

BLUFFDALE BRIDGE OPTIONS
Project ID: CEEEn_2018CPST_001

by

RSR Engineering
Ryan Wilkinson
Rex Henretta
Shane Oh

A Capstone Statement of Work

Submitted to

Michael Fazio & Dan Tracer
Bluffdale City

Department of Civil and Environmental Engineering
Brigham Young University

October 8, 2018

Introduction

PROJECT TITLE: BLUFFDALE BRIDGE OPTIONS
PROJECT ID: CEEEn_2018CPST_001
PROJECT SPONSOR: Bluffdale City
TEAM NAME: RSR Engineering

The City of Bluffdale (the City) has a bridge that spans across the Utah & Salt Lake Canal at 14400 South. Based on the latest UDOT Bridge Inspection Report, the current condition of the bridge includes delamination of precast members, exposing rebar in the lower section. The City is concerned that the bridge may not be able to support the loads require of its current use. As part of this project's scope, RSR Engineering (the Team) will be required to analyze the current bridge loading capacity, provide recommendations for rehabilitation, and provide possible funding sources the City could use for the rehabilitation.

The requirements of the project will be completed in two phases: analysis of current bridge structure and evaluation of options for rehabilitation and repair. Analysis will include a site visit, research of bridge inspection options, creating a three-dimensional model of the structure, and determining acceptable limits of the bridge capacity. The Team anticipates completion of these steps on January 18, 2019. The evaluation will include research of bridge deterioration, research of bridge rehabilitation options, and a cost comparison of rehabilitation options. The Team will complete these steps by early April 2019.

By completion of the project in April 2019, the Team will present the following deliverables to the City: Monthly status reports, a final report with design alternatives, a spreadsheet for analysis, a three-dimensional model of the structure, and a presentation delivered to the City Staff and City Council summarizing the results of the project. More details regarding the content and timing of these deliverables will be discussed below.

Proposed Work Plan

The project will be split into the following two phases: analysis of current bridge structure and evaluation of options for rehabilitation and repair.

The following list outlines the steps of the analysis phase:

- Discuss with faculty (Professor Christine Isom, Dr. Spencer Guthrie) regarding best methods for determining the current capacity of the bridge and possible rehabilitation options (October 9 at BYU Civil Engineering Offices)
- Research cost of full bridge inspection
- Perform a site visit and create a model of the structure (October 19 at structure location, Utah & Salt Lake Canal and 14400 S in Bluffdale)
- Determine acceptable limits of bridge capacity; estimate capacity based on conservation and non-conservation assumptions of the bridge structure (Approximately November 1 on BYU campus)
- Perform analysis of bridge – loading restrictions, etc. (Approximately November 1 on BYU campus)

These are the deliverables of the analysis phase, expected delivery by January 18, 2019:

- Three-dimensional model of the structure
- Report of the bridge conditions and capacity

This list indicates the steps of the evaluation phase, anticipated commencement January 19, 2019; each of these steps are expected to be completed on BYU campus:

- Research bridge deterioration with help from faculty advisors (Professor Isom, Dr. Fernando Fonseca, and Dr. Kevin Franke); determine the cause of deterioration (Approximately January 20)
- Research options for bridge replacement or repair (Approximately February 1)
- Economic analysis of replacement/repair options (Approximately March 22)

These are the deliverables of the evaluation phase, expected delivery by early April 2019:

- Spreadsheet for analysis that can be used in the future
- Presentation to the city
- Economic comparison chart of different options

Schedule

The project shall be completed according to the following schedule:

- October 19: Site Visit 1 – measurements of the bridge, photos to create a 3-D model, and visual inspection of the bridge damage.
- November 1: 3-D model created, report of existing structure conditions completed (based on visual inspections and model).
- December 10: 30% completion report – this report will contain a status update on the bridge analysis, the report of the bridge conditions, and the 3-D model. The full analysis will not be complete by this date.
- December 21: Structural Analysis completed, load capacities of the bridge determined. Report will not be compiled, but preliminary results will be available.
- January 18: Results of the structural analysis compiled and presented to the City.
- February 1: Possible remedies researched, a list of all possibilities compiled into one report.
- March 22: Completed economic analysis of all remediation options, sources of funding located, expected bridge life span for each remedy determined, final report completed.
- Early April: Results presented to the City and BYU ASCE student chapter. The exact date of the final presentations has yet to be determined, but it will take place at the beginning of April.

The Team will meet weekly for one hour to compile our individual weekly efforts. Each team member will be expected to spend 2 hours per week on the project during the 2018 calendar year; that expected hourly requirement will be increased to 4 hours during the 2019 calendar year until the project is finished. Weekly status reports will be provided to the client and our faculty advisors. These reports will contain detailed explanations of the project status, problems encountered, proposed solutions, and any necessary modifications to the schedule proposed above.

Meetings with BYU faculty members will be scheduled as needed. Professor Christine Isom, Dr. Kevin Franke, Dr. Spencer Guthrie, and Dr. Fernando Fonseca have agreed to assist the Team in the analysis process. The level of involvement of each of these faculty members will depend on the structural status of the bridge and the complexity of the analysis, determined at the time of the first site visit. The results of these meetings will be included in the weekly status reports.

Facilities, Tools, Data and Equipment

A thorough analysis of the structural integrity of the bridge must begin with accurate dimensions of the bridge. Taking accurate measurements will be the key to proper analysis of the bridge girders. During site visits, safety equipment will also be necessary because the bridge is an active roadway. Creation of the 3-D model of the bridge to use later in the analysis will also require specialized equipment.

All data collected will be compiled in a spreadsheet awaiting further analysis.

The following is a list of the equipment and tools necessary to complete the project:

Measurement

- 100-foot engineer's tape – this will be primarily used to measure the clear span of the bridge, total width of the bridge, and the total length of the bridge girders.
- 25-foot engineer's tape – this will allow us to measure the depth and width of the girders, their spacing, and the width of the structural slab above the beam webs.
- Calipers – exposed rebar is the main cause for concern on this bridge. The calipers will be required to measure the diameter of the rebar in the pre-stressed girders.
- Ladders – we will place ladders in the bottom of the canal to allow us to reach the girders for measurement.

Safety

- PPE – because this bridge is an active roadway, we will need safety vests, hard hats, and gloves to comply with safety requirements

Modeling

- Photography Equipment – A camera and surveying equipment will be required to create a 3-D model of the bridge. This model can be used as a secondary measurement tool to verify our hand measurements.

Analysis

- Microsoft Excel – this will be the primary tool used to analyze the bridge. It will allow us to use presumptive values where data is not readily available and to analyze the bridge with varying degrees of structural damage.

Project Budget

As a 1-credit class during the fall semester, the required contribution of each team member is 2 hours per week outside of class time; during winter semester, this will increase to 4 hours per week. This project is time-sensitive and will be completed as quickly as possible. The capstone experience is designed to have most of the work take place during the winter semester; however, at the request of the client, we will do more work during the fall semester than originally anticipated so it may be completed faster.

The project budget below indicates the number of hours anticipated in each step along with the timeline layout:

- October 19: Site Visit 1 – 6 Hours
- November 1: 3-D model created – 6 Hours
- December 10: 30% completion report – 40 Hours
- December 21: Structural Analysis complete with load capacities of the bridge – 20 Hours
- January 18: Results of the structural analysis compiled into preliminary report– 6 Hours
- February 1: Possible remedies researched – 10 Hours
- March 22: Economic analysis of all remediation options – 40 Hours
- Early April: Prepare presentation of results to the City – 10 Hours

Deliverables

1. **Monthly status reports** documenting challenges, solutions, & progress. These reports will summarize the progress and status of the project, discussing challenges of the project and how the Team mitigated these problems. These reports will also respond to the following:
 - a. What challenges have the Team encountered in the Capstone project?
 - b. What actions did the Team decide to take to overcome these challenges?
 - c. Any progress in overcoming these challenges?
 - d. Is project on schedule?
2. A **final report** with design alternatives for the bridge that include economic and environmental considerations. This report will include the following:
 - a. A full analysis of the current bridge loading capacity and other conditions
 - b. Recommendations for rehabilitation and repair
 - c. Recommendations for possible funding resources the City can use to fund rehabilitation
3. A **spreadsheet for analysis** that can be used for the current bridge and other structures in the future.
4. A **three-dimensional model** of the structure
5. A **poster** reflecting a summary of the project to be presented to student, faculty and other interested individuals in the final undergraduate seminar.
6. A **presentation** delivered to the City Staff and City Council summarizing the results of the project.

Performance Standards

The Team will provide work for this Capstone project “as is” using best practices and with best effort. Project results cannot be construed as work performed by licensed professionals and cannot be used as “stamped deliverables” without first being reviewed, approved and stamped by a qualified and relevant license professional engineer.

Conservative assumptions will be used in this project in situations where reliable data is not available. Further testing outside the scope of this project may be required to acquire precise data and increase the accuracy of the analysis.

Statement of Qualification

Outside Consultants

Dr. Kevin Franke—Capstone Team Advisor

- Dr. Franke's research is primarily focused on geotechnical earthquake engineering. His research includes creating three-dimensional models of affected areas through photography and continued analysis through use of these models.

Dr. Christine Isom—Bridge Expert Consultant

- Dr. Isom is the bridge design instructor at BYU. She currently works for Hatch Mott MacDonald as a bridge analyst. She has experience designing and analyzing both steel and concrete bridge structures.

Dr. Fernando Fonseca—Reinforced Concrete Consultant

- Dr. Fonseca is the reinforced concrete instructor at BYU. He has taught reinforced concrete design for over 20 years and has experience designing girders, beams, slabs, and other concrete structures.

Jeff Dericott—Photographer

- Jeff is a Civil Engineering student at BYU. He is a member of Dr. Franke's research team and has experience in creating models through photography.

Team Members

Ryan Wilkinson, Team Lead

- Ryan is a senior in the Civil Engineering program with an anticipated graduation date of December 2019. He will continue his education at BYU to complete an M.S. in Civil Engineering with an emphasis in structural engineering. He has been working at Acute Engineering for 18 months as a structural engineer with experience in light-frame engineering and foundation design. He is also a member of the Tau Beta Pi honor society.

Rex Henretta, Analyst

- Rex is a senior studying Civil Engineering who expects to graduate during the summer of 2019. He plans to continue his studies following graduation with a focus in structural engineering. Experience comes from relevant coursework taken at BYU, including Structural Analysis, Mechanics of Materials and Reinforced Concrete Design.

Shane Oh, Organization Specialist, Analyst

- Shane is a senior studying Civil Engineering with an anticipated undergraduate completion date of April 2019. He anticipates completing a M.S. in Structural Engineering from a university yet to be determined by 2021. His experience includes two years leading a steel bridge design team to two 1st-place finishes in the Student Steel Bridge AISC competition. He has also performed project management and proposal work as an intern at W. W. Clyde & Co. Construction Company.

RSR Engineering will be headed by Ryan Wilkinson as Team Lead. He will be responsible for all communication with clients and faculty members. Shane will be responsible for submitting weekly reports, compiling deliverables, and managing the schedule throughout the duration of the project. Rex will be primarily responsible for heading the analysis and research portions of the project. Each of these responsibilities has been assigned to maximize the effectiveness of the team. Each team member is expected to assist in all responsibilities, but each is primarily responsible for a different portion of the project.

Appendix A

Ryan Wilkinson

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EDUCATION **B.S., Civil Engineering**, Brigham Young University
Anticipated graduation December 2019

- 3.90 GPA
- Structural Engineering Emphasis

WORK EXPERIENCE

Student Engineer, Acute Engineering (Orem, UT) *May 2017 – Current*

- Designed and implemented new engineering and drafting procedures to reduce billable time by 70%
- Created training programs for seismic analysis, framing layouts, concrete design, steel design, and wood member design
- Provided structural engineering services for over 300 light-frame structures

Lab Instructor, BYU Physics Department (Provo, UT) *February 2017 – May 2017*

- Instructed 50 students weekly on principles of physics through lab demonstrations
- Managed all grading and testing for students in the class

Laborer, Cache Valley Electric (Salt Lake City, UT) *April 2016 - August 2016*

- Directed concrete forming and pouring, conduit laying, excavation, and groundwater control efforts
- Worked efficiently to meet weekly contractor deadlines in various phases of construction projects

OTHER EXPERIENCE

Volunteer Representative, The Church of Jesus Christ of Latter-day Saints
(North Dakota, South Dakota, Minnesota, Wyoming) *June 2013 – June 2015*

- Provided weekly training, feedback, and assistance for 30 volunteers
- Created and executed monthly multi-state travel plans for 60 volunteers

FUTURE EDUCATION

M.S., Civil Engineering, Brigham Young University
Anticipated graduation December 2020

- Foundation Engineering Research
- Structural Engineering Emphasis

SKILLS

Technical:

- C++ and VBA computer programming
- Proficient in AutoCAD
- Proficient in Microsoft Office programs

REX HENRETTA

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rwhenretta@gmail.com

My objective is to continually improve my civil engineering and leadership skills and to contribute to the company where I work in terms of productivity, customer satisfaction and product safety.

EXPERIENCE

. JULY 2017 – CURRENT

LEAD CUSTODIAN, BRIGHAM YOUNG UNIVERSITY

SUPERVISOR: CHRIS HUFF

SUPERVISOR'S PHONE: 425-418-4780

SUPERVISOR'S EMAIL: CHRISTIAN_HUFF@BYU.EDU

Assist supervisor in organizing daily tasks and training and directing other custodians.

MARCH 2016 – AUGUST 2016

HELP DESK TECHNICIAN, C7 DATA CENTERS

SUPERVISOR: BRANDON SWAIN

SUPERVISOR'S EMAIL: B.SWAIN@C7DC.COM

Communicated with customers, in person or over the phone, to carry out requested tasks regarding their data servers.

SEPTEMBER 2011 – SEPTEMBER 2013

VOLUNTEER REPRESENTATIVE, LDS CHURCH

Consistently woke up at 6:30 am every morning. Interacted with potential clients for several hours every day. Trained other representatives in weekly meetings

EDUCATION

APRIL 2019

CIVIL ENGINEERING, BRIGHAM YOUNG UNIVERSITY

SKILLS

- Fluent in Spanish
- Strong communication skills
- Microsoft Excel and Word proficient
- Able to work under pressure
- Able to adapt to criticism and instruction

SHANE OH

Brigham Young University Civil Engineering Senior
Graduating April 2019

Civil Engineering Experience

Business Development & Construction Intern / May 2018 – August 2018
W. W. Clyde & Co. Construction Company Provo, UT

- Expedited submittal documentation process by 3-4 months by coordinating with client and 15+ subcontractors and reviewing documents to ensure compliance with DOT construction specifications
- Assisted eventual shortlisting on 2 alternate-delivery heavy civil construction projects by researching resources for ATC development
- Accelerated project-bidding process for 8 future alternate-delivery projects by compiling project information and time lines

Research Assistant; Dr. Fernando Fonseca / March 2018 – June 2018
BYU Civil Engineering Department Provo, UT

- Ensured safe placement of freeway expansion through corrosion evaluation of 8-10 MSE walls
- Documented field process for safe extraction of MSE wall reinforcement

Research Assistant; Dr. Paul Richards / August 2017 – May 2018
BYU Civil Engineering Department Provo, UT

- Propelled patent creation process of steel moment frame designs
- Monitored proper testing of over 10 moment frame designs in university's structures lab

Club/Volunteer Experience

'17 & '18 Steel Bridge Captain / January 2017 – Current
Steel Bridge Competition (AISC) SLC, UT & Rapid City, SD

- Finished 1st in two consecutive years by designing and fabricating the most effective 20-ft steel bridge model to meet competition load requirements
- Appointed as Steel Bridge captain due to excellence in project management
- Established funding options for the team by coordinating contacting efforts with over 50 different companies

Full-Time Representative / August 2014 – August 2016
The Church of Jesus Christ of Latter-day Saints Arcadia, CA

- Established relationships with a myriad of church and community leadership through efforts in full-time volunteer services
- Provided community service (such as ESL classes) by leading groups of 15-20 volunteers; mitigated conflicts within volunteering groups
- Coordinated volunteering efforts with different cultural groups using Chinese language skills

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Education

BS in Civil Engineering /
Brigham Young University
Graduating April 2019

- GPA: 4.0
- Minor: Physics

Skills

Languages

- English
- Mandarin (conversational)
- Cantonese (conversational)

Programs

- Microsoft Office Suite
- Bluebeam Revu
- AutoCAD (classroom exp.)
- Revit (classroom exp.)
- LabView (classroom exp.)
- Adobe Photoshop
- Adobe Illustrator
- Adobe InDesign

Miscellaneous

Other Jobs

- BYU Library Research Assistant
- Physics Teaching Assistant
- Civil Engineering Teaching Assistant

Other Clubs

- Officer / Tau Beta Pi Engineering Honors Society
- Officer / BYU Chapter of American Society of Civil Engineers (ASCE)

Personal Interests

- Piano
- Graphic Design