

STEEL BRIDGE

CENE 476C

1

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PROJECT UNDERSTANDING

Project Purpose/Background

- San Diego National Wildlife Refuge
- Sweetwater River Bridge in San Diego
- Design a 1:10 scale model of a bridge to provide better access
- University of Nevada Reno, April 2023
- Client: Mark Lamer



LOCATION



PROJECT UNDERSTANDING

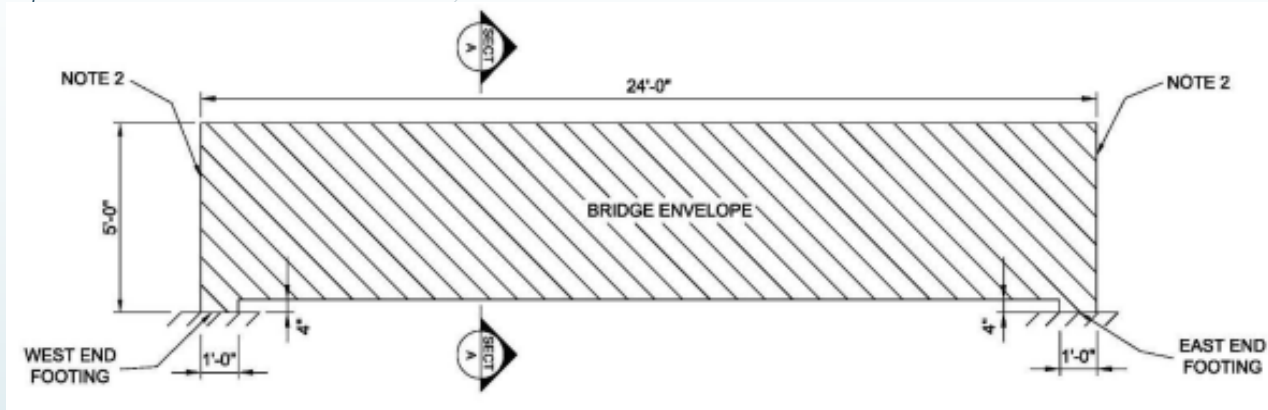


Figure 1: Bridge Envelope – Elevation View

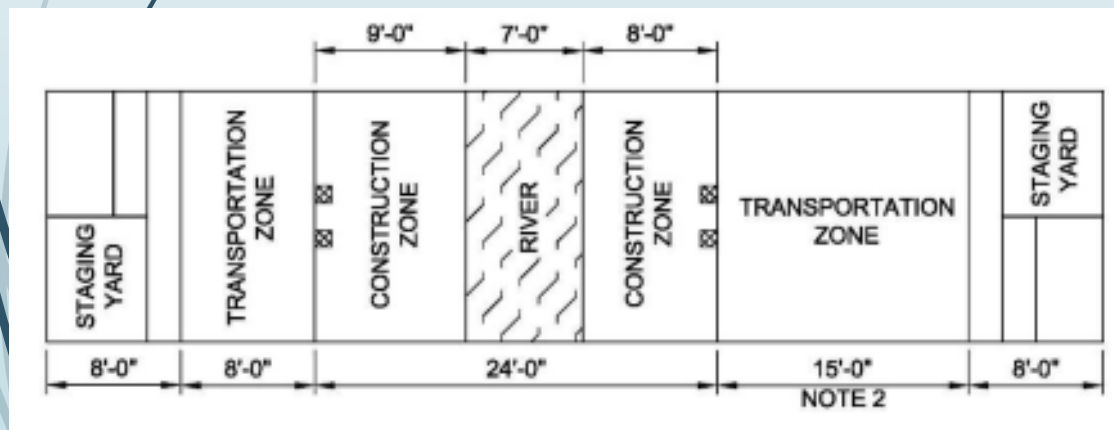


Figure 2: Construction Zone – Plan View

Technical Considerations

- Bridge Envelope
- Construction zone

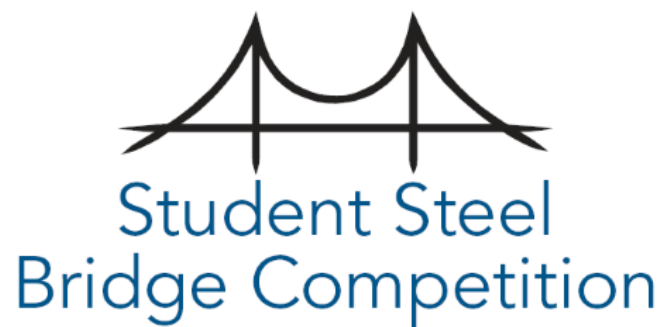
Potential Challenges

- Competition constraints

Stakeholders

- San Diego National Wildlife Refuge
- NAU's Engineering Department
- Competition Sponsors

TASK 1.0: BACKGROUND RESEARCH



Smarter.
Stronger.
Steel.

ASCE AMERICAN SOCIETY
OF CIVIL ENGINEERS

Task 1.1 Competition Rules

- Understand Rules

Task 1.2 Analysis Methods

- Traditional Hand Calculations
- Computer Modeling Software

Task 1.3 Truss Patterns and Connections

- Truss Variations
- Fittings and Connections

Task 1.4 Material Properties and Selection

- Magnetic Steels
- Weight vs. Strength vs. Availability

TASK 2.0: DESIGNING

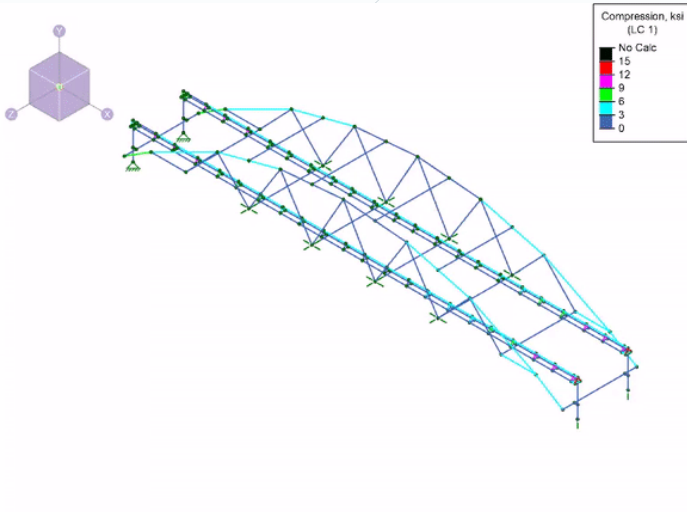


Figure 3: Sample Bridge Deflection

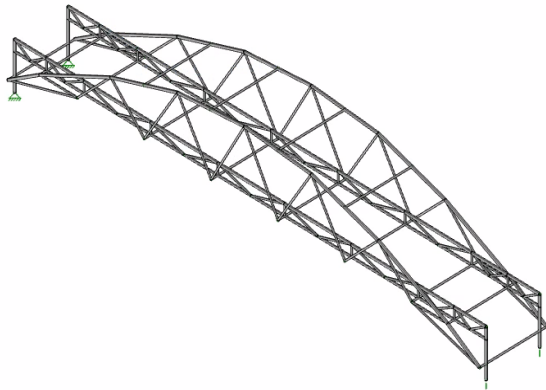


Figure 4: Bridge Design

Task 2.1 Preliminary Sketches

- Design options/Decision Matrix

Task 2.2 Member Selection

Task 2.3 Risa Modeling and Analysis

- Load Combinations

Task 2.4 Connection Modeling and Analysis

- AutoCAD and SolidWorks

Task 2.5 Select Final Design

Task 2.6 Material Procurement



7

TASK 3.0: FABRICATION

Task 3.1 Fabrication Documents

- Shop drawings, technical specs, and tolerances

Task 3.2 Fabrication Oversight

- Construction of members
- Measuring
- Cutting
- Welding
- Assembly

TASK 4.0: TESTING PRIOR TO COMPETITION

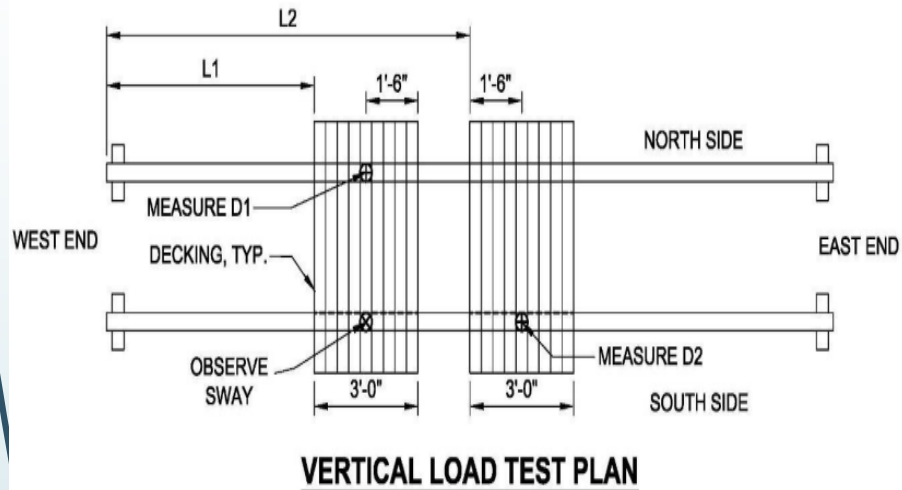


Figure 5: Vertical Load Plan

N	L1	L2	S
1	4'-0"	7'-6"	7'-0"
2	4'-6"	8'-6"	7'-0"
3	7'-0"	13'-0"	10'-0"
4	8'-6"	13'-6"	13'-0"
5	10'-0"	15'-0"	10'-0"
6	11'-6"	16'-0"	13'-0"

Figure 6: Bridge Loading Locations

Task 4.1 Pre-Load Bridge

- Apply 100 lb. to decking at L1 and L2 per the rules stated in the SSBC rules

Task 4.2 Lateral Load Test

- S – Location at which the lateral load will be applied
- 50lb. Lateral load to test sway (1in max sway)

Task 4.3 Vertical Load Test

- Ensure the bridge matches analytical behavior

TASK 5.0: PRACTICE

Task 5.1 Practice Assembling Bridge

- Familiarize members with components

Task 5.2 Optimize Construction Speed

- Improve techniques & Efficiency
- Tool/Member staging
- Identify modifications to design, if necessary

Task 5.3 Competition Management

- Designate positions



TASK 6.0: COMPETITION

Task 6.1 Travel Arrangements

- ASCE Coordination

Task 6.2 Competition Day

- Review rules

Go over previous lessons
learned from practice

- Win awards!



9 SSBC National Finals. Photo Credit: Steve Buhman, New Leaf Studio

TASK 7.0: PROJECT IMPACTS



SOCIAL IMPACTS



ENVIRONMENTAL
IMPACTS



ECONOMIC
IMPACTS

TASK 8.0: DELIVERABLES



30 Percent Deliverable

Design Report & Presentation
Tasks 1 and 2



60 Percent Deliverable

Design Report & Presentation
Tasks 2, 3, and 4



90 Percent Deliverable

Design Report and
Presentation
Task 5, 6, and 7



Final Deliverables

Competition Results, Final
Report, Website

Task 9.0: PROJECT MANAGEMENT

9.1 Schedule

Availability –
Microsoft Project

9.2 Meetings

Client - Technical
Advisor - Grading
Instructor - Team

9.3 Communication

Email - Google
Drive - Discord -
Texting

9.4 Resource Management

Advisors - AISC
Staff - AISC grant

EXCLUSIONS



Decking and Footings



Full Scale Construction



Traffic Impact



Exact Location of Bridge

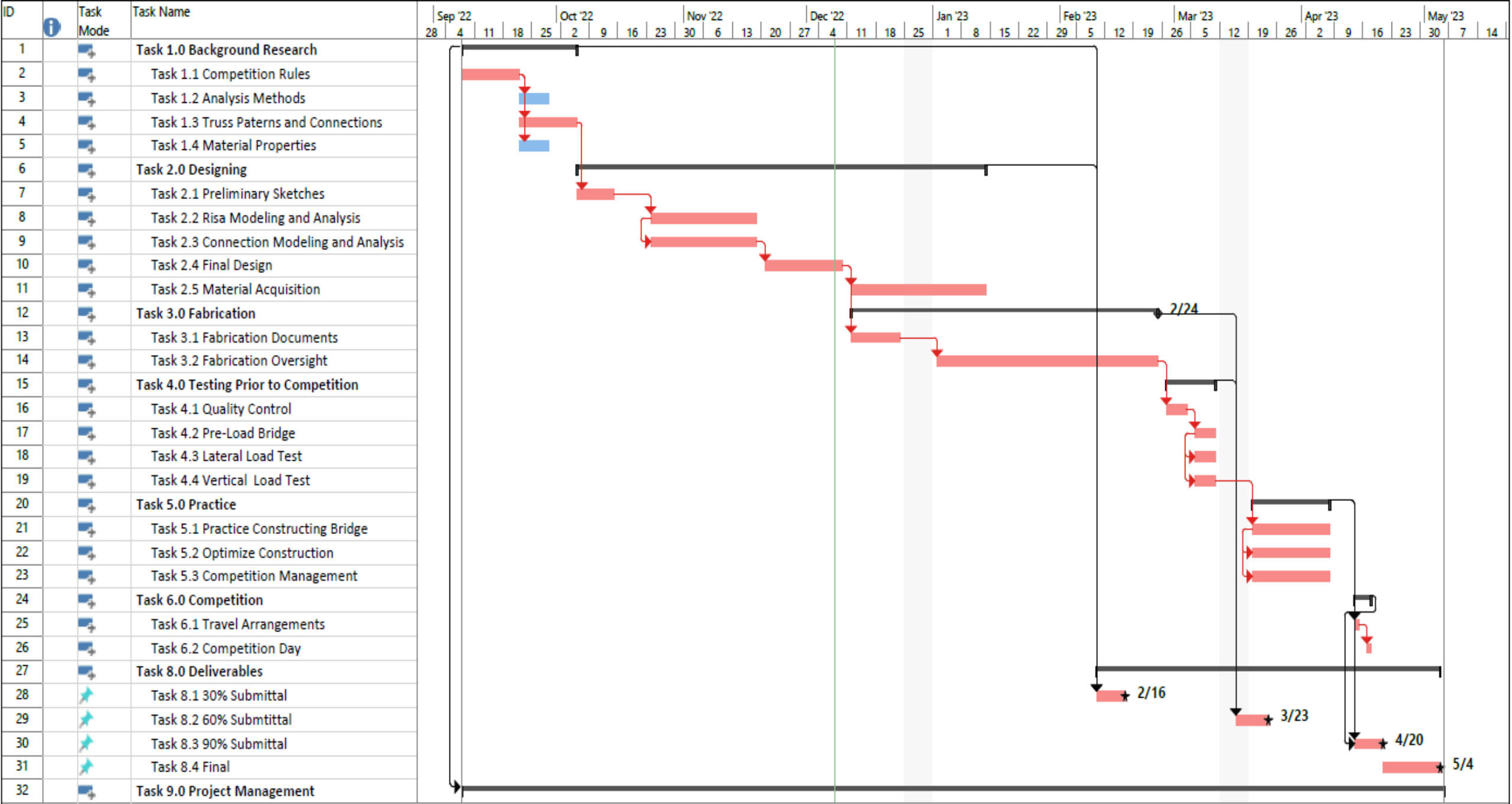


Figure 7: GANTT Chart

STAFFING POSITIONS

Senior Engineer

- Oversees, quality control

Project Engineer

- Collaborate with drafter, bulk of engineering work

Engineer in Training

- Gather experience through collaboration with PE

Drafter

- RISA design and Fabrication Documents

Engineering Intern

- Assist and Shadow

Table 1: Staffing Positions

Classification	Code
Senior Engineer	SE
Project Engineer	PE
Engineer in Training	EIT
Drafter	DRF
Engineering Intern	INT

Table 2: Staffing Hours

Task Name	Personnel					SUM							
	SE	PE	EIT	DRF	INT								
Task 1.0 Background Research	7	4	16	0	16	43							
Task 1.1 Competition Rules	4	4	4	0	4	16							
Task 1.2 Analysis Methods	1	0	4	0	4	9							
Task 1.3 Truss Patterns and Connections	1	0	4	0	4	9	Task 5.0 Practice	21	17	13	0	13	64
Task 1.4 Material Properties	1	0	4	0	4	9	Task 5.1 Practice Constructing Bridge	8	8	8	0	8	32
Task 2.0 Designing	23	23	45	55	42	188	Task 5.2 Optimize Construction	5	5	5	0	5	20
Task 2.1 Preliminary Sketches	0	5	5	5	5	20	Task 5.3 Competition Management	8	4	0	0	0	12
Task 2.2 Risa Modeling and Analysis	5	10	15	30	15	75	Task 6.0 Competition	13	8	8	0	12	41
Task 2.3 Connection Modeling and Analysis	3	3	10	0	10	26	Task 6.1 Travel Arrangements	5	0	0	0	4	9
Task 2.4 Final Design	10	5	15	20	10	60	Task 6.2 Competition Day	8	8	8	0	8	32
Task 2.5 Material Acquisition	5	0	0	0	2	7	Task 8.0 Deliverables	32	32	32	0	32	128
Task 3.0 Fabrication	18	21	26	30	26	121	Task 8.1 30% Submittal	8	8	8	0	8	32
Task 3.1 Fabrication Documents	2	5	10	30	10	57	Task 8.2 60% Submittal	8	8	8	0	8	32
Task 3.2 Fabrication Oversight	16	16	16	0	16	64	Task 8.3 90% Submittal	8	8	8	0	8	32
Task 4.0 Testing Prior to Competition	10	25	25	0	25	85	Task 8.4 Final	8	8	8	0	8	32
Task 4.1 Quality Control	10	10	10	0	10	40	Total	124	130	165	85	166	670
Task 4.2 Pre-Load Bridge	0	5	5	0	5	15							
Task 4.3 Lateral Load Test	0	5	5	0	5	15							
Task 4.4 Vertical Load Test	0	5	5	0	5	15							

Cost of Engineering Services

Table 3: Cost of Engineering Services

Cost of Engineering Services				
Classification	Details	Rate	Quantity	Cost, \$
1.0 Personnel	Title	\$ per hr.	Hours	Total
	Senior Engineer	\$180.00	124	22,320
	Project Engineer	\$140.00	130	18,200
	Engineer in Training	\$70.00	165	11,550
	Drafter	\$75.00	85	6,375
	Intern	\$35.00	166	5,810
	Total Personnel			
2.0 Supplies	Members	\$3/lb	250 lb	750
	Bolts	\$0.01/unit	200	2
	Plates	\$3/lb	10 lb	30
	Supplies Cost			
3.0 Subcontract	Labor	\$65.00	60	3,900
4.0 Travel Expenses	Lodging	\$170/person/night	4 nights	2,720
	Rental	\$68/day	5 days	340
	Mileage	\$0.45/per mile	691x 2 miles	622
	Travel Cost			
Total Project Cost				72,619

QUESTIONS?



THANK YOU, SPONSORS!