2024 Steel Bridge Capstone Proposal

Final

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TRUSS-TY ENGINEERING

CENE 476

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Abbreviations

ASCE ..... American Society of Civil Engineers

DRFT.....Drafter

EIT.....Engineer in Training

ENG.....Project Engineer

FHS..... Flagstaff High School

GI..... Grading Instructor

ISWS..... Intermountain Southwest Student Symposium

NAU..... Northern Arizona University

SENG.....Senior Engineer

SSBC..... Student Steel Bridge Competition

TA..... Technical Advisor

1.0 Project Understanding

1.1 Project Purpose

The Skunk River Water Trail runs through Story County, Iowa, acting as a river corridor that provides multiple recreation opportunities for visitors and a home for local wildlife. Story County Conservation is seeking a bridge that will connect trails within Peterson Park. It is also important to acknowledge the sandbar island in the middle of the river, which must not be disturbed during or after construction of the bridge due to the presence of plants and wildlife there. Story County Conservation also requests that the bridge be made of recycled steel because of the material's ease of prefabrication, ability to construct quickly, high strength and durability, and the steel industry's commitment to sustainability. The design of the bridge must also be aesthetically pleasing to the visitors within the park. Mark Lamer, the client for this project, has requested that the model bridge compete in the American Society of Civil Engineers (ASCE) Intermountain Southwest Student Symposium (ISWS). At the competition, a 1:10 scale model of the bridge will be constructed and presented with an accompanying poster. The assembled bridge will be loaded, scored, and judged based on its performance in a variety of categories such as construction economy, structural efficiency, and overall performance. Upon successfully passing the loading tests, the bridge will be deemed effective and ready for future implementation in Peterson Park. Truss-ty Engineering seeks to provide Mark Lamer with a bridge design that will meet the requirements set by the 2025 Student Steel Bridge Competition (SSBC) Rules [1].

1.2 Project Background

As requested by Mark Lamer, a scaled steel bridge will be designed and constructed to provide preliminary results regarding the strength and ease of construction associated with the design. The scale bridge needs to replicate the proposed bridge spanning across the Skunk River in Peterson Park, located in central Iowa. The bridge model will be designed and fabricated at the Northern Arizona University (NAU) campus. The bridge members will be taken to the ISWS which will take place in Tucson, Arizona at the University of Arizona campus. NAU participates in the SSBC every year, however the bridges typically do not pass the loading portion of competition. Last year's steel bridge team recommended avoiding a compression style bridge with eccentric connections. Other previous steel bridge teams also struggled with the connections, which is where the bridge would fail during loading. Sticking with the current schedule developed by the team will ensure tasks are completed with enough time to account for issues that previous teams have encountered. Overall, the intent of the bridge for the upcoming competition is to successfully complete both load tests and place within the competition.

1.3 Technical Considerations

To design and construct the steel bridge, Truss-ty Engineering will need to perform several types of technical work. This includes developing a model using RISA 3D, which was recommended by the team's technical advisor Sabrina Gibson of Sirius Structures, LLC, and which a few of the team members are already familiar with [2]. It will also be necessary to determine the required strength and size of connections (welds and bolts) and individual bridge members, in addition to drafting a full plan set using AutoCAD so that the Flagstaff High School welding team will be able to properly weld the applicable components of the bridge [3]. The Truss-ty Engineering team will also need to know how to use the tools needed to construct the bridge at the competition.

1.4 Potential Challenges

For this project, the constraints mainly revolve around the design of the bridge. It is essential that the bridge meets all the requirements listed in the 2025 SSBC Rules. The bridge must comply with requirements regarding length, width, height, weight, and load requirements, and stay within the allowable deflection limits while also keeping aesthetics and costs in mind. In the process of designing the bridge, it is likely that at least one of the requirements will not be met, so multiple designs may be considered in order to choose the most effective bridge that meets all the requirements. There are also requirements during construction at the competition, such as where components can be placed, where builders can move within the construction area, and the construction time limit.

1.5 Stakeholders

Surrounding this project are a variety of stakeholders ranging from the client to those who donate time, supplies, or services. Truss-ty Engineering is the team that is responsible for design and construction of the scaled bridge. NAU is the university that supports Truss-ty Engineering as part of its civil engineering program. Mark Lamer is the client for this project, who the bridge is designed for and who will provide discussion and feedback as the design develops. Story County Conservation also plays a role in this project, as it is the entity that requested this bridge and determined the initial project needs. The American Institute of Steel Construction (AISC) and ASCE are both stakeholders, as they develop the rules and guidelines for the competition. Sabrina Gibson of Sirius Structures, LLC is donating her time to Truss-ty Engineering as the technical advisor, providing feedback and assistance to the team as they design and construct the bridge.

The investments and donations from multiple entities make this project possible. The NAU student chapter of ASCE provides funding for the project, allowing Truss-ty Engineering to travel to and participate in the ASCE ISWS, as well as cover other expenses such as additional tools or materials that may become necessary. Page Steel donates the required steel for the final bridge design, Copper State donates the nuts and bolts needed for the connections, and Flagstaff High School (FHS) provides welding services to aid in the construction of the bridge.

2.0 Scope of Work

2.1 Task 1: Background Research

2.1.1 Task 1.1: Steel Properties and Types

The team will research the various shapes, grades, and sizes of steel members as presented in the AISC Steel Construction Manual. The team will determine which ones are compliant with the size requirement stated in Section 8.2.2.2 of the SSBC Rules, stating members must fit in a box having the dimensions of 3'-6" x 6" x 4". The team will then verify that the sizes and shapes compliant with this requirement are available in the Page Steel inventory or could be fabricated with a custom request.

2.1.2 Task 1.2: Connection Types

2.1.2.1 Task 1.2.1: Bolts

In this task, the team will determine the available sizes, required spacing, and minimum edge distance of bolted connections from the AISC Steel Construction Manual. Then, the team will review the bolt requirements stated in the SSBC Rules and verify that Copper State Nut and Bolt has the types of bolts that are permitted.

2.1.2.2 Task 1.2.2: Welds

In this task, the team will consult the AISC Steel Construction Manual to determine what types and sizes of welds exist and how to calculate their required strengths. The team will also consult the FHS welding program to determine what types of welds they can provide and whether these agree with the weld requirements in the SSBC Rules.

2.1.3 Task 1.3: Bridge Types

The team will research a variety of different bridge styles to determine the possible designs and the benefits of each bridge type. The benefits and drawbacks of each bridge type will be considered to determine which style of bridge the team shall move forward with for design. The SSBC Rules will be consulted during this process to ensure that the proposed bridge type is permitted for the ISWS competition. More than one bridge type may be considered at this stage.

2.2 Task 2: Design

2.2.1 Task 2.1: Preliminary Sketches

The purpose of this task is to plan and roughly sketch bridge alternatives so that the designs can be compared based on aesthetics and anticipated ease of construction. Team members will each sketch at least one initial design to provide alternatives for the project. Sketches may be done by hand, in AutoCAD, or a combination of the two and will be given approximate measurements to ease modeling and ensure that the alternative meets the SSBC requirements.

2.2.2 Task 2.2: RISA-3D Models

The purpose of this task is to model, analyze, and optimize each bridge alternative in RISA 3D to determine which one best withstands the applied loads and stays within the deflection limits

stated in the SSBC Rules. The bridge members and connection types will be modified as needed to see if each model is capable of meeting all the requirements in the SSBC Rules, such as those of member sizes, connection types, and global dimensions. The team will likely use an iterative approach to optimize each alternative, to determine the design that will move forward.

2.2.3 Task 2.3: Final Design Selection

The purpose of this task is to decide which of the bridge alternatives will be constructed at the ISWS competition. Upon the completion of Task 1 in its entirety and Tasks 2.1 and 2.3, a decision matrix will be used to evaluate the best bridge alternative based on the categories that will be judged at the competition and other factors that the team deems important, such as anticipated ease of construction. The alternative that scores the best in the decision matrix will be the design that moves forward to shop drawings and eventually the competition. If a design is not able to be modified in RISA 3D such that it meets all SSBC requirements, it will not be included in the decision matrix as a legitimate alternative.

2.2.4 Task 2.4: Connection Design

The purpose of this task is to calculate what type and size of weld or bolt is needed at each connection modeled in the final design. Connection calculations will be completed using knowledge gained from Task 1.2. Once the size and type of each weld and bolt has been determined, this information will be called out in the shop drawings so that FHS can properly weld all applicable components and so the bridge can be properly bolted at the competition.

2.3 Task 3: Develop Shop Drawings

2.3.1 Task 3.1: Title Block and Cover Sheet

The team will use AutoCAD to create a typical title block layout for shop drawings that will be used for all the team's drawings. The title block will provide relevant information including the title of each drawing, the scale, sheet number, and the team's name and logo. The team will also create a cover sheet in AutoCAD, which will contain the team's name and logo, project name, location, date, the team's and client's contact information, sheet index, site location map, relevant project codes, and any necessary approvals or signatures.

2.3.2 Task 3.2: Required Views

The team will create shop drawings in AutoCAD that show various views of the bridge that are needed for fabrication. Views that may be included are elevation views of each side of the bridge (north, south, east, and west) and a plan view.

2.3.3 Task 3.3: Connection Details

The team will draft connection details in AutoCAD needed for the bridge within the shop drawings. The details will include the weld or bolt type, the size of the connection, spacing and edge distance (in the case of bolts), the length of the weld, and any further description necessary to explain how each connection must be fabricated or constructed. The details will be given to FHS so they can properly weld applicable components of the bridge.

2.3.4 Task 3.4: General Structural Notes

The purpose of this task is to provide general structural notes within the shop drawings. These notes will provide guidance to the FHS welding program during fabrication.

2.3.5 Task 3.5: Materials Schedule

The team will provide a materials schedule in the shop drawings. Regarding the steel members of the bridge, the bill of materials will include the size, shape, and quantity of steel to be used, in addition to a numbering system so members can be quickly referenced in the elevation and plan views. For the connections, size and quantities of nuts, bolts, and welds will be provided by the team. The materials schedule will be sent to the companies that provide the team with materials, which are Page Steel and Copper State Nut and Bolt.

2.4 Task 4: Sub-Consultant Coordination and Fabrication

2.4.1 Task 4.1: Coordination with Page Steel

The purpose of this task is to provide Page Steel with the steel section of the materials schedule so they will supply the team with the steel members needed to construct the bridge. The team will be able to provide quantities upon the completion of design and bill of materials.

2.4.2 Task 4.2: Coordination with Copper State Nut and Bolt

The team shall provide Copper State Nut and Bolt with the connections section of the bill of materials. The information will include the type, size, and quantity of any bolts that the team deems necessary for the assembly of the scaled bridge.

2.4.3 Task 4.3: Coordination with Flagstaff High School Welding

The purpose of this task is to provide FHS with the required materials and plan set so they can properly weld the applicable steel members. The completion of this task is dependent on the completion of Tasks 2 and 3 in their entirety, as well as the completion of Task 4.2, obtaining the steel needed for the bridge. The shop drawings that are created by the team will be provided to FHS for the fabrication of the bridge.

2.4.4 Task 4.4: Team Fabrication

The purpose of this task is to ensure the team completes any outlying fabrication that is needed. A majority of the fabrication is expected to be completed by FHS; however, it is likely that the team may have to make adjustments to the bridge. Adjustments may include cutting members, altering connections, or altering any other components to allow for proper assembly of the bridge.

2.5 Task 5: Competition Preparation

2.5.1 Task 5.1: Practice Bridge Assembly

The purpose of this task is to give the team experience assembling the bridge prior to the timed construction at the ISWS. The team will practice the assembly as many times as possible before the competition to better prepare for the timed construction portion of the competition. The team will also include any mentees during practice as they will aid in the assembly at competition.

2.5.2 Task 5.2 Poster

Prior to the competition, the team will put together a 2’ x 3’ poster displaying information about the bridge. The poster shall include any required information that is listed in Section 6.2.1.2.1 of the 2025 SSBC Rules.

2.6 Task 6: Competition

2.6.1 Task 6.1: Display Day

The purpose of this task is to ensure that all materials and the team are ready for competition. On the display day, the team shall assemble the bridge with no time limit. The bridge shall be on display along with the poster to allow judges to score the aesthetics portion of the competition.

2.6.2 Task 6.2: Competition Day

This task is the final consideration for the project. The team will attend the competition where the bridge will be assembled by the team, aiming to complete the bridge quickly to maximize the score for this portion of the competition. Following construction, the bridge will be loaded at locations determined by a dice roll. Once the bridge is loaded, the lateral and vertical deflection will be measured and scored. Other factors that will be scored are the bridge weight, stiffness, structural efficiency, overall performance, and the team’s cost estimation.

2.7 Task 7: Project Management

2.7.1 Task 7.1: Deliverables

2.7.1.1 Task 7.1.1: 30% Submittal

The purpose of this task is to submit a complete 30% submittal, which will be due approximately February 13, 2025. The submittal shall consist of any design work that has occurred leading up to this submittal. Inclusions will be any preliminary sketches and RISA 3D work that has been completed.

2.7.1.2 Task 7.1.2: 60% Submittal

The purpose of this task is to submit a complete 60% submittal, which will be due approximately March 13, 2025. The submittal shall consist of a report containing any information regarding the design process until this point. A design shall also be completed at this point and shop plans will be included in the submittal.

2.7.1.3 Task 7.1.3: 90% Submittal

The purpose of this task is to submit a complete 90% submittal, which will be due approximately April 17, 2025. The submittal shall act as a draft to the final deliverable and be mostly completed and accurate.

2.7.1.4 Task 7.1.4: Final Submittal

The purpose of this task is to submit a complete final submittal, which will be due approximately May 6, 2025. The submittal shall consist of a completed report which describes the team’s work from design to construction. The report shall contain the final

design and analysis with a complete appendix. The final submittal shall be submitted along with the final website.

2.7.1.5 Task 7.1.5 Website

The team shall create a website including relevant information for the project, which will be due approximately May 6, 2025. Upon completion of the project, the website will also be completed. The website will include information about the team, the project, any analysis done, the competition, and any documents created by the team such as the poster used for the competition, shop drawings, and the final proposal and report.

2.7.1.6 Task 7.1.6 Final Presentation

The team shall create a presentation that clearly displays the process that the team went through for design, analysis, and construction, which will be due approximately May 2, 2025. The final presentation shall be presented to stakeholders such as the client and grading instructor to provide proof that the project objectives were met and that the project is held to a quality standard.

2.7.2 Task 7.2: Schedule Management

The purpose of this task is to ensure that the team completes all tasks related to the project. To remain on schedule and work effectively, tasks will be assigned to team members to be completed. Team members will act as project managers for their tasks to ensure all tasks are completed on time, based on a schedule developed by the team.

2.7.3 Task 7.3: Resource Management

The purpose of this task is to ensure that team members are managing resources needed for the project. Each team member will work to complete tasks, some of which need resources such as computers, software, and time. It will be the responsibility of the team to ensure that each member has the required resources to complete their given tasks.

2.7.4 Task 7.4: Meetings

2.7.4.1 Task 7.4.1: Client Meetings

The purpose of the task is to ensure that the team meets with the client to discuss the project objectives. Meetings will be held bi-weekly to ensure that the team is moving forward with the design and fabrication and that any steps taken are towards the completion of the project objectives.

2.7.4.2 Task 7.4.2: Grading Instructor Meetings

The team will meet with the grading instructor (GI) on a biweekly basis. At the biweekly meetings, the team will be able to ask questions regarding the deliverables as well as inform the GI of any progress made on the project. These meetings will also allow the GI to make sure that the team is on schedule with design, fabrication, and submittals. The GI will also be able to provide feedback to the team about their previous submittals.

2.7.4.3 Task 7.4.3: Technical Advisor Meetings

The purpose of this task is to ensure that the team is consulting the technical advisor (TA) as they make progress on the project. There will be a minimum of four meetings with the TA, one before each of the deliverables (30, 60, 90, and Final). There may be additional meetings with the TA depending on what guidance the team needs throughout the design process.

2.7.4.4 Task 7.4.4: Team Meetings

During the design process the team will have several team meetings to discuss relevant tasks and determine what task each member will work on and when the deadline for that task is. During this time, the team may also ask and answer questions, collaborate and make decisions about any aspect of the project, ensure everyone is on the same page, and help each other to ensure all members are confident about how to complete their assigned task. There will likely be 20 team meetings to allow for discussion of tasks.

2.7.4.5 Task 7.4.5: Mentee Meetings

The purpose of this task is to ensure that mentees are informed regarding the project's status. Mentee meetings may take the form of team meetings in some situations as the mentees will aid in the completion of tasks for the sake of the project.

2.8 Task 8: Project Impacts

The team shall evaluate and address the impacts of the project upon completion. Positive and negative impacts will be addressed regarding environmental, economic, and social impacts.

2.9 Exclusions

Exclusions of the project include footings, geotechnical considerations, effects due to weathering, life-cycle cost analysis, and the design and construction of the full-size bridge. These exclusions do not contribute to the project objectives, and therefore will not be completed by the team as part of this project.

3.0 Schedule

3.1 Schedule Overview

The work required for the completion of the project has been broken down into tasks and subtasks that need to be completed. These tasks and subtasks were identified and used to create a project schedule. The schedule spans a total of 180 days, starting with Task 1: Background Research and ending with Task 8: Project Impacts. The schedule addresses all primary tasks and subtasks that were identified in the scope (Section 2.0). Important milestones on the schedule include completion of the final design, creation of shop drawings, coordination with sub-consultants, and the assembly of the bridge. Deliverables including a 30%, 60%, 90%, and Final Submittal are included within the project management portion of the schedule. The developed schedule will allow the team to stay on task and provide guidance as to when important milestones need to be met. The complete schedule is shown in *Appendix A* and was created using Microsoft Project [4].

3.2 Critical Path

Within the schedule, the critical path was identified. This critical path identifies tasks and subtasks that must be completed in sequential order, and one cannot be started until the previous one has been completed. If a task is delayed by one day, the entire project will be delayed by one day unless another critical task is completed a day early. Having the critical path allows the team to understand which tasks should be prioritized and will help with time and resource management throughout the project. It is the responsibility of the team to work effectively in order to prevent the delay of tasks on the critical path, and therefore the entire project. The critical path begins with Task 2, Design. The completion of the project is entirely reliant on a functional design, making this the first task in the critical path. The next task along the critical path, which is reliant upon the completion of a successful design, is the creation of shop drawings. The completion of the shop drawings allows the team to begin sub-consultant coordination and fabrication of the final bridge design. Once materials have been ordered and fabrication has been completed the team can prepare for the last step in the critical path, the ASCE ISWS competition, where the bridge will be assembled, loaded, and judged alongside the team's 2x3 poster.

4.0 Staffing Plan

4.1 Staffing Positions

This project will involve four staff positions, including a Senior Engineer (SENG), Project Engineer (ENG), Engineer in Training (EIT), and a Drafter (DRFT). *Table 1* shows these staffing positions and their associated code.

Table 4-1:Staffing Positions

Position	Code
Senior Engineer	SENG
Project Engineer	ENG
Engineer in Training	EIT
Drafter	DRFT

4.2 Qualifications and Responsibilities

4.2.1 Senior Engineer

The Senior Engineer has at least 10 years of experience as a Civil or Structural Engineer. In addition to experience, the Senior Engineer is a licensed Professional Engineer (PE) and Structural Engineer (SE). The Senior Engineer will oversee the project and its completion, including the approval of each major task. Quality assurance will be the main responsibility of the Senior Engineer, ensuring all technical work including the final report meet the needs of the client.

4.2.2 Project Engineer

The Project Engineer has at least 6 years of experience and is a licensed Professional Engineer (PE) and Structural Engineer (SE). The Project Engineer will act as the project manager for this project and will be responsible for most of the technical work needed, including but not limited to bridge design, modeling, connection design, and shop drawings. Throughout the project the Project Engineer may delegate tasks to the EIT and Drafter. The Project Engineer will also be responsible for updating the Senior Engineer on any relevant progress that has been made for quality assurance.

4.2.3 Engineer in Training

The Engineer in Training (EIT) has one to two years of experience and is a certified EIT. The EIT will work closely with the Project Engineer to gain experience in the field. Work completed by the EIT may include research, design, modeling, and shop drawings. Each of the tasks will be overseen by the PEs on the project.

4.2.4 Drafter

The Drafter has a least 2 years of experience working with drafting for a variety of projects related to civil and structural engineering. The main role of the drafter will be to create the shop drawings once the bridge design has been completed. During the design phase, the drafter may also assist with modeling the bridge.

4.3 Staffing Table

A staffing table was created to determine the approximate number of hours completed by each staffing role needed for each task and subtask, and the total number of hours for the project. *Table 2* provides a summary of the staffing table. The complete and detailed staffing table can be found in *Appendix B*.

Table 4-2: Summary Staffing Table

Tasks	SENG	ENG	EIT	DRFT	Task Totals
Task 1: Background Research	5	15	15	5	35
Task 2: Design	15	65	50	30	160
Task 3: Shop Drawings	20	40	25	55	140
Task 4: Sub-Consultant Coordination and Fabrication	20	20	20	10	70
Task 5: Competition Preparation	15	25	25	10	75
Task 6: Competition	20	20	20		60
Task 7: Project Management	40	45	30	35	150
Task 8: Project Impacts	5	5	5		15
Staff Totals	140	235	190	145	**710**

5.0 Cost of Services

5.1 Summary of Cost

A cost of services has been put together for this project. Included in the estimated cost is staffing, supplies, subcontracting, and travel. *Table 3* shows a summary of the costs of this project by category. The total cost of this project is projected to be $102,659. The complete and detailed cost can be found in *Appendix C*.

Table 5-1: Summary of Cost

Category	Cost
1.0 Staffing	$ 89,050.00
2.0 Supplies	$ 2,200.00
3.0 Subcontracting	$ 9,000.00
4.0 Travel	$ 2,409.00
Total Cost	$ 102,659.00

5.2 Determination of Cost

Staffing is an essential part of this project and therefore makes up a majority of this project cost. The cost of staffing was determined using the hours determined in the staffing table at a predetermined rate set by Truss-ty Engineering. The complete proposed cost in *Appendix C* contains the hours and rate for each staffing position.

Supplies include any steel, nuts, bolts, and additional supplies needed for the bridge's fabrication. Quantities for steel, nuts, and bolts needed were estimated, as the team does not yet know the exact quantities needed for the bridge. A lump sum was added to the cost of supplies to account for tools or additional materials that may be needed for successful construction.

The welded connections on the bridge will be subcontracted out. The welding is estimated to take 100 hours. The labor for the subcontracting was valued at approximately $90 per hour. The cost of welding services is based on the range of $50-$125 per hour provided by Homeguide Cost Guide [5]. The subcontracting cost does not include any fabrication that will be completed by the staff.

For this project, the team will be required to travel to Tucson, Arizona. The rate for the van and mileage to get to Tucson was determined using the NAU FY25 Fleet Rates [6]. Lodging and additional expenses were determined by the State of Arizona Accounting Manual Section 5095 [7]. Rates and quantities for travel are shown in *Appendix C*.

6.0 References

[1] American Institute of Steel Construction and American Society of Civil Engineers, “Student Steel Bridge Competition: 2025 Rules”, *aisc.org*. [Online]. Available: https://www.aisc.org/education/university-programs/student-steel-bridge-competition/ssbc-rules-and-clarifications/

[2] *RISA-3D* (2022), RISA Tech Inc.

[3] *AutoCAD* (2024), Autodesk.

[4] *Project* (2024), Microsoft.

[5] T. Hazen, “How much does welding cost?,” *HomeGuide*, Apr. 22, 2024. https://homeguide.com/costs/welding-cost

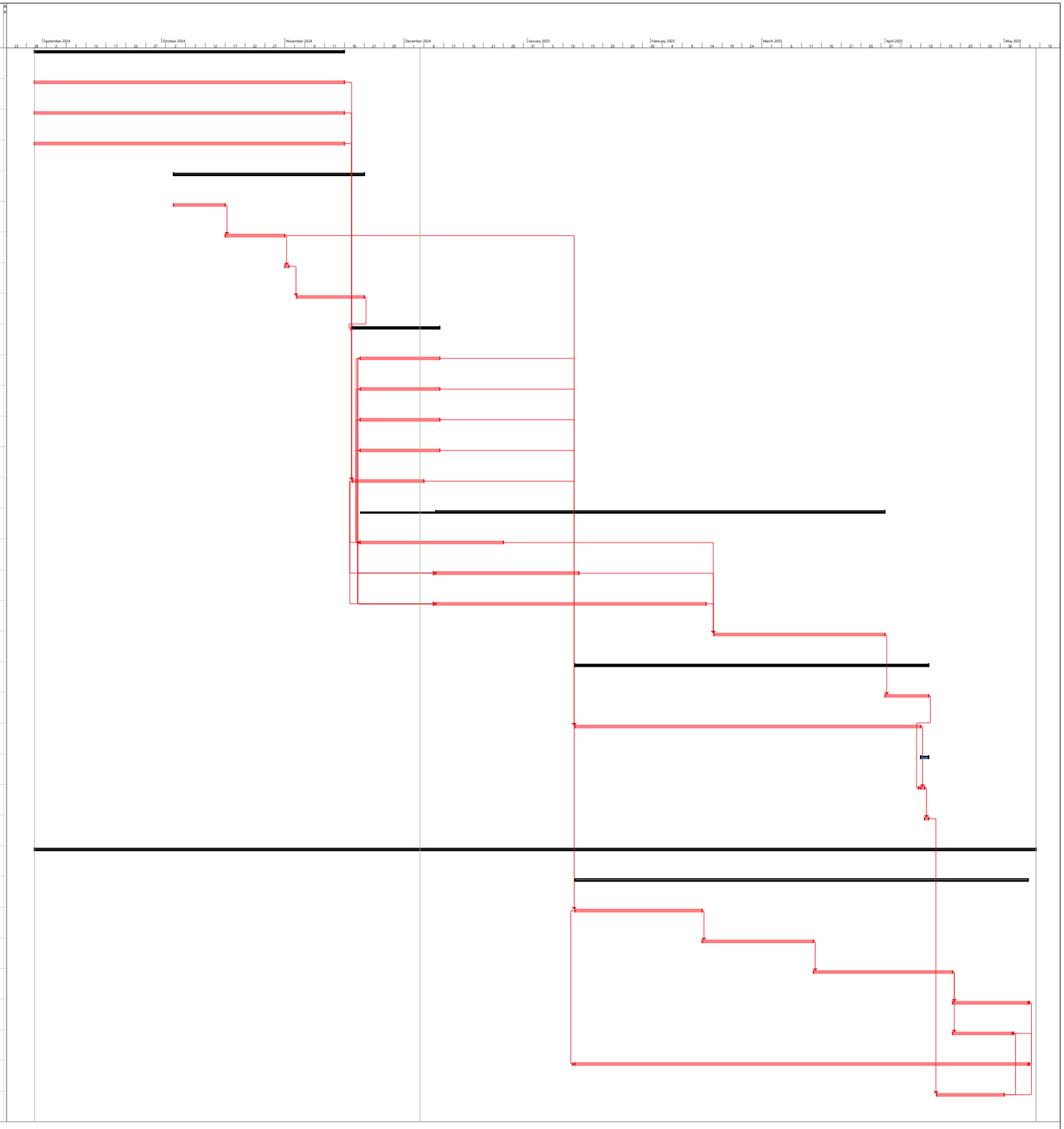
[6] Northern Arizona University, "NAU Transit Services," [Online]. Available: https://in.nau.edu/university-transit-services/fleet-services/vehicle-rental/

[7] ADA, “State of Arizona Accounting Manual 5095 - Maximum Mileage, Loading, Meal, Parking and Incidental Expense Reimbursement Rates”

Appendix A: Project Schedule

See the following page for the project schedule.

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		**Task 1: Background Research**	**56 days**	**Fri 8/30/24**	**Fri 11/15/24**	
2		Task 1.1: Steel Properties and Types	56 days	Fri 8/30/24	Fri 11/15/24	
3		Task 1.2: Connection Types	56 days	Fri 8/30/24	Fri 11/15/24	
4		Task 1.3: Possible Bridge Types	56 days	Fri 8/30/24	Fri 11/15/24	
5		**Task 2: Design**	**34 days**	**Fri 10/4/24**	**Wed 11/20/24**	
6		Task 2.1: Preliminary Sketches	9 days	Fri 10/4/24	Wed 10/16/24	
7		Task 2.2: RISA-3D Models	11 days	Thu 10/17/24	Thu 10/31/24	6
8		Task 2.3: Final Design Selection	1 day	Fri 11/1/24	Fri 11/1/24	7
9		Task 2.4: Connection Design	13 days	Mon 11/4/24	Wed 11/20/24	8
10		**Task 3: Develop Shop Drawings**	**16 days**	**Mon 11/18/24**	**Mon 12/9/24**	**9**
11		Task 3.1: Title Block and Cover Sheet	14 days	Wed 11/20/24	Mon 12/9/24	
12		Task 3.2: Required Views	14 days	Wed 11/20/24	Mon 12/9/24	
13		Task 3.3: Connection Details	14 days	Wed 11/20/24	Mon 12/9/24	
14		Task 3.4: General Structural Notes	14 days	Wed 11/20/24	Mon 12/9/24	
15		Task 3.5: Develop Materials Schedule	14 days	Mon 11/18/24	Thu 12/5/24	2,3,4
16		**Task 4: Sub-Consultant Coordination and Fabrication**	**81 days**	**Mon 12/9/24**	**Mon 3/31/25**	
17		Task 4.1: Coordination with Page Steel	26 days	Wed 11/20/24	Wed 12/25/24	11SS,12SS,13SS,14SS,15SS
18		Task 4.2: Coordination with Copper State Nut and Bolt	26 days	Mon 12/9/24	Mon 1/13/25	11SS,12SS,13SS,14SS,15SS
19		Task 4.3: Coordination with Flagstaff High School Welding	50 days	Mon 12/9/24	Fri 2/14/25	11SS,12SS,13SS,14SS,15SS
20		Task 4.4: Team Fabrication	31 days	Mon 2/17/25	Mon 3/31/25	17,18,19
21		**Task 5: Competition Preperation**	**65 days**	**Mon 1/13/25**	**Fri 4/11/25**	
22		Task 5.1: Practice Bridge Assembly	9 days	Tue 4/1/25	Fri 4/11/25	20
23		Task 5.2: Poster	63 days	Mon 1/13/25	Wed 4/9/25	11,12,13,14,15
24		**Task 6: Attend Competition**	**2 days**	**Thu 4/10/25**	**Fri 4/11/25**	
25		Task 6.1: Display Day	1 day	Thu 4/10/25	Thu 4/10/25	22,23
26		Task 6.2 Competition Day	1 day	Fri 4/11/25	Fri 4/11/25	25
27		**Task 7: Project Management**	**180 days**	**Fri 8/30/24**	**Thu 5/8/25**	
31		**Task 8: Deliverables**	**82 days**	**Mon 1/13/25**	**Tue 5/6/25**	
32		Task 8.1: 30% Submittal	24 days	Mon 1/13/25	Thu 2/13/25	7
33		Task 8.2: 60% Submittal	20 days	Fri 2/14/25	Thu 3/13/25	32
34		Task 8.3: 90% Submittal	25 days	Fri 3/14/25	Thu 4/17/25	33
35		Task 8.4: Final Submittal	13 days	Fri 4/18/25	Tue 5/6/25	34,38FF
36		Task 8.6: Final Presentation	11 days	Fri 4/18/25	Fri 5/2/25	34,38FF
37		Task 8.5: Website	82 days	Mon 1/13/25	Tue 5/6/25	36FF,32SS
38		**Task 9: Project Impacts**	**13 days**	**Mon 4/14/25**	**Wed 4/30/25**	**26**



Appendix B: Staffing Table

Tasks	SENG	ENG	EIT	DRFT	Task Totals
Task 1: Background Research					
Task 1.1: Steel Properties and Types		5	5		10
Task 1.2: Connection Types	5	5	5	5	20
Task 1.3: Bridge Types		5	5		10
Task 2: Design					
Task 2.1: Preliminary Sketches		5	5		10
Task 2.2: RISA-3D Models	5	25	15	15	60
Task 2.3: Final Design Selection	5	10	10		25
Task 2.4: Connection Design	5	25	20	15	65
Task 3: Develop Shop Drawings					
Task 3.1: Title Block and Cover Sheet			5	5	10
Task 3.2: Required Views	5	10	5	20	40
Task 3.3: Connection Details	5	20	5	15	45
Task 3.4: General Structural Notes	5	5	5	10	25
Task 3.5: Materials Schedule	5	5	5	5	20
Task 4: Sub-Consultant Coordination and Fabrication					
Task 4.1: Coordination with Page Steel	5	5	5		15
Task 4.2: Coordination with Copper State Nut and Bolt	5	5	5		15
Task 4.3: Coordination with Flagstaff High School Welding	5	5	5	10	25
Task 4.4: Team Fabrication	5	5	5		15
Task 5: Competition Preparation					
Task 5.1: Practice Bridge Assembly	10	15	15		40
Task 5.2 Poster	5	10	10	10	35
Task 6: Competition					
Task 6.1: Display Day	10	10	10		30
Task 6.2: Competition Day	10	10	10		30
Task 7: Project Management					
Task 7.1: Deliverables	5	15	10	15	45
Task 7.2: Schedule Management	10	10	5	5	30
Task 7.3: Resource Management	10	5		5	20
Task 7.4: Meetings	15	15	15	10	55
Task 8: Project Impacts	5	5	5		15
Staff Totals	140	235	190	145	710

Appendix C: Cost of Services

1.0 Staffing	Description	Quantity	Units	Unit Cost	Cost
	SENG	140	HR	$ 200.00	$ 28,000.00
	ENG	235	HR	$ 150.00	$ 35,250.00
	EIT	190	HR	$ 90.00	$ 17,100.00
	DRFT	145	HR	$ 60.00	$ 8,700.00
			SUBTOTAL		$ 85,350.00
2.0 Supplies	Description	Quantity	Units	Unit Cost	Cost
	Steel	150	FT	$ 10.00	$ 1,500.00
	Nuts	100	EA	$ 1.00	$ 100.00
	Bolts	100	EA	$ 1.00	$ 100.00
	Miscellaneous	1	LS	$ 500.00	$ 500.00
			SUBTOTAL		$ 2,200.00
3.0 Subcontracting	Description	Quantity	Units	Unit Cost	Cost
	Fabrication	100	HR	$ 90.00	$ 9,000.00
			SUBTOTAL		$ 9,000.00
4.0 Travel	Description	Quantity	Units	Unit Cost	Cost
	Rental Van	5	Days	$ 73.54	$ 367.70
	Fuel	530	Miles	$ 0.41	$ 217.30
	Hotel	4	Nights (2 rooms)	$ 120.00	$ 960.00
	Meals and Incidental Expenses	4	People (4 days)	$ 54.00	$ 864.00
			SUBTOTAL		$ 2,409.00
				TOTAL	$ 102,659.00