

Rehak MSA Engineering

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Acceptance Committee
Clyde Building
471 class

Dear Acceptance Committee

It is with great anticipation that my team and I would like to submit our proposal for the Provo Tabernacle Footing Restoration and Upgrade. It is understood that this historical relic caught fire and suffered much damage during the fire that occurred December 17th, 2010. Due to this accident everything but the four exterior walls were burned to the ground. Now this building needs extensive renovation, including, but not limited to a new foundation, basement and game plan to accomplish this without taking down the existing exterior brick walls.

Rehak MSA Engineering has a great team that is well equipped to handle this type of project. Not only have they had the appropriate training (classes: soils, foundations, structures, revit, slope stability, etc.), but one of the members of the team actually has experience building, lifting, and replacing foundations. The team has only been together for a few short weeks, but they have already exhibited excellent work ethics and teamwork. The team is made up of two civil engineers with an emphasis in soils, one has an emphasis in structures, and the last in hydrology. The engineers are, Eric Scott, Alisha Maxwell, Tyler Rehak and Elizabeth Alletto. This team of engineers is a powerful combination for designing the best foundation for the new temple that is going to be built.

As a team we have discussed the issue at hand, and have concluded that a series of tests need to be run on the soil near the foundation to find out its characteristics and what loads it can carry. We also need to find out the live and dead loads that are going to be put on the completed structure so that we can design a footing strong enough to withstand these loads. From this information, and with some help from professors we are going to design the foundation, and the method to hold the walls up as we remove and replace the existing foundation.

As there is considerably more to relate, our team looks forward to the time where we can meet in person and discuss more about our qualifications and how we will be an asset to the construction of the temple.

Sincerely,

Rehak MSA Engineering

Executive Summery

The Provo Tabernacle is a very sacred and cherished building among Latter-Day Saints. This past December an unfortunate fire destroyed most of the building. However, when the First Presidency of the Church announced during this past General Conference that this building would be restored and converted into a new temple, our sadness changed to excitement. There is going to be a lot of work and money put into rebuilding the structure. The building needs a new foundation and basement. This would not be that difficult if we started from scratch, however the four outer walls are standing and the church wants them to remain erect during construction. This is going to require skillful engineering to complete.

Our group is ready and willing to take on the challenges of designing a new foundation and has a plan to get it done. Each member of our group has unique traits and knowledge; and when brought together as a whole we are the perfect group for this project. Most of the individuals in the group have taken, or are going to be taking the most important classes that would prepare them for this project. These classes are, soils, structures, slope stability, foundation design, hydrology, geology and much more. However important that these classes really are, our experience and the people that we know really make us strong. Our team leader, Tyler Rehak, has many years of experience building houses, foundations, lifting houses, and retaining walls. He has also done an internship with a geotechnical firm in which he worked alongside a soils engineer. He is also working right now for a firm in Orem Utah called Earthtech Engineering. Tyler is well connected with these engineers who could help with this project. Eric Scott's Father is also a structural engineer that owns his own business. We have also talked to Dr. Richards, and Dr. Rollins and they are willing to help us out if we get this project.

As mentioned above Tyler Rehak is the team leader, and he will be ultimately responsible that things get done and on time. Elizabeth Alletto is the secretary of the team, and will email the team

notes and deadlines. Eric Scott is well acquainted with multiple computer modeling programs and he will help us interpret the data we get from these programs. Alisha Maxwell has a solid understanding of soils engineering and she also has experience with soils tests and programs. She is also very organized and is an excellent planner.

We plan on meeting three hours every Monday from 3:00 – 6:00 pm as a group to work on the project, and another three hours individually sometime during the week. During these group meetings we are going to discuss what we need to accomplish that week, delegate what needs to be done, and resolve any issues that might have arisen.

Designing the foundation for the tabernacle will not be an easy feat. There are many unknown variables that we are going to have to find; the live and dead loads that the building will on the ground and the strength. Tests and programs are going to be run to determine the capacity of the soils below the foundation. We have run most of these tests and programs; and are fully equipped to use them in the design process.

Lastly, using Maximum Allowable Construction Cost (MACC) of the project and minor calculations we determined the cost of this project. Realizing that we are beginning engineers, we carefully calculated how much it would cost for us in the four months given next semester to create a plan and design the foundation to be built. That cost was about \$18,000 for the entire project.

STATEMENT OF QUALIFICATIONS

We have outlined below the factors which demonstrate our qualifications to complete the Provo Tabernacle Footing Design Project. Not only have we taken the required classes, we also have experience and a strong support base. With these strengths and backgrounds we will perform in an accurate, timely, and proficient manner.

Between the four members of our team, we have taken the required courses for this project. With regards to geotechnical engineering, Tyler and Alisha have taken Elementary Soils Mechanics (CE 341) while Elizabeth and Eric will be in soils during winter semester. In addition, Alisha and Tyler will be taking Foundation Engineering (CE 542) during winter semester. Alisha is currently enrolled in Seepage and Slope Stability (CE 544) which has instructed her in the usage of seepage and slope analysis programs. With respect to structural engineering, we meet the requirements as well. All four team members have taken Structural Analysis (CE 321) and Reinforced Concrete Design (CE 424). Furthermore, three of us have completed Structural Steel Design (CE 421).

Perhaps most importantly, Eric is currently taking Building Information Modeling/Revit (CM 494 R), educating him how to use analysis programs.

While the completion of pertinent course work is necessary, what distinguishes our team is the depth of experience gleaned outside of the classroom. Tyler has constructed multiple houses, foundations, and retaining walls, as well as experience lifting houses and foundations. Additionally, he worked for SHARP construction, a company that builds soil retention systems. Alisha currently TA's for Dr. Rollins' Elementary Soil Mechanics class and Elizabeth learned group and leadership skills while on the Mexico study abroad program. On the structures side, Eric previously worked in the CAD department at PCS Structural Solutions in Tacoma, WA. Due to what he learned from this experience, in addition to his modeling class, Eric is proficient with analysis and modeling programs. As a result of these past and current experiences, our team rises above our competition in competence and ability.

Our team also has access to multiple outside consultants. We have already succeeded in enlisting Dr. Rollins and Dr. Richards as counselors if awarded this project. In addition to these professors, our group members have personal contacts that would be valuable during the design process. Tyler's father has many years of construction experience lifting and removing foundations. Tyler has also worked for a family friend who is a geotechnical engineer and owns his own firm Grice Engineering. Eric also has an important contact; his father, Don Scott, P.E., is a practicing structural engineer.

Although we are novice engineers, we have the course work, experience, and support base needed to perform well on the Provo Tabernacle Footing Design Project. We are confident our abilities fit this project well.

Work Plan

Our team will work together to integrate our knowledge of structural, geotechnical, and water resource engineering to design the footing restoration and upgrades of the Provo Tabernacle. We will be working as a group once a week for three hours. Each team member will also be working independently for three hours once a week. Every person has an individual role in the team and responsibility as outlined below.

Tyler Rehak will be the team leader. He will help each member of the team stay on track with the scheduled outcomes as well as make final decisions for the team. He is outgoing and confident in his decisions and will be accountable for the scheduled deadlines. Based on Tyler's work experience with contractors and construction, he can better lead the group and make judgments as issues arise. He has had helped build and lift buildings in the past and will be able to guide our group to a feasible solution.

Elizabeth Alletto will be the secretary of the team. Her responsibilities will include taking notes for the weekly team meetings as well as for any other project planning meetings. In order for

the team to be unified and working the most efficiently, she will provide the team with weekly emails summarizing the agenda and outlining any assignments. Elizabeth will also be the main contact with Dr. Rollins and Dr. Richards.

Eric Scott is proficient in computer modeling and analysis programs. He has a background in structures and will be performing many of the tasks associated with computer analysis. He will be the one other members of the team will go to if they experience difficulties with any programs or other structure related problems. He will instruct the team members how to use and interpret the analysis from the programs.

Alisha Maxwell is comfortable and knowledgeable in geotechnical engineering and has had experience with the associated computer programs. Her main job will be to use and teach the other team members the soils programs needed for analyzing the lateral forces of the soil on the basement. Alisha is also very organized and will be making a detailed schedule for each member of the team. She will organize group meeting times based on the individual team member's schedules.

Each week, we will spend three hours together as a team working on the project and three hours working individually on the problem. We have scheduled our time so that we can meet every Monday as a team from 3:00 to 6:00. Elizabeth will be working every Tuesday from 3:00 to 6:00, Eric and Alisha will be working Friday from 8:00 to 11:00, and Tyler will work every Friday from 10:00 to 1:00.

We cannot foresee every problem that may arise while designing the footings for the Provo Tabernacle, but we are problem solvers who will work together and work hard to overcome the challenges this project will bring. We will research and analyze solutions and methods for the footing restoration and upgrade of the Provo Tabernacle. We will be organized and stay on schedule for each milestone in the project. We are excited about this project and hope to work to restore a building that is not only significant to the Church's history, but to its future.

Tools, Data, and Equipment necessary

Proper preparation for the project allows us to fully assess the various problems and challenges that come in the design of the Provo tabernacle foundation and basement. Listed below are some of the tools, data, and equipment that we intend on using to complete our project.

Understanding the design procedures of the project requires that we share a unified vision with the Church of Jesus Christ of Latter-day Saints. Having such a vision allows us to determine what is necessary for the design of the Provo Tabernacle footing restoration. Necessary data would include the design codes and expectancy of the building. It is essential to have information outlining the desired design criteria for the project. Specific examples of necessary data include loads that can be expected to fall on the structure. Additionally, understanding the seismic requirements of the structure during construction is crucial. Furthermore, it will be necessary to retrieve data about the soil currently located near the Tabernacle. Collected soil data will allow us to efficiently assess the lateral earth pressure that will be exerted on the basement.

Collecting proper data constitutes a big part of the project. One specific area of concern is the data necessary to plan for the pressure that the soil places on the basement portions of the structure. Depending on the resources available to the team, collecting soil sample and running analysis tests may be necessary to determine the soil type and how it will react to the demands of a basement foundation. We would like to have access to the site with the accessibility of collecting a site sample for examination. Given provided permission, we would hope to use the BYU soils lab to analyze the site sample.

Major tools essential for the projects allow our team to complete a professional design for the client. One of the most important tools that we intend to use is computer programs to analyze and model the design. We anticipate using AutoCAD's Revit Structures to efficiently model what the foundation will look like. Additionally, using the Revit program will allow us to provide a visual presentation for the client. Likewise, having a model that is well developed provides easy integration

to structural analysis programs. We hope to use student available structural analysis programs provided by the BYU construction management program. Analyzing the design allows for a professional style report for clients.

MILESTONES

January 11: Have necessary data and distribution of responsibilities

February 1: Analyses determined in order to present to an advisor to look over

February 8: Appropriate assessment of the forces which the structure may be called upon to resist complete

March 15: Decision made on the type of foundation to be designed

March 29: Final design will be complete

Project Due: Poster, Presentation, Final Report, and other aspects of the project will be Finished

Engineering Design Budget

In determining our design budget for our project, we hope to use several different factors to govern how much we would charge for our services. Several items will be discussed in the following paragraphs that lead to an overall determination of what a realistic design budget for our project would be.

By assessing the knowledge and skills of our team members, we agree that our level experience is relatively low in comparison to other firms. Using one of our contacts, we learned that entry level Civil Engineers without a master's degree look at a starting salary around \$50,000 per year. We estimate that the project will require 4 months out of the year to complete the design. Furthermore, we estimate that an average of 6 work hours per week per team member will be spent on the project. Therefore, we would reduce the \$50,000 per year for an entry level engineer by factors of 1/3 to account for number of months of work and by 24/40 to account for the weekly time put into the project. Based on these calculations we would estimate to charge \$10,000 for the

engineering of the project.

Another method of estimation would be based on an hourly wage for the various members of the team. Assuming that all the members of our team have passed the fundamentals of engineering exam, we would hope to charge a flat rate of \$55 per hour of labor. Working for 6 hours a week, over a 16 weeks period, we hope to charge a rate of \$5280 per team member, or a total of \$21,120 for the duration of the project.

Lastly, we might calculate the design budget based on the Maximum Allowable Construction Cost (MACC) of the project. Assuming that the foundation and basement design for the Provo Tabernacle would be a \$1,500,000 project, we would do the following calculations to determine what the overall costs for our project would be.

For us to do a \$1,500,000 Provo tabernacle basement we would take the MACC (\$1,500,000) and find the allowable fee percentage of 6.03% (it is a schedule B building type). Then we would use the following formula to calculate our portion of the fee.

$$\text{Overall design team fee} = \$1,500,000 \times 6.03\% = \$90,450$$

$$\text{The Structural portion of the fee} = \$1,500,000 \times 6.03\% \times 60\% \text{ (this is to reduce the MACC for mechanical, electrical and civil work leaving only the architectural and structural)} \times 21.5\% \text{ (a common factor used for the structural portion of the work)} = \$19,446.80$$

Our structural design fee would then be broken down into different portions to account for the phases in the project.

Taking into account the three different methods of determining our cost for the project, we have chosen a total amount for \$18,000 to be billed for the entire project.