NORTHERN ARIZONA UNIVERSITY

Final Proposal

2015 ASCE Steel Bridge

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December 10, 2014

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1 Project Understanding

The objective of this project is to design, analyze, fabricate, and construct a 1:10 scale model of a steel bridge. The model bridge will be the Northern Arizona University (NAU) – American Society of Civil Engineers (ASCE) Student Chapter entry in a competition held during the Pacific Southwest Conference (PSWC). The event is sponsored by ASCE and the American Institute of Steel Construction (AISC).The AISC and ASCE provide regulations and specifications on the AISC website. The rules are available to all parties who wish to enter a design. At the conference bridges will be tested for construction speed, aesthetics, and strength. The team that performs the best overall will be awarded a contract for the full-scale project. The client and technical advisor for this project have been identified and meetings with these parties were held to assess expectations. Both parties would like the team to qualify for the competition and place as highly as possible.

1.1 Background

From the fictional back-story provided in this year's competition rules, the President of Kuprica requested construction of a bridge to increase commerce in their country. The bridge will span over the Nogo River to connect the capital city, H'sogo, to surrounding villages. The project will be funded by the Sonarpin Foundation, which recommends that the bridge be made of steel. This is because of the material's durability, ease of maintenance, and its ability to be prefabricated, allowing speedy construction. The bridge cannot have piers in the riverbed or immediate surrounding area due to the highly organic soil. Only one footing on either side of the river will be available for use. The bridge must provide clearance over the river, with enough room for boats to pass under during the wet season. A temporary causeway will be placed to help with construction.

The Sonarpin Foundation will give a contract to the company with the most effective 1:10 scale bridge model. The bridge model will be assembled during a timed construction period as part of the ASCE Steel Bridge Competition in order to determine constructability. The model will be loaded both laterally and vertically to find the aggregate deflection and will be judged against other models. Any model that does not follow the rules will be rejected, and the team's eligibility for the project will be terminated. The best bridge model will be awarded a contract with the country of Kuprica.

1.2 Stakeholders

Since this project is for the ASCE and AISC Student Steel Bridge Competition, the stakeholders for this project are divided into two primary groups. The first group is the people of Kuprica, for whom the model bridge is being built. The main client in this stakeholder group is the President of Kuprica, who has requested a bridge be constructed over a local river to increase commerce within the country. The model bridge should demonstrate stability, strength, serviceability, and ease of construction, allowing Kuprica to choose the bridge that will best meet their needs. The chosen bridge will be constructed; thus, all of the citizens are stakeholders in this project.

The second group of stakeholders is people affiliated with NAU: the client Mark Lamer, Northern Arizona University, and the NAU-ASCE Student Chapter. Due to the competitive nature of the steel bridge project, the team will be representing these stakeholders.

1.3 Existing Conditions

Every year, AISC and ASCE collaborate to hold a competition for civil and environmental engineering students. NAU has competed in this competition in previous years; however, each year the rules are changed so that a bridge design cannot be reused. A new bridge design must be constructed each year. Therefore, there are no existing conditions at NAU for this project. However, currently there is not a bridge in the country of Kuprica. Any river crossing would be an improvement to the current conditions.

1.4 Technical needs

The 1:10 scale bridge will be designed within the parameters set forth by the Sonarpin Foundation. Foremost, the bridge must be constructed with steel only. The bridge dimensions must meet the building envelope provided in Figure 1 of the Appendix. Each bridge member must be at most 3’ by 6” by 4”. The completed model will be judged on display, construction speed, weight, stiffness, construction economy, and structural efficiency. Aesthetics of the bridge are based on its balance, proportion, elegance, and finish. Construction economy (Cc) assesses the design's cost and is based on the following formula:

Equation 1:

$$Cc = \textit{Total Time (minutes)} \times \textit{Number of Builders (persons)} \times 50{,}000\ (\$/\textit{person-minute}) + \textit{Load Test Penalties}\ (\$)$$

Construction speed is the time it takes to construct the bridge model. Time is added for various penalties such as dropping a tool. The time to construct the bridge must be less than 45 minutes, but any time over 30 minutes will result in a construction time of 180 minutes for the total time. Construction will be halted at the 45-minute mark regardless of build completion. The Structural Efficiency (Cs) is used to judge the model's structural design, and will be calculated using the formulas based on the weight of the model:

Equation 2: (weight < 400 lbs)

$$Cs = \textit{Total Weight (Pounds)} \times 20{,}000\ (\$/\textit{Pound}) + \textit{Aggregate Deflection (Inches)} \times 1{,}000{,}000\ (\$/\textit{Inch}) + \textit{Load Test Penalties}\ (\$)$$

Equation 3: (weight > 400 lbs)

$$Cs = [\textit{Total Weight (Pounds)}]^2 \times 50\ (\$/\textit{Pound2}) + \textit{Aggregate deflection (Inches)} \times 1{,}000{,}000\ (\$/\textit{Inch}) + \textit{Load test penalties}\ (\$)$$

Weight will be a combination of actual weight of the bridge and the weight incurred through penalties. The loading decking is not incorporated into the weight of the bridge since it will be uniform for all bridges entered. The overall performance of the bridge will be judged on a combination of the construction economy and the structural efficiency. A lower score indicates a more effective design.

The bridge must meet the following requirements:

- All bolts must be 3" or shorter
- Nuts must be hexagonal in shape and may be welded to members
- Each bolt and nut location must be tight so that the bolt and nut touch the member they are fastening
- Each nut must be fully engaged

- The bridge may be at most five feet tall, five feet wide, and at least 18'- 6" long (Figures 1 and 2 in Appendix).
- There must be at least a 1'-6" clearance over the river (Figures 1 and 2 in Appendix)
- A minimum of 3.5" clearance over the surrounding ground must be maintained
- There must be two decking support surfaces that run parallel along the length of the bridge with no more than 2'-7" above the ground or river
- The supports for the decking must be at least 2'-6" wide and at most 3'-2" wide (Figure 1 in Appendix)
- There must be a path of travel on top of the deck supports that measures at minimum 3'-7" wide by 1'-6" tall for a hypothetical vehicle, (Figure 1 in Appendix)

1.5 Potential Challenges

The ASCE PSWC will be held in April at the University of Arizona in Tuscon, AZ. The team must complete design and fabrication by this time. Completing all necessary tasks in the limited amount of time will be a challenge as a team. To combat this time constraint, the team will utilize the accelerated bridge construction method and follow a strict schedule. By planning, the team aims to reduce the affect that the time constraint has on the overall project.

An additional challenge for this project is the highly organic soil. This makes the use of temporary piers, false work, and barges impractical due to the high cost to construct and lack of water during the building season. Because of the tropical climate and extreme monsoons, the building season is short; meaning the bridge will need to be constructed quickly while remaining durable. Another challenge will come from the need to cart all materials in by ox. The materials will need to be light and compact. This will be a consideration for the model design.

2 Scope and Tasks

The scope of services for which the 2015 NAU ASCE Steel Bridge team is responsible for is listed below. This project has been divided into five main tasks with subtasks for each. The five main tasks are: research, design/analysis, fabrication/construction, ASCE conference, and project management.

2.1 Research

2.1.1 Truss Design – Each team member will research different types of trusses. The team members will discuss the strengths and weaknesses of the designs and then determine trusses that best fit the problem as outlined in the competition rules. These designs will then be ranked in a design matrix to determine the ranking of the initial truss designs. The truss design chosen will be researched and analyzed in detail, considering factors such as constructability, strength, and aesthetic appeal.

2.1.2 Rules – The ASCE Steel Bridge competition rules will be read and discussed by all team members. Each member must understand the competition guidelines for the bridge. The bridge envelope will be redrawn so that the members understand the wording of the maximum and minimum dimensions given in the rules. All rules shall be followed in designing and construction.

2.1.3 Clarifications – When the team does not understand a rule, the team will submit a clarification request to the ASCE competition website. Periodically, the team will look at the clarifications requested by other groups.

2.1.4 Connection Types – Different connections will be researched to determine the most efficient connection type for the members of the bridge. The connections must withstand the different loading patterns denoted by ASCE and be easy to connect during construction.

2.1.5 Construction Methods – The team will research and brainstorm different ways the bridge can be constructed given the rules. These different construction techniques will be tested on small and full-size scales with materials, such as PVC, to determine which techniques will be easiest and quickest.

2.2 Design/Analysis

2.2.1 Truss Design Selection - After ranking the initial geometric designs with the design matrix, the top designs will be discussed further. The team will consult the faculty advisor and additional structural professors for their professional input on the truss design's performance and ease of construction.

2.2.2 Determining Dimensions – After deciding on a final truss design, a team member will draft an AutoCAD drawing of the truss. From the drawing, the team will determine the structural member dimensions needed to stay within the building envelope.

2.2.3 RISA Analysis – The final truss design will be analyzed with RISA, a structural analysis software program. The RISA computer-based analysis will provide the necessary steel specifications for each member, such as dimensions and cross-sectional area. The team plans to analyze connection types with RISA if possible.

2.2.4 Steel Specifications- The team will determine the steel gage based on the dimensions and RISA analysis. The steel will be designed to withstand the load cases set forth in the ASCE Steel Bridge rule set.

2.2.5 Final Design Drafting – The final design will be drawn with the final dimensions and steel type determined by the group. These plans will be submitted to the client for review. After the design is finalized, a shop drawing set will be provided for fabrication of individual structural members.

2.3 Construction/Fabrication

2.3.1 Fabrication- The team is responsible for all fabrication of the bridge. If the team is unable to satisfactorily complete a piece of fabrication then an outside source will be located and compensated.

2.3.2 Shop drawings- The team will provide adequate shop drawings for fabrication. The shop drawings will be reviewed and approved by the client and technical advisor. The team will procure all raw materials for fabrication. The team will begin fabrication with adequate time for completion prior to ASCE conference in April.

2.3.3 Post fabrication- After fabrication has been completed, the team is responsible for construction and inspection of fabrication to ensure everything has been completed appropriately.

2.3.4 Construction- The team will practice construction methods on the fully fabricated bridge. This will serve as practice for conference. The team will be responsible for practicing their construction time so that it is within the 45-minute building time constraint.

2.4 ASCE Conference

2.4.1 Conference Activities – The team is expected to compete at the PSWC ASCE Student Conference in the Steel Bridge Competition, held at the University of Arizona in Tucson, Arizona. All team members are expected to attend and participate. Only builders, up to six team members specified for construction, may work on the bridge during the specified competition time. All aspects required by the competition are expected to be completed at the appropriate times.

2.4.2 Display Day –During the conference, a display of the bridge is required. At that point, the bridge must be complete and no further changes may be made, per ASCE 2015 Steel bridge regulations.

2.4.3 Travel and Lodging – Travel, lodging, conference fees, and meals during the Steel Bridge Competition are not within the scope. The funding for these items is not to be provided by the steel bridge team.

2.4.4 Display Board – As part of the competition, a display board is required. The mentees, underclassmen assisting with the project, shall be responsible for the display's completion. In the event that the display board is not completed, responsibility falls on the steel bridge team members. The display board shall be completed by conference.

2.4.5 Tools – The steel bridge team is responsible for procuring all tools needed to complete the bridge construction during the competition. In addition to competition tools, the team is responsible for any tools that may be needed for last minute repairs. If the bridge breaks pre-construction due to actions by a team member, the team is responsible for repairing the damages. The team is not responsible for transportation of tools or materials to the competition site; that will be handled by the NAU ASCE student chapter.

2.4.6 Unexpected Circumstances - If an unforeseen circumstance arises and the ASCE PSWC competition is canceled, the team is no longer expected to travel to Tucson, AZ or build the bridge at that location. Further decisions on how to proceed would need to be determined at that point.

2.5 Project Management

2.5.1 Project Schedule – The team has generated a schedule with all of the project milestones, tasks, subtasks, and their respective dates (Figure 3). The team is expected to follow this schedule. Should the team miss a due date; modifications to the schedule will be made to correct the timeline. The team must complete the bridge by conferene. The team is responsible for keeping the client informed about the schedule's status.

2.5.2 30% Drawings – The 30% bridge design plans will include a general schematic plan of the bridge and basic dimensions. The team will provide a copy of the 30% design plans to the client for his/her review.

2.5.3 60% Drawings – The 60% bridge design plans will include a detailed schematic of the bridge and all dimensions. In addition, preliminary analysis of the design's performance under loading will be included. The team will provide copies of the 60% design plans to the client for his/her review.

2.5.4 90% Drawings – The 90% bridge design plans will include all of the information provided in the 60% plans with the addition of the member cross-sectional area, connection specifics, and the grade of steel. All quantities will be included in the 90% plans. All analysis of the design's performance will have been conducted. The team will use the 90% plans to create shop drawings for fabrication. The team will provide a copy of the 90% design plans to the client for his/her review.

2.5.5 Material Procurement – The team is responsible for establishing sponsorships for the fabrication and construction of the bridge. This may include steel, nuts, bolts, paint, hand-tools, and other miscellaneous tools needed for construction. The team is also responsible for establishing a method of transporting the materials from the vendors to Northern Arizona University.

2.5.6 Staffing – The team established internal roles and respective tasks. The roles are: Design Engineer, Safety Engineer, Scheduling Engineer, Materials Engineer, and Project Manager. The team is responsible for verifying that all tasks under each role are fulfilled. In addition to these four roles, four mentees will shadow and assist the team in the project. The team is responsible for selecting mentees, arranging meeting times with the mentees, and assigning tasks for the mentees. Team members and mentees will be compensated for their hours put towards the project.

2.5.7 Conflict Resolution – The team is responsible for handling any conflicts according to the Team Charter. The charter requires team members to handle the conflict internally at two levels. If the conflict cannot be resolved internally, the team will escalate the conflict to an instructor.

3 Schedule

A Gantt Chart was created to illustrate the duration of the project, shown in Figure 3. Milestones, tasks, and subtasks have been denoted. Milestones are depicted as diamonds on the bottom of the line and are paired with their specific date. All tasks and milestones are indicated, as well as dependencies, start dates, and end dates. If any changes need to be made, then the team will notify the client and make appropriate adjustments.

4 Cost of Engineering Services

Based on the scope and schedule of the Steel Bridge Project, a staffing and cost estimate was assembled.

4.1 Staffing and Qualifications

The team selected to complete the steel bridge project is comprised of four engineers and four interns. Collectively, the team has over 15 years of engineering experience. Qualifications of the four engineers are provided below.

Noel Cruz (Project Manager/Materials Procurement)

Noel began her engineering training as a civil engineering student at Northern Arizona University. During her time as a student, she held internship positions with Hunter Contracting and Archer Western Construction and is currently an intern at Peak Engineering. Through her work experience and time as a student, Noel developed skills in budgeting, structural analysis, quantity calculations, and civil engineering design.

- **Education/Training**
  - Northern Arizona University, Undergraduate, Civil Engineering
- **Affiliations/Memberships**
  - American Society of Civil Engineers
  - Global Engineering Outreach
- **Comparable Projects**
  - Onsite Forced Aeration Composting System, Grand Canyon Expeditions Company – Noel, as a Project Manager, led the multi-disciplinary design team in the concept development and design of an onsite, forced aeration composting system to eliminate food waste generated on Grand Canyon river rafting tours.
  - Ammonia Removal Improvements, Tolleson Wastewater Treatment Plant – The project included replacing pumps and pipework used throughout the Tolleson Wastewater Plant and implementing a recycle system to remove excess ammonia from the effluent. As a project engineer, Noel assisted in quantity checks, field surveys, as-built development, and shop drawings.

Lauren Stadelmeier (Conference Captain/ Safety Engineer)

Lauren Stadelmeier is currently studying to become a Civil Engineer at Northern Arizona University. Experience includes course work within her undergraduate career analyzing civil engineering design in various aspects. Lauren Stadelmeier has been responsible for participating in construction competitions through her mentorship and previous schooling as well as managing safety during fabrication and construction methods.

- **Education**
  - College of Southern Nevada, General studies
  - Northern Arizona University, Undergraduate, Civil Engineering

- **Affiliations/Memberships**
  - American Society of Civil Engineers
  - American Concrete Institute
  - Multicultural Engineering
- **Comparable Projects**
  - ASCE Steel Bridge Mentorship, Northern Arizona University-Lauren Stadelmeier participated in the construction and fabrication of the 2014 ASCE Steel Bridge Project. As a mentee, Lauren was responsible for the safety of the team members during the construction and fabrication processes.
  - Balsa Bridge Building Contest- Lauren created a full sized drawing of a truss to all regulations provided by the contest, used approved materials to construct a model, and completed testing. Lauren completed fabrication with an overseeing advisor.

Sarah Higgins (Design Engineer)

Sarah's experience includes undergraduate courses in water resources, traffic, and structures as well as professional experience in site grading, roadway improvements, including striping plans, and other municipal projects. She is responsible for the design of the Steel Bridge; this includes RISA 2D and 3D modeling, as well as AutoCAD modeling.

- **Education:**
  - Northern Arizona University, Undergraduate, Civil Engineering
- **Affiliations/Activities:**
  - American Society of Civil Engineers
  - Multicultural Engineering
  - Tau Beta Pi Member
- **Comparable Projects:**
  - Design of Anspach's Jewelry Parking Lot – As project designer, Sarah, re-graded to improve drainage in a small urban downtown parking lot, and increased the number of parking spots for the public.

- First Robotics Team– As team lead, Sarah designed and constructed the robot body, and internal component containment boxes for three separate competitions.

Wendy Clark (Scheduling Engineer)

Wendy is currently a student at Northern Arizona University, where she is studying Civil Engineering, with a minor in Mechanical Engineering. She has taken classes in a variety of structural and material science classes. In addition, she has interned as a project engineer at Jacobs Engineering on a pipeline testing project, providing skills in project management and scheduling.

- **Education/Training**
  - Northern Arizona University, Undergraduate, Civil Engineering
  - Northern Arizona University, Minor, Mechanical Engineering
- **Affiliations/Memberships**
  - American Society of Civil Engineers
  - Global Engineering Outreach
- **Comparable Projects**
  - Environmental Engineering ASCE Competition 2014 - Wendy assisted in the completion of a nitrate and phosphate removal system for competition at the ASCE Pacific Southwest Conference. She ran tests, formulated solutions, assisted in construction, and participated in the competition.
  - Line 2000-West hydrotest- Wendy interned as a project engineer on the Line 2000-West gas pipeline hydrotest. The test was completed in order to satisfy safety requirements from the CPUC. Her duties included checking the schedule, writing procedures, overseeing budget and materials, and participating in drawing reviews.

4.2 Fee Schedule

A fee schedule, including all team members, was assembled and is shown below.

Personnel Classification	Billing Rate ($/hr)
Project Manager ………………………………………………………...	78.00
Conference Captain/Safety Engineer…………………………………	73.00
Scheduling Engineer……………………………………………….	65.00
Design Engineer …………………………………………………...	70.00
Intern …………………………………………………………….....	14.00

4.3 Cost of Engineering Services

Engineering services for this project are divided into five main tasks: initial design, design finalization, materials, fabrication, and Pacific Southwest Conference. A breakdown of the anticipated hours for each task is provided in Table 1. All hours required for the remaining tasks of the project were estimated from the current completed hours. Total time to complete this project is approximately 1107 hours, with a bulk of the time occurring during the initial design phase of the project. The estimated amount of time is reasonable due to the accelerated bridge construction method that will be utilized.

Table 1: Estimated Project Hours

Personnel	Task Name					Total Hours[1] per Personnel
	Initial Design	Design Finalization	Materials	Fabrication	Conference Competition	
Project Manager	88	18	15	90	32	243
Conference Captain/Safety Engineer	85	18	5	90	32	230
Scheduling Engineer	88	18	5	90	32	233
Design Engineer	99	9	5	90	32	230
Intern 1	23	4	0	15	7	49
Intern 2	23	4	0	15	7	49
Intern 3	23	4	0	15	37	79
Intern 4	23	4	0	15	37	79
Total Hours[1] per Task	383	58	30	420	216	1107

[1] (Number of Hours/Day) x (Number of Days/ Task)

Table 2 is a summary of all costs associated with completion of the project. These costs include all personnel costs, travel expenses, subcontracts, and materials. Material costs were estimated from preliminary design analysis and equipment inventory. These values are subject to change upon determination of the final design. The anticipated cost for this project is $72,670.50, with a majority of the cost allocated towards personnel costs. Information regarding the calculation of billable rates for all personnel is located in Table 3 in the appendix.

Table 2: Cost of Engineering Services for 2015 Steel Bridge project

1.0 Personnel			
Classification	***Hours[1]***	***Rate [$/hr]***	***Cost [$]***
Project Manager	243	78.00	18,954.00
Conference Captain/Safety Engineer	230	73.00	16,790.00
Scheduling Engineer	233	65.00	15,145.00
Design Engineer	230	70.00	16,100.00
Intern 1	49	14.00	686.00
Intern 2	49	14.00	686.00
Intern 3	79	14.00	1,106.00
Intern 4	79	14.00	1,106.00
		Subtotal	***70,573.00***
2.0 Travel			
Classification	***Distance (Miles)***	***Rate [$/hr]***	***Cost [$]***
Steel Transport	310	0.50	155.00
Nuts and Bolts Transport	5	0.50	2.50
Fabrication Transport	310	0.50	155.00
		Subtotal	***312.50***
3.0 Materials			
Classification	***Analytical***		***Cost [$]***
Compression/Tension Members	Analytical		400.00
Steel plate for sign	Analytical		50.00
Steel plates for connections	Analytical		300.00
Cross-bracing	Analytical		70.00
Drill Bits	Analytical		20.00
Cleaning Supplies	Analytical		15.00
Storage containers	Analytical		40.00
Paint	Analytical		100.00
Strapping/Pulley System	Analytical		75.00
Box wrenches	Analytical		140.00
Nuts and Bolts	Analytical		100.00
Display Poster	Analytical		80.00
Welding Materials	Analytical		500.00
Miscellaneous	Analytical		50.00
		Subtotal	***1,940.00***
5.0 Total			**$34,714.68**

5 References

[1] "STUDENT STEEL BRIDGE COMPETITION, 2015 Rules." 2015 National Student Steel Bridge Competition. ASCE, AISC, 1 Jan. 2014. Web. 30 Aug. 2014.

6 Appendix

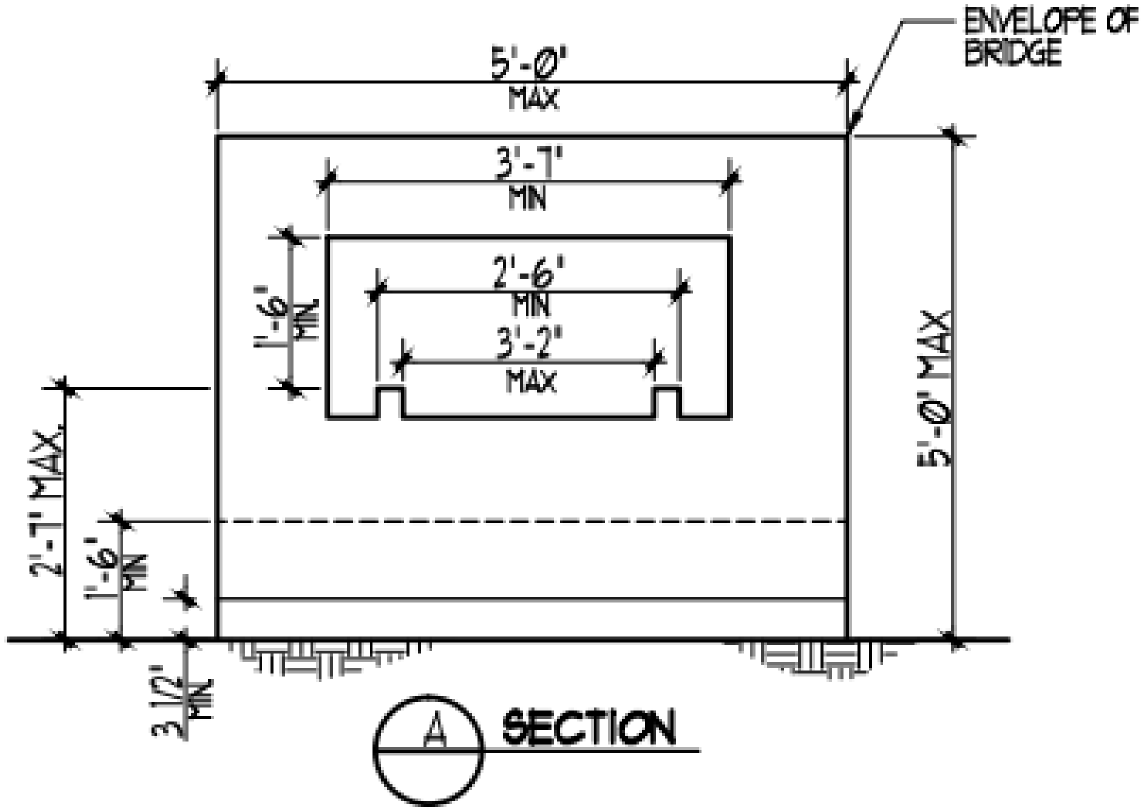

Figure 1: Bridge Envelope

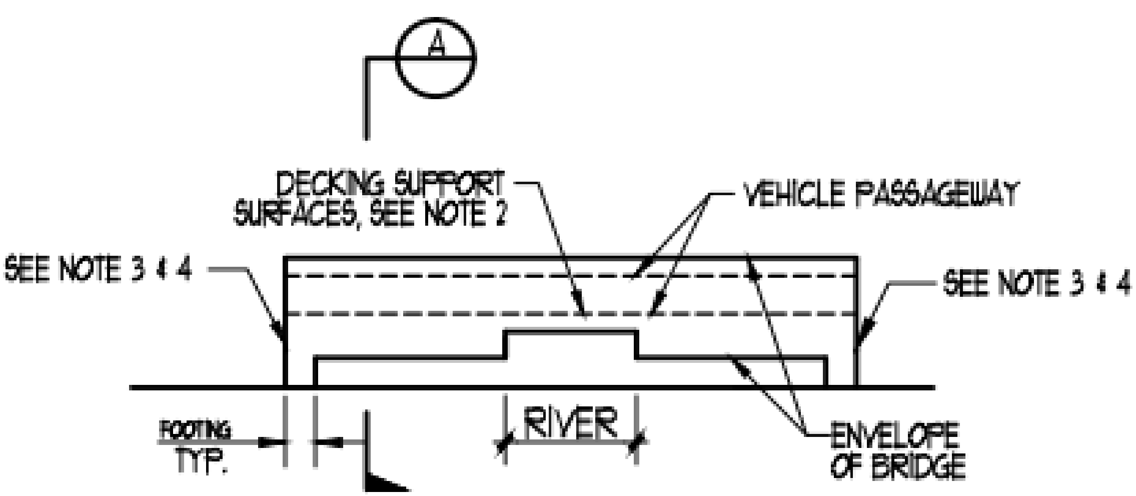

Figure 2: Profile of Bridge

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		**Initial Design**	**64 days**	**Tue 9/16/14**	**Fri 12/12/14**	
2		Conceptual Approaches	9 days	Tue 9/16/14	Fri 9/26/14	
3		Determine Truss	10 days	Mon 9/29/14	Fri 10/10/14	2
4		Initial Dimensions	4 days	Tue 10/7/14	Fri 10/10/14	
5		30% Drawings	0 days	Fri 10/10/14	Fri 10/10/14	3,4
6		Learn to use RISA	20 days	Mon 9/29/14	Fri 10/24/14	
7		60% Drawings	0 days	Fri 11/7/14	Fri 11/7/14	5FS+20 days
8		RISA Analysis	15 days	Mon 10/27/1	Fri 11/14/14	6
9		Finalize Joints/Dim.	15 days	Mon 11/17/1	Fri 12/5/14	7,8
10		90% Drawings	0 days	Fri 12/5/14	Fri 12/5/14	9
11		**Design Finalization**	**10 days**	**Mon 1/26/15**	**Fri 2/6/15**	
12		Conduct Drawing Review	5 days	Mon 1/26/15	Fri 1/30/15	18FS+30 days
13		Make Final Edits	5 days	Mon 2/2/15	Fri 2/6/15	12
14		100% Drawings	0 days	Fri 2/6/15	Fri 2/6/15	13
15		Shop Drawings	0 days	Fri 2/6/15	Fri 2/6/15	13
16		**Materials**	**66 days**	**Mon 11/10/1**	**Mon 2/9/15**	
17		Determine Quantity	5 days	Mon 11/10/1	Fri 11/14/14	7
18		Order Materials	20 days	Mon 11/17/1	Fri 12/12/14	17
19		Receive Materials	1 day	Mon 2/9/15	Mon 2/9/15	18FS+40 days
20		**Fabrication**	**36 days**	**Mon 2/9/15**	**Mon 3/30/15**	
21		Fabrication Planning	5 days	Mon 2/9/15	Fri 2/13/15	15
22		Begin Fabrication	0 days	Mon 2/16/15	Mon 2/16/15	19FS+5 days,21
23		Fabrication	30 days	Tue 2/17/15	Mon 3/30/15	22
24		Finish Fabrication	0 days	Mon 3/30/15	Mon 3/30/15	23
25		**Conference**	**39 days**	**Tue 2/17/15**	**Sat 4/11/15**	
26		Practice Building	6 days	Tue 3/31/15	Tue 4/7/15	24
27		Create Poster	25 days	Tue 2/17/15	Mon 3/23/15	22
28		Finish Poster	0 days	Mon 4/6/15	Mon 4/6/15	27
29		Conference	3 days	Thu 4/9/15	Sat 4/11/15	26
30		Bridge Competition	0 days	Sat 4/11/15	Sat 4/11/15	

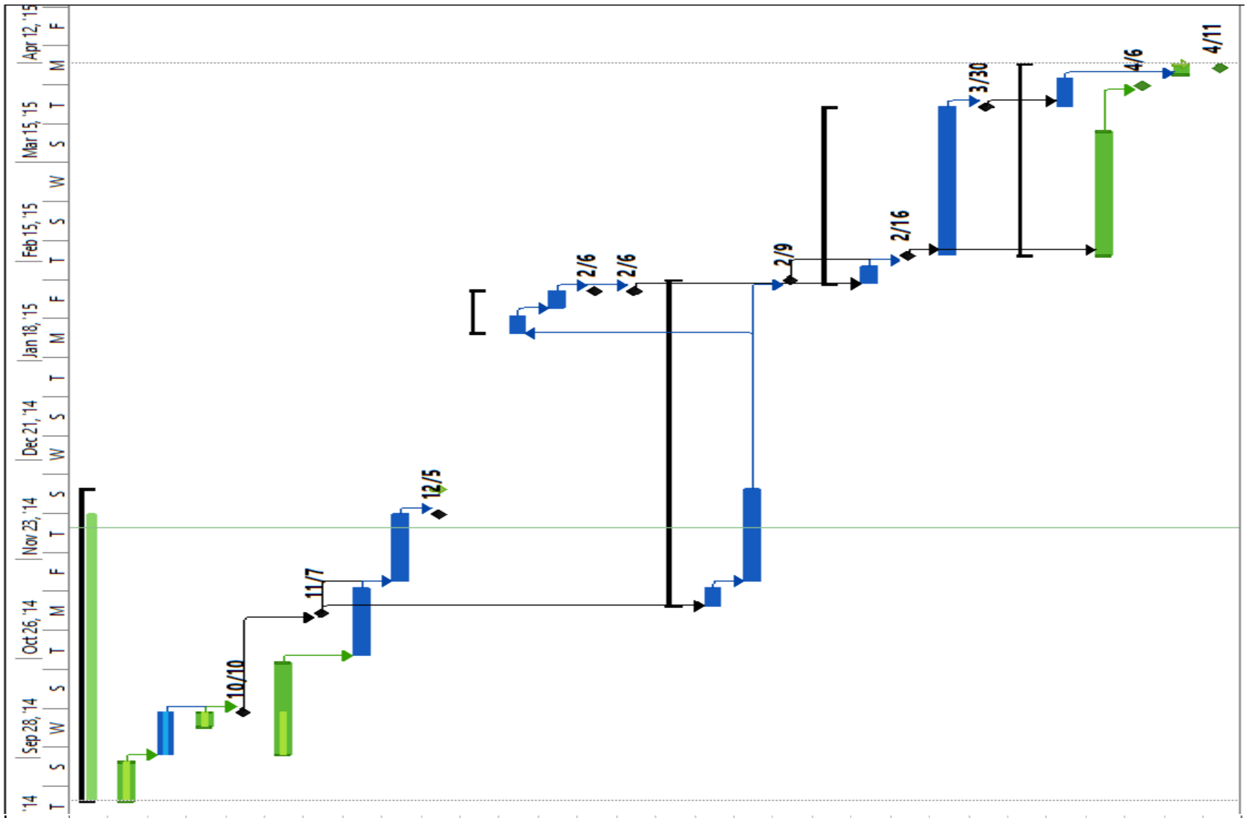

Figure 3: Project Schedule

Table 3: Billing Rate Calculations

Personnel Classification	Base Pay [$/hr]	Benefits [%]	Actual Pay [$/hr]	Overhead [%]	Actual Pay + Overhead [$/hr]	Profit [%]	Billing Rate [$/hr]
Project Manager	48.00	20	57.60	30	72.00	10	78.00
Conference Captain/Safety Engineer	45.00	20	54.00	30	67.50	10	73.00
Scheduling Engineer	40.00	20	48.00	30	60.00	10	65.00
Design Engineer	43.00	20	51.60	30	64.50	10	70.00
Intern	10.00	0	10.00	30	13.00	10	14.00