows a few of the trees surrounding the kiln that need to be preserved.

Figure 1-6: Trees West of the Kiln Needing to be Preserved

Weather can impact the project in many ways. Rain and snow can prevent the team from surveying the area due to low visibility. When setting up survey equipment, the total station and tripod have to be stabilized to a reference point that cannot be moved. In order to accurately survey the project site; the survey equipment cannot be shifted or bumped into. If the soil absorbs too much water, it can become unstable and move the equipment requiring the process to be redone.

Another challenge that can be encountered is access to equipment or resources. Due to various teams performing either geotechnical analysis or structural analysis it can become hard to have access to required equipment. In some cases, the equipment required is not accessible on NAU's campus.

Per the client's request, the ramada will be constructed with materials that match the rustic aesthetic of existing nearby structures as shown in Figures 1-7 and 1-8. The challenge that lies within this is ensuring that the structural analysis is done on wood that meets the look requested by the client.

Figure 1-7: Existing Ramada #1

Figure 1-8: Existing Ramada #2

1.5 Stakeholders

The main stakeholder involved in this project is Jason Hess, head of the NAU Department of Ceramics. Northern Arizona University is also a stakeholder in this project considering it is intended to be an on-campus structure. Additional stakeholders in the project would be the students, faculty, and guests on campus using the kiln underneath the ramada.

2.0 Scope of Services

2.1 Task 1: Analyze Existing Site

2.1.1 Task 1.1: Pre-Site Visit Research

A pre-site visit helps determine what information will need to be recorded from the site. Additionally, a pre-visit allows the engineer to collaborate with the client to better understand more clearly the client's needs. Reviewing the purpose of the site visit and understanding what needs to be done will help with pre-site visits.

2.1.2 Task 1.2: Site Visit

A site visit is required to establish an understanding of the existing conditions and limitations of the site. This task will be done by going to the project location and walking the site and its surroundings and taking pictures and notes. Multiple site visits will be done to ensure all data recorded is correct. Additionally, Arizona 811 will need to be contacted to determine where existing utilities lie in the site area.

2.1.3 Task 1.3: Survey

A topographic/boundary survey of the site will be conducted using a total station, a tripod, grade rods, a prism and prism pole, and flagging tape. The recorded survey data will aid the engineering team in creating a topographic map of the site. In addition, the extents of the kiln will be measured such as its height, width, length, etc. using a tape measure.

2.1.4 Task 1.4: Topographic Map

The recorded survey data will be used and combined to create a topographic map of the site. It will be created by using the collected data points from the total station and uploaded into Civil 3D software, which the team will use to generate a visual representation of the data. The topographic map will be used to determine the boundaries, elevations, existing grading, and cut/fill proportions of the site.

2.1.5 Task 1.5: Hydraulic Drainage Analysis

Per the client's request, the topographic map created previously will be used to examine the existing flow conditions of the site. The topography will be the only aspect examined and the topography will determine what site grading changes are needed to control runoff.

2.2 Task 2: Geotechnical Analysis

2.2.1 Task 2.1: Soil Collection

An engineering team will visit the site and collect soil samples from various points across the area of the site. Soil samples will then be tested in the laboratory. The state of the soil will determine if the existing soil is adequate for footings or whether engineered fill will need to be used.

2.2.2 Task 2.2: Laboratory Testing

The team of engineers will examine and analyze the soil samples that were collected from the site and determine appropriate laboratory tests. The following laboratory tests will be performed for analysis:

- Moisture Content (ASTM D2216)
- Atterberg Limits (ASTM D4318)
- Density and Unit Weight of In-Situ Soil by Sand-Cone Method (ASTM D1566)
- Proctor Compaction (ASTM D698)

This will aid in determining the amount of clay in the soil in terms of its moisture content, plasticity index, density, and soil internal friction angle. Classifying the soil will help to determine the shear strength, compressibility, and general characteristics of the soil which will be used when designing the ramada.

To calculate the allowable soil bearing pressure, the Terzaghi ultimate bearing capacity for shallow square foundation equation will be used. In order to calculate the bearing pressure, soil cohesion, depth of foundation, width of foundation, and friction angle will be required. Within the equation the bearing capacity factor will be based on the friction angle. A factor of safety of 2 will be required to ensure the footing does not fail based on the shear stress. The factor of safety will be calculated by dividing the ultimate bearing pressure by the gross bearing capacity.

2.2.3 Task 2.3: Soil Classification

Based on the results from the laboratory testing of the soil samples, the soil classification can be determined using the ASTM soil classification system. Soil classification results will help to determine further necessary steps in the design of the ramada. Depending whether the soil is determined to be clay or sand different measures will be taken such as removal of existing soil.

2.3 Task 3: Structural Analysis

2.3.1 Task 3.1: Examination of Existing Structures

A visual examination of the existing ramadas and kilns on site will need to be completed in order to identify existing materials and ramada geometry. This examination will help in selecting truss, beam, column, joist, decking, and footing designs and material types due to the project design needing to be similar to existing structures.

2.3.2 Task 3.2: Develop Alternatives

Various alternatives will be designed to ensure the client is satisfied with the project. Each alternative will meet the project goal. Having multiple designs will give the client options as well as aiding in determining the best design for the site.

2.3.3 Task 3.3: Ramada Geometry

The dimensions of the ramada, including the height of the columns, the lengths of the trusses/joists and beams, the space between the trusses/joists, the spacing between the columns and beams, the slope of the roof, and all other dimensions will be determined and sketched in AutoCAD.

2.3.4 Task 3.4: Proposed Design Analysis

2.3.4.1 Task 3.4.1: Design Loads

The loading that will be applied to the structural components will be determined. Dead load, live roof load, snow load, wind load, and seismic load will be calculated. Using Table C3.1-1a: Minimum Design Dead Loads (psf) of ASCE 7-16, the roof dead load will be calculated in psf. Roof live load will be calculated using Table 4.3-1: Minimum Uniformly Distributed Live Loads, Lo, and Minimum Concentrated Live Loads of ASCE 7-16. The roof snow load will be calculated using the City of Flagstaff's minimum ground snow load of 60 psf and ASCE 7-16. Wind load will be calculated using ASCE 7-16. Seismic load will be calculated using ASCE 7-16. All the loads determined will be applied to all structural components to ensure the structure can withstand the loads.

2.3.4.2 Task 3.4.2: Roof Diaphragm

Plywood sheathing will be analyzed for max spans, max shear, and max moment. The National Design Specification manual provides tables of values that include the properties of plywood sheathing. These properties include the max allowable lateral loads. These values will be compared to the shears calculated for the design and nailing and plywood thickness will be determined.

2.3.4.3 Task 3.4.3: Trusses/Joists

Trusses/joists will be designed to withstand all the loading seen by the roof: dead, live, snow, wind, and seismic load. Additionally, the trusses/joists must not exceed their allowable stress, allowable bending stress, and allowable deflection when maximum loading is applied.

2.3.4.4 Task 3.4.4: Beams

Beams will be designed to withstand all the loading seen by the roof: dead, live, snow, wind, and seismic load. Additionally, the beams must not exceed their allowable stress and allowable deflection when maximum loading is applied.

2.3.4.6 Task 3.4.5: Columns

Columns will be designed to ensure they do not exceed their allowable deflection from both axial and lateral loading. Additionally, they must not exceed their allowable stress. The reactions from the column due to its loading will be used to analyze the size of footings needed.

2.3.4.7 Task 3.4.6: Foundations

The reactions seen by the columns will be used to design the footings. The shear and axial values and moment values from the column will be transferred to the footing. The compressive strength of the structural concrete will be taken as 4000 psi. Reinforcing will be determined for the thickness and concrete type of the footings. Additionally, the load that will act on the footing will influence the type of reinforcing needed.

2.3.4.8 Task 3.4.7: Connections

The connections that will be designed are listed as follows: roof diaphragm to trusses/joists, trusses/joists to beams, beams to columns, and columns to footings. The connections will either be screws, nails, bolts, plates, etc. The reactions seen at the ends of the member will be used to determine the capacity of a single nail, screw, or bolt. This will in turn determine the number of nails, screws, or bolts needed at the connection. For the column to footing connection, the column moment values will be used to determine the base plate size and anchor bolt size.

2.3.4.9 Task3.4.8: Lateral Analysis

Once the truss/joist design has been specified, a model of the columns and beams will be created using the program RISA 3D. The reactions from the hand calculated truss/joist design, including dead load, live load, snow load, wind load, and seismic load, will be added as a uniform load to the beams in the model. Lateral wind load and seismic load will be applied to both the columns and beams in RISA 3D.

2.3.4.10 Task 3.4.9: Decision Matrix

A decision matrix is a tool that allows the engineer to determine which project design is the best for the client. The decision matrix will help organize the pros and cons of each project and compare them. The design chosen will be based on what the client needs, what the team believes is best and on constraints of the project.

2.4 Task 4: Material Specifications

Wood, steel, and concrete will be the three main materials used for this design. Wood types will be selected for the truss, column, and beams while steel types will be selected for the roofing and decking. Footings will be constructed using a selected concrete.

2.5 Task 5: Site Design

2.5.1 Task 5.1: Plan Set

A plan set will be created once all design aspects are finalized. This will be done by various reviews and addendums done by technical advisors, grading instructors and possibly clients. The plan set will include a cover page, topographic map sheet, general notes and material specifications sheet, plan view and elevation view sheet, foundation plan, framing plan, and foundation details and framing details sheet.

2.5.2 Task 5.2: Cost Estimate

Pricing will be put together based on the materials specified in the plan set. This will give the client a budget. Based on the cost received, changes can be made on the materials to ensure the client is satisfied with the price. Not all prices can be negotiable due to the standards set by NAU and the City of Flagstaff.

2.6 Task 6: Project Management

2.6.1 Task 6.1: Project Impacts

2.6.1.1 Task 6.1.1: Environmental Impacts

The team will look and record pre and post conditions of the project to determine how it impacts the environment. This is important because some impacts can be negative. Minimizing negative impacts is important to the project.

2.6.1.2 Task 6.1.2: Economic Impacts

The existing kiln is exposed to weather and deterioration due to weathering. By protecting the kiln with a ramada, the kiln will have a longer lifespan and the university will save money rather than paying for repairs or replacements.

2.6.1.3 Task 6.1.3: Social Impacts

The aesthetics of the ramada will greatly impact the student's and faculty's view on ceramics at NAU. The ceramics department takes pride in their ceramics complex and using the complex should be a good experience. By providing cover from weather, students and faculty will be protected and therefore enjoy firing in the existing kiln.

2.6.2 Task 6.2: Project Deliverables

2.6.2.1 Task 6.2.1: 30% Submittal

The 30% submittal consists of a report and presentation that will consist of a final determination of existing studies, including a site visit assessment of the project site and analysis of the collected topographical survey data.

2.6.2.1.1 Task 6.2.1.1: 30% Report

The 30% report will discuss the team has completed up to this point in the design phase. Pre-site research and site visit will need to be completed prior to the 30% report. The tasks that are included in the 30% report will include Task 1: Pre-site Visit Research, Task 2: Surveying, and Task 3: Hydraulic Drainage Analysis.

2.6.2.1.2 Task 6.2.1.2: 30% Presentation

A presentation will outline the topics discussed in the report. This is a great opportunity to showcase what we have done and feedback on what needs to be improved.

2.6.2.1.3 Task 6.2.1.3: 30% Plan Set

A 30% plan set will be submitted to illustrate design selections and specifications up until this point.

2.6.2.2 Task 6.2.2: 60% Submittal

The 60% submission consists of a report and presentation that will discuss information found from geotechnical and structural analysis.

2.6.2.2.1 Task 6.2.2.1: 60% Report

The 60% report will show the progress and improvements the team has completed from the previous milestone. Edits will be made based on comments given in the 30%

submission. The tasks that are included in the 60% report will include Task 4: Geotechnical Analysis, and Task 5: Structural Analysis.

2.6.2.2.2 Task 6.2.2.2: 60% Presentation
A presentation will outline the topics discussed in the 60% report. Suggestions based on the previous presentation will be added or improved upon.
2.6.2.1.3 Task 6.2.1.3: 60% Plan Set
A 60% plan set will be submitted to illustrate design selections and specifications up until this point, as well as show improvements from previous submittals.

2.6.2.3 Task 6.2.3: 90% Submittal
The 90% submission will include the final edits to the report and presentation. This will conclude the team's final design. Edits will be made based on comments given in the 60% submission. All of the work will be completed at this point but will be submitted as a first version of the final draft. The tasks that are included in the 90% report will include Task 6: Material Specifications and Task 7: Site Design.

2.6.2.3.1 Task 6.2.3.1: 90% Report
The 90% report will show the progress and improvements the team has completed from the previous milestone. Edits will be made based on comments given in the 60% submission. The tasks that are included in the 90% report will include the first finalized drafts of all of the tasks.

2.6.2.3.2 Task 6.2.3.2: 90% Presentation
A presentation will outline the topics discussed in the 90% report. Suggestions based on the previous presentation will be added or improved upon.

2.7.2.3.3 Task 7.2.3.3: 90% Website
The 90% website will include the first version of the website that will include the plan set, project proposal, presentation, and team contact information.

2.6.2.1.3 Task 6.2.1.3: 90% Plan Set
A 90% plan set will be submitted to illustrate design selections and specifications up until this point, as well as show improvements from previous submittals.

2.6.2.4 Task 6.2.4: Final Submittal
The final submission to the client will include the final report, presentation, plan set, and website.

2.6.2.4.1 Task 6.2.4.1: Final Report

The final report will consist of the final analysis and final proposed design and plan set which will be provided to the client. All tasks will be complete and ready for final submission.

2.6.2.4.2 Task 6.2.4.2: Final Presentation

The final presentation will consist of the final analysis, proposed design, project schedule, staffing plan, and cost of services.

2.6.2.4.3 Task 6.2.4.3: Final Plan Set

The final plan set will be the team's proposed design, which will be provided to the client for construction.

2.6.2.4.4 Task 6.2.4.4: Final Website

The final website will include the completed plan set, finalized proposal, final presentation, and team contact information.

2.6.3 Task 6.3: Meetings

Meetings with the client, technical advisor, grading instructor, and team will be held at various times throughout the project timeline. The purpose of these meetings will be to better the project deliverables and create a ramada design that meets all of the client's constraints and criteria.

2.6.3.1 Task 6.3.1: Client Meetings

Client meetings will be held periodically to ensure that the engineering team is meeting design expectations from the client. The client, Jason Hess from the NAU Ceramics Department, will provide the team with feedback and possible concerns for each of the deliverables.

2.6.3.2 Task 6.3.2: Technical Advisor Meetings

Technical Advisor meetings will be scheduled prior to the 30%, 60%, 90%, and final design submittals to the client. The technical advisor, Sabrina Ballard from Hubbard Merrell Engineering, will provide the team with helpful insight and assistance in making sure each deliverable is accurate and meets all of the needs of the client.

2.6.3.3 Task 6.3.3: Grading Instructor Meetings

Meetings with the grading instructor, Jeffrey Heiderscheidt, will be conducted frequently throughout the project timeline and will include discussions of deliverables, scheduling, project updates, redlines, and guidance for the team.

2.6.3.4 Task 6.3.4: Team Meetings

Team meetings will be held at minimum once per week throughout the project timeline. This will ensure that every member is on the same page with project deliverables, scheduling, and meetings.

2.6.4 Task 6.4: Resource Management

Resource management will be done as a team effort in order to complete all deliverables at a high-quality level within the time constraints provided. The team will keep track of resources such as money, time, and personnel.

2.6.5 Task 6.5: Schedule Management

The project schedule is based on information the team has to complete the task. The schedule shows the start and finish of the project as well as task information. Possible scheduling setbacks will be addressed to the team in a timely manner in order to prevent further delays. Changes/updates will be made based on how the team is performing the task. Some task time might increase or decrease.

2.7 Exclusions

We will be excluding the acquisition of materials, designing drainage structures, analysis of the watershed, analysis of the drainage on site, and analysis design of modifications to existing structures due to lack of expertise in construction, time, and personnel.

3.0 Project Schedule

The project schedule can be seen in Appendix A located at the end of this report. The project timeline is expected to begin on August 24th, 2020 and end on December 8th, 2020.

3.1 Overview

The project duration will be approximately 99 days, this excludes major holidays and weekends. Major tasks and deliverables include geotechnical analysis, structural analysis, 30% submittals, 60% submittals, 90% submittals, and the project website.

3.2 Milestones

Several milestones key to the success of the project are as follows: the topographic map, soil classification, the ramada geometry, each task within the proposed design analysis, the decision matrix, material specifications, the final site design plan set and cost estimate, and the 30%, 60%, 90%, and final submittal deliverables. Each plan set deliverable indicates significant progress of the project and will act as an internal check to ensure the team is on track.

3.3 Critical Path

The critical path is shown in red on the GANTT chart in Appendix A. The key tasks on the critical path include the site visit, topographic map, soil classification, ramada geometry, the proposed design analysis, the final site design plan set, and final submittal deliverable. The most crucial aspect of the critical path is the proposed design analysis. This task will take the longest time to complete due to each design aspect needing to be selected one after the other based on the determined ramada geometry. The team will consult with the grading instructor and technical advisor to ensure the analysis is done properly. To ensure that the project stays on the critical path, the team will update scheduling as needed.

4.0 Staffing Plan

The staffing plan table can be seen in Appendix B located at the end of this report. The following personnel are required to complete the project and must have the following qualifications:

1. Senior Engineer
   A professional engineer registered in Arizona who has worked a minimum of 15-20 years in the structural engineering field.
2. Engineer
   A professional engineer registered in Arizona who has worked a minimum of 5 years in the structural engineering field.
3. Engineer in Training
   Recent graduate from an ABET accredited university that is pursuing structural engineering as a career. Must have 6 months of experience in the structural engineering field.
4. Lab Technician
   A technician who has a degree in geotechnical engineering and must have worked in the field for a minimum of 5 years.
5. Engineering Intern
   A current student or new graduate pursuing a structural engineering license and must have worked a minimum of 6 months in the structural engineering field.
6. Administrative Assistant
   An administrator who has worked a minimum of 5 years in a role as an office manager. Must be proficient in the use of Microsoft Word, Microsoft Excel, Microsoft Project, and Ajera.

5.0 Cost of Engineering Services

The cost of personnel is $72,237.55 while the cost of supplies is $1850.00, which gives an overall total cost of $74,087.55. The billing rate per personnel is based on a base pay, dollars per hour, benefits percentage of the base pay, an actual base pay, overhead percentage of base pay, actual pay plus overhead pay, and a profit percentage of actual pay plus overhead. Each percentage is applied to the base pay and a billing rate per personnel is created. A multiplier, the billing rate divided by the base pay, can be multiplied to the base pay to simplify the process, with the highest multiplier for the senior engineer and the lowest multiplier for the intern. The estimated hours, billing rate, and cost for the project can be seen in Table 5-3 located below.

Table 5-3: Project Costs

1.0 Personnel	**Classification**	**Hours**	**$/hr**	**Cost**
	SENG	67	$201.50	$13,500
	ENG	141	$132.50	$18,682.50
	EIT	291	$99.40	$28,925.40
	LAB	86	$47.60	$4,093.60
	INT	140.5	$21.70	$3,048.85
	AA	64	$62.30	$3,987.20
	Total Personnel			**$72,237.55**
2.0 Supplies	**Classification**	**Days**	**$/day**	**Cost**
	Surveying	1	$250.00	$250.00
	Geotechnical Equipment	1	$200.00	$200.00
	Geotechnical Lab	4	$350.00	$1,400.00
	Total Supplies			$1,850.00
3.0 Total				**$74,087.55**

The hours reflect which roles are specifically involved with this project. The senior engineer has less hours than the engineer due to only having to approve calculations and determine that the team is on schedule. The engineer has to work alongside the engineer in training to ensure that the analysis process is being done correctly. The engineer in training has the most hours due to the fact that he is assigned most of the work in order for the senior engineer to approve final plans. The intern will assist the engineer and engineer in training on any of the tasks that require research for each of the submittals, therefore they will have a fair share of hours on this project. The administrative assistant will help with the financial side of the project, their role is to ensure the budget is not exceeded. The lab technician will only work on the project tasks where lab analysis is required.

6.0 References

[1] C. Laminated, "Coconino County Arizona Map", *OnlyGlobes.com*, 2020. [Online]. Available: https://www.onlyglobes.com/Coconino_County_AZ_Map_p/lam-coconino-az.htm. [Accessed: 02- Feb- 2020].

[2] "Google Maps", *Google Maps*, 2020. [Online]. Available: https://www.google.com/maps. [Accessed: 02- Feb- 2020].

7.0 Appendix

Appendix A: Project Schedule

ID	Task Name
1	**Task 1: Analyze Existing Site**
2	1.1: Pre-Site Visit Research
3	1.2: Site Visit
4	1.3: Survey
5	1.4: Topographic Map
6	1.5: Hydraulic Drainage Analysis
7	**Task 2: Geotechnical Analysis**
8	2.1: Soil Collection
9	2.2: Lab Testing
10	2.3: Soil Classification
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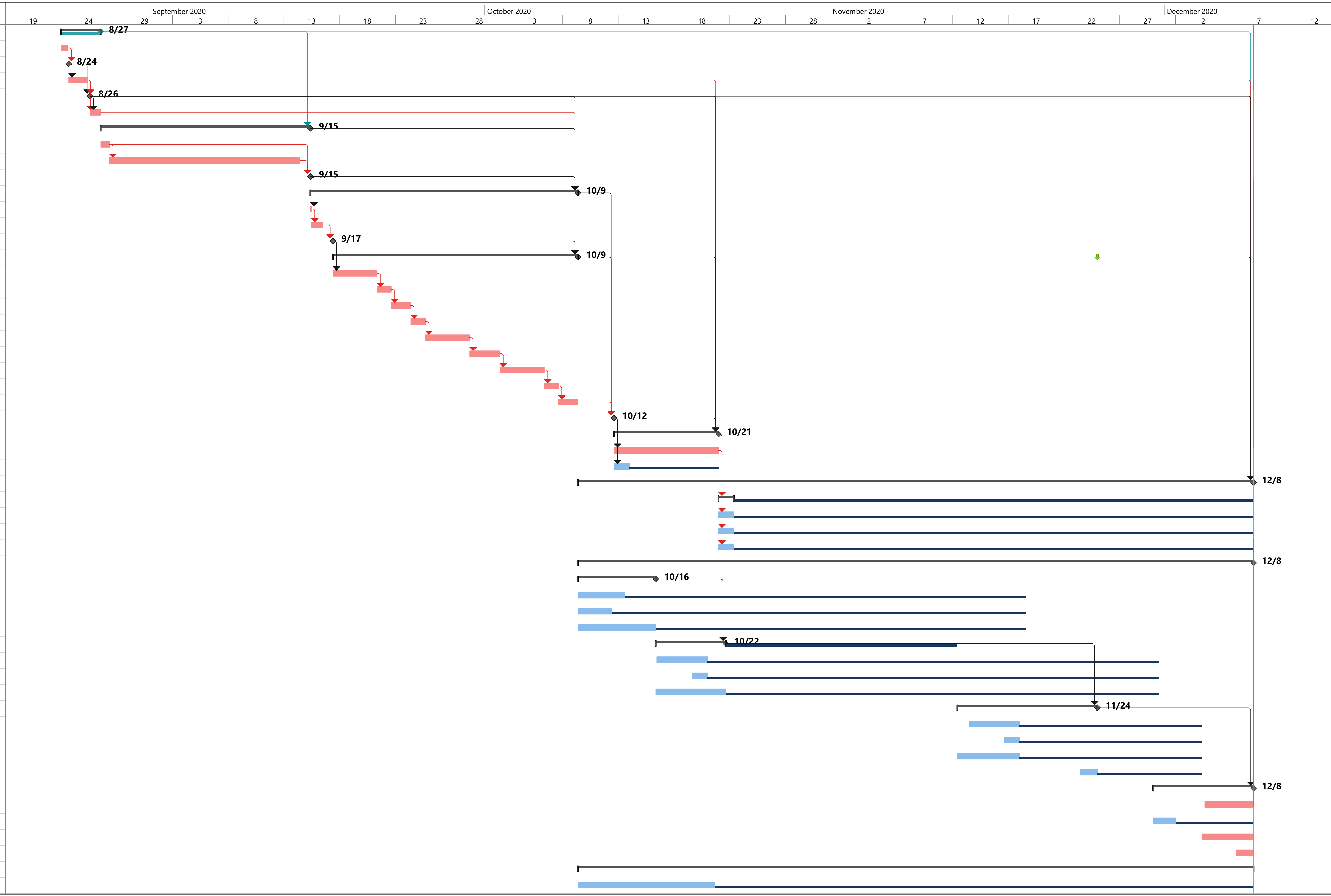
19	3.4.4: Beams
20	3.4.5: Columns
21	3.4.6: Foundations
22	3.4.7: Connections
23	3.4.8: Lateral Analysis
24	3.4.9: Decision Matrix
25	**Task 4: Material Specifications**
26	**Task 5: Site Design**
27	5.1: Plan Set
28	5.2: Cost Estimate
29	**Task 6: Project Management**
30	**6.1: Project Impacts**
31	6.1.1: Environmental Impacts
32	6.1.2: Economic Impacts
33	6.1.3: Social Impacts
34	**6.2: Project Devilerables**
35	**6.2.1: 30% Submittal**
36	6.2.1.1: 30% Report
37	6.2.1.2: 30% Presentation
38	6.2.1.3: 30% Plan Set
39	**6.2.2: 60% Submittal**
40	6.2.2.1: 60% Report
41	6.2.2.2: 60% Presentation
42	6.2.2.3: 60% Plan Set
43	**6.2.3: 90% Submittal**
44	6.2.3.1: 90% Report
45	6.2.3.2: 90% Presentation
46	6.2.3.3: 90% Plan Set
47	6.2.3.4: 90% Website
48	**6.2.4: Final Submittal**
49	6.2.4.1: Final Report
50	6.2.4.2: Final Presentation
51	6.2.4.3: Final Plan Set
52	6.2.4.4: Final Website
53	**6.3: Meetings**
86	**6.4: Resource Management**



Project: CAPSTONE SCHEDULE
Date: Sun May 3

Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Critical Split	Slack
Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline	Progress	
Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Critical	Manual Progress	

Appendix B: Staffing Plan

	Staff (Hours)							
Task	SENG	ENG	EIT	LAB	INT	AA	**Total Hours**	Days Allotted
1.0 Analyze Existing Site								
1.1 Pre-Visit Site Research	0	2	2	0	2	0	**6**	0.75
1.2 Site Visit	0	0.5	0.5	0	0.5	0	**1.5**	0.1875
1.3 Survey	0	1	4	0	4	0	**9**	1.125
1.4 Topographic Map	0	0	1	0	4	0	**5**	0.625
1.5 Hydraulic Drainage Analysis	0	0.5	4	0	2	0	**6.5**	0.8125
2.0 Geotechnical Analysis								
2.1 Soil Collection	0	0	0	0	4	0	**4**	0.5
2.2 Laboratory Testing	0	0	0	80	2	0	**82**	10.25
2.3 Soil Classification	0	0	0	6	1	0	**7**	0.875
3.0 Structural Analysis								
3.1 Examination of Existing Structures	0.5	0	0.5	0	0.5	0	**1.5**	0.1875
3.2 Develop Alternatives	1	2	4	0	2	0	**9**	1.125
3.3 Ramanda Geometry	0.5	2	3	0	0.5	0	**6**	0.75
3.4 Proposed Design Analysis								
3.4.1 Design Loads	1	4	8	0	2	0	**15**	1.875
3.4.2 Decking	1	4	6	0	2	0	**13**	1.625
3.4.3 Trusses/Joists	1	4	4	0	2	0	**11**	1.375
3.4.4 Beams	1	4	8	0	2	0	**15**	1.875
3.4.5 Columns	1	4	8	0	2	0	**15**	1.875
3.4.6 Foundations	1	4	6	0	7	0	**18**	2.25
3.4.7 Connections	1	4	8	0	3	0	**16**	2
3.4.8 Lateral Analysis	1	4	6	0	2	0	**13**	1.625
3.4.9 Decision Matrix	1	2	8	0	0	0	**11**	1.375
4.0 Material Specifications	2	3	8	0	0	0	**13**	1.625
5.0 Site Design								
5.1 Plan Set	12	14	24	0	8	0	**58**	7.25
5.2 Cost Estimate	2	2	2	0	4	0	**10**	1.25
6.0 Project Management								
6.1 Project Impacts	1	2	4	0	2	0	**9**	1.125
6.1.1 Environmental Impacts	1	2	4	0	2	0	**9**	1.125
6.1.2 Economic Impacts	1	2	4	0	2	0	**9**	1.125
6.1.3 Social Impacts	1	2	4	0	2	0	**9**	1.125
6.2 Project Deliverables								
6.2.1 30% Submittal								
6.2.1.1 30% Report	0.5	4	12	0	4	0	**20.5**	2.5625
6.2.1.2 30% Presentation	0.5	1	4	0	4	0	**9.5**	1.1875
6.2.1.3 30% Plan Set	4	8	24	0	4	0	**40**	5
6.2.2 60% Submittal								
6.2.2.1 60% Report	1	4	12	0	4	0	**21**	2.625
6.2.2.2 60% Presentation	1	1	4	0	4	0	**10**	1.25
6.2.2.3 60% Plan Set	2	8	24	0	4	0	**38**	4.75
6.2.3 90% Submittal								
6.2.3.1 90% Report	1	8	8	0	4	0	**21**	2.625
6.2.3.2 90% Presentation	1	1	4	0	4	0	**10**	1.25
6.2.3.3 90% Plan Set	6	4	16	0	4	0	**30**	3.75
6.2.3.4 90% Website	0	1	4	0	8	0	**13**	1.625
6.2.4 Final Submittal								
6.2.4.1 Final Report	2	4	8	0	4	0	**18**	2.25
6.2.4.2 Final Presentation	2	4	8	0	2	0	**16**	2
6.2.4.3 Final Plan Set	2	8	8	0	4	0	**22**	2.75
6.2.4.4 Final Website	1	2	2	0	8	0	**13**	1.625
6.3 Meetings								
6.3.1 Client Meetings	0	4	4	0	0	0	**8**	1
6.3.2 Technical Advisor Meetings	4	2	4	0	4	0	**14**	1.75
6.3.3 Grading Instructor Meetings	4	2	4	0	2	0	**12**	1.5
6.3.4 Team Meetings	2	4	8	0	8	0	**22**	2.75
6.4 Resource Management	2	2	2	0	0	64	**70**	8.75
						Total	**789.5**	**98.6875**

SENG	ENG	EIT	LAB	INT	AA
67	141	291	86	140.5	64