2.0 Scope of Services

2.1 Task 1: Competition Due Diligence

Thoroughly read the provided competition rules and determine the ways in which the information will be applied to the bridge design process. Make note of the grading criteria for the competition and follow closely to design and construct a high-scoring final product. This is necessary to ensure the team cannot be disqualified for rule violations and the overall team performance leads to a high rank at the competition.

2.2 Task 2: Impact Analysis

Analyze the potential environmental, social, and cultural impacts the project might have in the area of study. Ensure the construction process can take place within the given area parameters to avoid major disruption of the surrounding environment. This is necessary to reduce the negative impacts that result from the project.

2.3 Task 3: Conduct Material Research

Conduct research on various construction materials by noting respective tensile strength, ultimate strength, modulus of elasticity and other relevant material specifications. Use the aforementioned research to determine the most effective material with which to construct the steel bridge members and connections. This is necessary to identify the ideal material options to be used in the design and maximize positive results.

2.4 Task 4: Research Potential Bridge Designs

2.4.1 Task 4.1: Cantilever Design

Conduct research on common cantilever designs in similar scenarios to the project objective and the potential setbacks and benefits of each design option. Conduct analysis through RISA to test different cantilever designs and make note of weak points and/or areas of failure that must be adjusted in the design. This is necessary to verify the success of failure of the cantilever design and identify any areas needing improvement.

2.4.2 Task 4.2: Member Design

Conduct research on common member shapes, sizes, etc. and the applications in scenarios similar to the project statement. Conduct analysis through RISA to test different member designs and make note of weak points and/or areas of failure that must be adjusted in the design. This is necessary to verify the success of failure of the member configuration and identify any areas needing improvement.

2.5 Task 5: Conduct Connections Design Research

2.5.1 Task 5.1: Material Specifications

Conduct research on the various possibilities of connection materials that comply with the project specifications and compare them to determine the best possible connection to use to maximize strength while minimizing weight and cost in the design. This is necessary to ensure the connections in each part of the design are capable of withstanding the necessary loads without failure.

2.5.2 Task 5.2: Connection Schematics

Conduct research regarding the options of commercially available connection types and the corresponding advantages and disadvantages of each. Research entails making note of possible connection dimensions, prices, weights, and material. Hand calculations will be made to account for the impact at each point of connection. This is done to verify there are no points of failure in the design at points of connection and identify any points of improvement.

2.6 Task 6: Conduct Modelling and Analysis of Design

2.6.1 Task 6.1: Loading Calculations

Conduct loading calculations to determine loads the bridge can withstand that follow the parameters defined by competition rules. Conduct analysis through RISA to determine the amount of loading the bridge can withstand at various points along the span. Ensure the design can withstand at minimum, the loads set to be applied at competition and make note of any weak points and/or area of failure to be adjusted. This is necessary to determine the loading capabilities of the design and identify any points of failure that must be adjusted.

2.6.2 Task 6.2: Calculate Stress and Strain Values

Calculate the stress and strain values using the aforementioned material specifications to determine what loads the bridge is capable of withstanding before cracking and/or breaking. Conduct analysis through RISA to determine the stress and strain values within members and connections for various loading combinations on the bridge. Consider stress and strain resulting from both dead and live load combinations. This is done to determine the maximum loading values the materials can withstand so they can be accounted for in the final design.

2.6.3 Task 6.3: Log Data of Tensile Tests

Collect and record the data outlining results for tensile strength testing as it pertains to members and connections and graph the collected data. This is done to determine the relationship between stress and strain to show the yield strength, ultimate strength and point of fracture for each material.

2.7 Task 7: Shop Drawings

Develop shop drawings outlining profile, plan and perspective views of final design as developed in RISA. Clearly outline all member and connection dimensions, materials and locations in a professional and organized manner so that drawings may be easily read by subcontractors. This is

done to provide a comprehensible guide for subcontractors to follow in attempts to minimize error during manufacturing.

2.8 Task 8: Coordinated Assembly: Member Fabrication

Facilitate with the subcontractors that are responsible for the steel member fabrication and welding and provide them with the chosen material specifications necessary for the design. This is done to ensure the successful fabrication of the members within the necessary timeframe of the project.

2.9 Task 9: Coordinated Assembly: Connection Fabrication

Facilitate with the subcontractor that is responsible for connection fabrication and provide them with all the necessary material specifications such as size and materials. This is done to ensure the successful fabrication of the connections as outlined in the shop drawings within the necessary timeframe of the project.

2.10 Task 10: Team Assembly: Modifications and Member Connection

As a team, conduct member connection practice upon the completion of member and connection fabrication by the contracting companies. Ensure that the member and connection dimensions are compliant with the competition requirements and verify that they match the details provided in the shop drawings. Make note of any variance in dimensions or material and if necessary, modify parts accordingly. This is done as a means of quality assurance to ensure the manufactured pieces align with the final RISA design.

2.11 Task 11: Team Assembly: Construction Practice

As a team, practice assembly of the bridge and ensure construction time is under the limit defined within the competition rules. Repeat the process as needed until the time limit as defined in competition rules is not exceeded and safe assembly of the bridge with no faults or hindrances can be consistently achieved. This is done so adjustments can be made as necessary in attempts to minimize construction time as much as possible, resulting in a higher score in the construction time category at the competition.

2.12 Task 12: Compete in Regional Competition

Compile all bridge members and connections and transport to the competition location. Assemble the bridge and submit to be subjected to load tests as outlined in the competition guidelines. Present poster outlining final design and the summary of steps followed to develop the final product. Execution of each task is necessary for successful performance in the competition.

2.13 Task 13: Project Deliverables

2.13.1 Task 13.1 30 Percent Deliverable

Complete the 30 percent deliverable containing the completed competition research and planning. It must include the provided dimension parameters and required loading capacity for the bridge as defined within the competition rules. In addition, background research, steel design/analysis, material selection, decision matrix and preliminary design for the bridge must be included. This is necessary to ensure the successful progression of the project.

2.13.2 Task 13.2: 60 Percent Deliverable

Complete the 60 percent deliverable containing a complete model of the bridge including the shop drawings and schematics of every component of the bridge. Begin construction of the bridge upon the arrival of the materials received from subcontractors. This is necessary to ensure successful project progression along the given timeline and allow for time to make potential member and connection adjustments.

2.13.3 Task 13.3: 90 Percent Deliverable

Complete the 90 percent deliverable containing the completed product. This deliverable requires the bridge to be completely fabricated and ready for competition, with all respective calculations and records of construction documented. For instance, the fastest recorded time constructing the bridge as a team, the loading and stress and strain calculations will all be included in this deliverable. This is meant to serve as quality assurance before the final presentation and highlight any areas that need further improvement.

2.13.4 Task 13.4: Final Report

Generate a final report outlining all processes of design, analyses and results. Compile aforementioned items into organized sections to be presented in a professional report format. This is needed to effectively present and summarize all steps of the design process and the supporting calculations and factors behind the final design.

2.13.5 Task 13.5: Plans

Compile the completed portfolio of plans and generate both in the presentation and as a hard copy. Plans should effectively illustrate the bridge appearance and dimensions from every relevant perspective. In addition, tables generated through RISA should be provided. This is necessary for providing the client with a neat and comprehensible illustration of the final design.

2.13.6 Task 13.6: Product

Complete the physical construction of the bridge and present it as a finished product. This is necessary for the aesthetics and loading tests in the competition.

2.13.7 Task 13.7: Presentation

Prepare a presentation outlining the design process and clearly display preliminary and final bridge designs. This is necessary to effectively illustrate the full design process and the adjustments that were made throughout the course of the project.

2.14 Task 14: Project Management

2.14.1 Task 14.1 Schedule Management

Coordinate between team members to ensure everyone knows which tasks are on the schedule and by when individual jobs need to be completed. This is necessary to maintain organization and ensure the team functions as efficiently as possible. The schedule itself is discussed in Section 3 and can be seen in Appendix A.

2.14.2 Task 14.2 Resource Management

Coordinate between team members to ensure that resources are being distributed correctly and efficiently. This is done by overseeing inventory in what specific equipment and materials need to be utilized by both the Steel Bridge Team and the fabricators. A main aspect of resource management is overseeing the budget of the project with the staff rate breakdown and the cost of the engineering services.

2.14.3 Task 14.3 Meetings

Coordinate between team members to ensure that meetings are done routinely, verifying that the progression of the project is being done correctly and efficiently. Meetings will include the client, technical advisors, sponsors, and faculty grading instructors when necessary. All communication with these individuals and groups will be organized and handled by the Steel Bridge Team.

2.14.4 Task 14.4 Coordination with Fabricators

Contact and coordinate with potential donors to fabricate steel members and connections, and steel plates needed for design. This is necessary to save money on potential steel costs and help maximize the efficiency of the project.

2.14.5 Task 14.5 Coordination with Mentees

Coordinate with the NAU ASCE Student Chapter to start a Steel Bridge mentee group. The mentee group would help with construction practice and competing in the Regional Competition. This is done in order to provide guidance and experience for future potential Steel Bridge teams.

2.15 Exclusions

Exclusions include providing the exact coordinates of the bridge within the given location area, application of a green surface to the top of the bridge, and full-scale construction of the bridge.