Engineers in Action Bridge Program - Creation of the Cal Poly Chapter

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The purpose of this project was to establish a chapter of Engineers in Action at California Polytechnic State University in San Luis Obispo. Engineers in Action is a non-profit organization which is dedicated to constructing footbridges in underserved countries. Bridges are linked to many benefits for those without reliable access year-round. Chapters of this organization work to design, fund, and build the footbridges in remote locations consisting of West Virginia, eSwatini, and Bolivia. The plan for the chapter was to establish a founding team which can work together to both recruit new members, and complete the tasks needed to successfully build the bridge assigned to the team. This required that the team was to be interdisciplinary in nature, including construction managers, structural engineers, and more. Due to the extensive requirements of needing to design and fund a project, the Cal Poly chapter opted to join other teams in the construction of a bridge in West Virginia. This was intended to gradually ease the newly founded chapter into the work needed for a successful bridge project. This allowed for a streamlined process to have the chapter focus on growth. While the chapter was unable to travel this year, opportunities for continued growth remain.

Key Words: Interdisciplinary, Footbridge, Team, Non-Profit, Development

Introduction

The non-profit organization Engineers in Action (EIA), supports the "development of sustainable systems and infrastructure with underserved communities, local expertise, and global partners" (What We Do, 2021). The purpose of the organization is to bring together students of interdisciplinary fields including architectural engineering, construction management, and marketing, to build a bridge and work with a community in need to improve their livelihood.

It was decided that a partnership with Engineers in Action should be made to help bring a chapter to Cal Poly, due to the alignment of values of learning through hands-on experience. Additionally, there was a strong need for more student awareness about humanitarian construction work and the value it holds. This is a sector of the construction industry that does not receive equal amounts of attention in regards to student employment opportunities. While the passion of bringing awareness of

humanitarian construction fueled the idea of the chapter, many struggles arose throughout the development of the club. The layout of the Engineers in Action Bridge Program is very rigid in that each step of the process is clearly stated. This allowed for the creation of the chapter to be an interesting experience during the COVID-19 pandemic. Many challenges faced during this project tied back to the pandemic and the shutdowns resulting from it.

Process of Work

Chapter Establishment

The first step of this project was to connect with Engineers in Action Bridge Program director. This was crucial to the success of the chapter because with the support of Engineers in Action, the new chapter will have access to the EIA resources provided to all of the existing chapters.
This information consists of the online portal called Bridge EDU. This is where all online courses are located. Each member of the team was required to complete the courses listed below to understand each of the topics relevant to EIA:

- History of Engineers in Action
- Chapter operations
- Bridge Program Introduction
- Project Management
- Construction Management
- Bridge Design (suspended and vehicular)

These courses provided training to successfully understand the steps required to build a bridge. With access to the courses and support from Engineers in Action, the next step was to become a Cal Poly affiliated club. To do this, bylaws were created based off of Cal Poly standard bylaws (Start a Club, 2021), and EIA standard chapter bylaws. These bylaws, accompanied by a faculty advisor, only needed additional club members' signatures for acceptance by Associated Students, Incorporated (ASI-. Member recruitment was executed by emailing existing clubs in the College of Architecture and Environmental Design, as well as clubs in the College of Engineering. Responding potential members then joined the petition and it was submitted for approval.

The approval process was finished and the chapter was awarded a position as a Cal Poly affiliate. However, in discussion with a representative from ASI, it was decided that the club would thrive if it was not yet affiliated with Cal Poly. This was due to the COVID-19 pandemic and resulting school shutdowns of funding for student travel. In addition to funding, travel was restricted to all non-essential student travel in order to reduce the spread of COVID-19. Since this travel was non-essential for club purposes, there would not be a way to travel with affiliation with Cal Poly.

Instructionally Related Activity

This obstacle quickly revealed a better situation for providing longevity to the chapter. Due to the non-affiliation with Cal Poly, would allow for the chapter to apply for an Instructionally Related Activity (IRA) in the fall of 2021. This recognition through Cal Poly creates opportunities to advertise for club recruitment, as well as receive funding from major departments and grants. The decision to apply for the IRA also created another objective to keep chapter involvement, by insuring that future members reapply for the position every year.

With this goal in mind, the team set out to complete the necessary courses to prepare for a bridge project assignment. These courses, as seen previously, closely relate to bridge construction, but also the Cal Poly coursework of several team members. This allowed for familiar subjects like structure design and land surveying to be studied with the emphasis on bridge construction.

Bridge Site Assignment

The next step in this project was the assignment of a bridge project to design, fund, and build. While the majority of bridges built by Engineers in Action reside outside of the United States, due to COVID-19, the organization needed to work to keep its chapters involved. The assigned bridge for the Cal Poly chapter was to be built in a co-op with Georgia Tech, an established chapter of the Engineers in Action Bridge Program. The location of this bridge was located domestically, in West Virginia.

The bridge project known as Keen is an existing culvert bridge connecting a single family to the rest of its community. With the potential for a flood to destroy their access to civilization, a newer and stronger bridge was needed to insure reliable crossing year-round.

Figure 1.1 - Street view of existing culvert

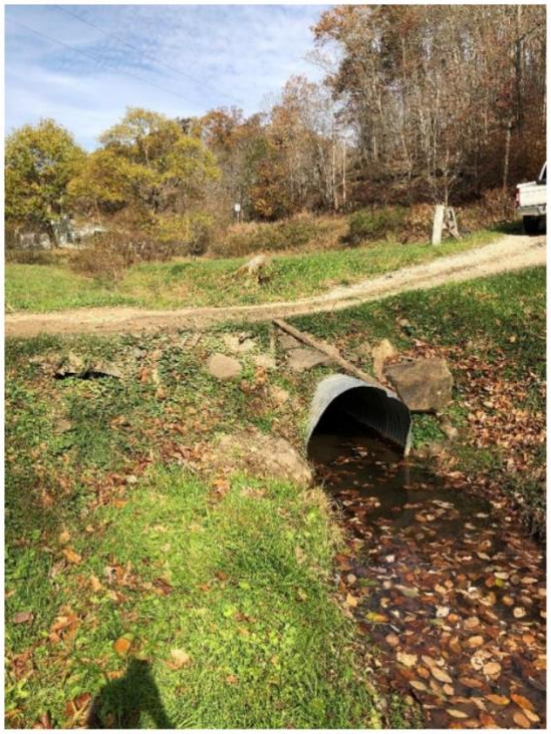


Figure 1.2 - View of existing culvert from upstream

The information from this site was provided by an engineering firm and a disaster relief organization local to the area of the project site. These organizations worked to improve their community by providing Cal Poly's project team with a site elevation survey, as well as information on the severity of damage of the existing crossing, and flow data for the water which flows through the existing culvert.

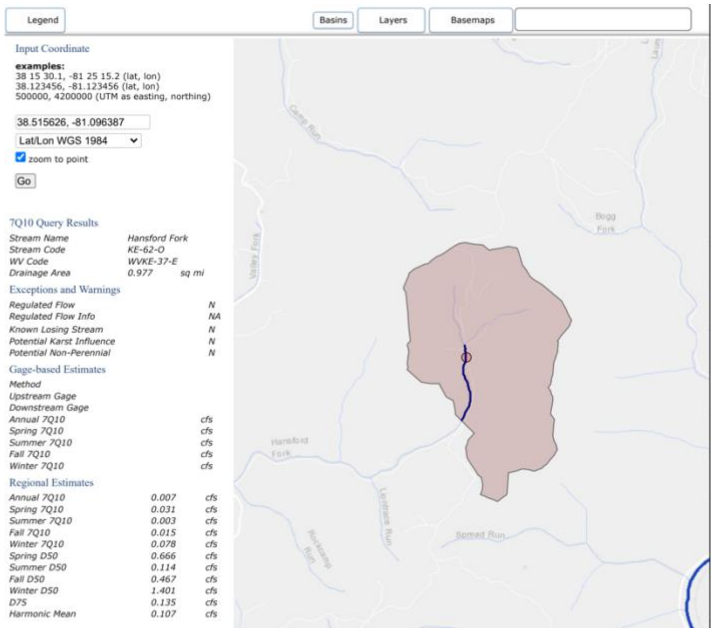
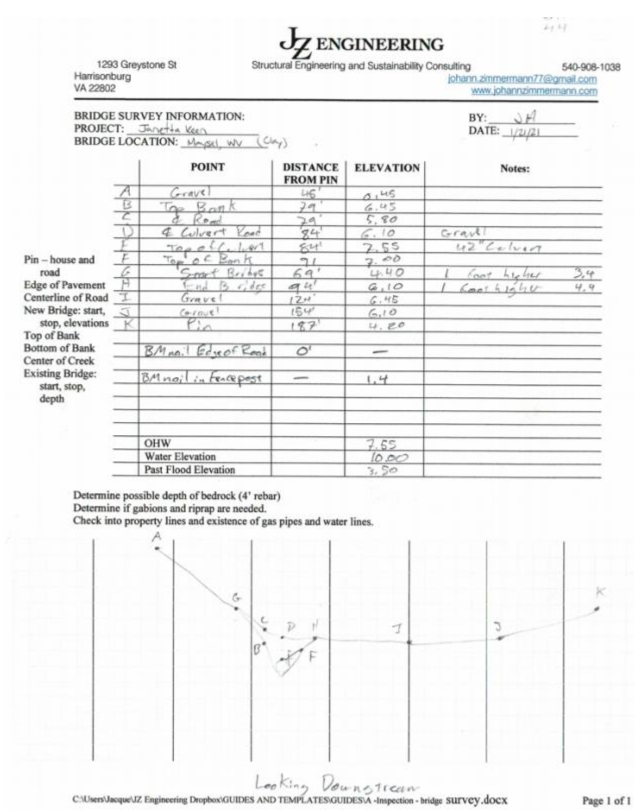


Figure 1.3 - Flow Data



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BRIDGE SURVEY INFORMATION:
PROJECT: Janetta Keen
BRIDGE LOCATION: Maysel, WV (Clay)

BY: JM
DATE: 1/21/21

Pin – house and road
Edge of Pavement
Centerline of Road
New Bridge: start, stop, elevations
Top of Bank
Bottom of Bank
Center of Creek
Existing Bridge: start, stop, depth

	POINT	DISTANCE FROM PIN	ELEVATION	Notes:
A	Gravel	46'	0.45	
B	Top Bank	79'	6.45	
C	℄ Road	79'	5.80	
D	℄ Culvert Road	84'	6.10	Gravel
E	Top of Culvert	84'	7.55	42" Culvert
F	Top of Bank	71	7.00	
G	Start Bridge	69'	4.40	1 foot higher 3.4
H	End Bridge	94'	6.10	1 foot higher 4.4
I	Gravel	124'	6.45	
J	Gravel	154'	6.10	
K	Pin	187'	4.20	
	BM nail Edge of Road	0'	—	
	BM nail in Fencepost	—	1.4	
	OHW		7.55	
	Water Elevation		10.00	
	Past Flood Elevation		3.50	

Determine possible depth of bedrock (4' rebar)
Determine if gabions and riprap are needed.
Check into property lines and existence of gas pipes and water lines.

Looking Downstream

C:\Users\Jacque\JZ Engineering Dropbox\GUIDES AND TEMPLATES\GUIDES\A -Inspection - bridge survey.docx

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Figure 1.4 - Land Survey

West Virginia Bridge Program Course

Equipped with information of the project site and location, Cal Poly's team worked towards completing the West Virginia Vehicular Bridge Program Course, which goes in-depth into all aspects of this project. Since this region of West Virginia differs greatly in culture compared to San Luis Obispo, a part of the course involved the history of West Virginia, and especially the Appalachian Mountain region. Knowing the background of the community we serve is imperative for respecting their culture. Additionally, the course also contains general practice for understanding vehicular bridge loading, as well as the order of construction for the bridge.

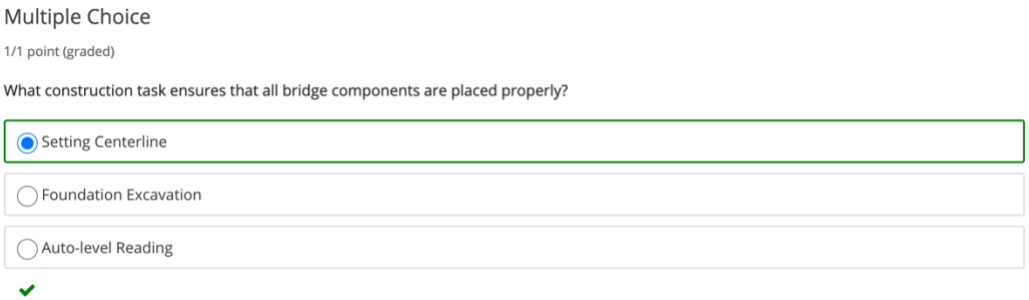

Figure 2.1 - Example of construction portion of course

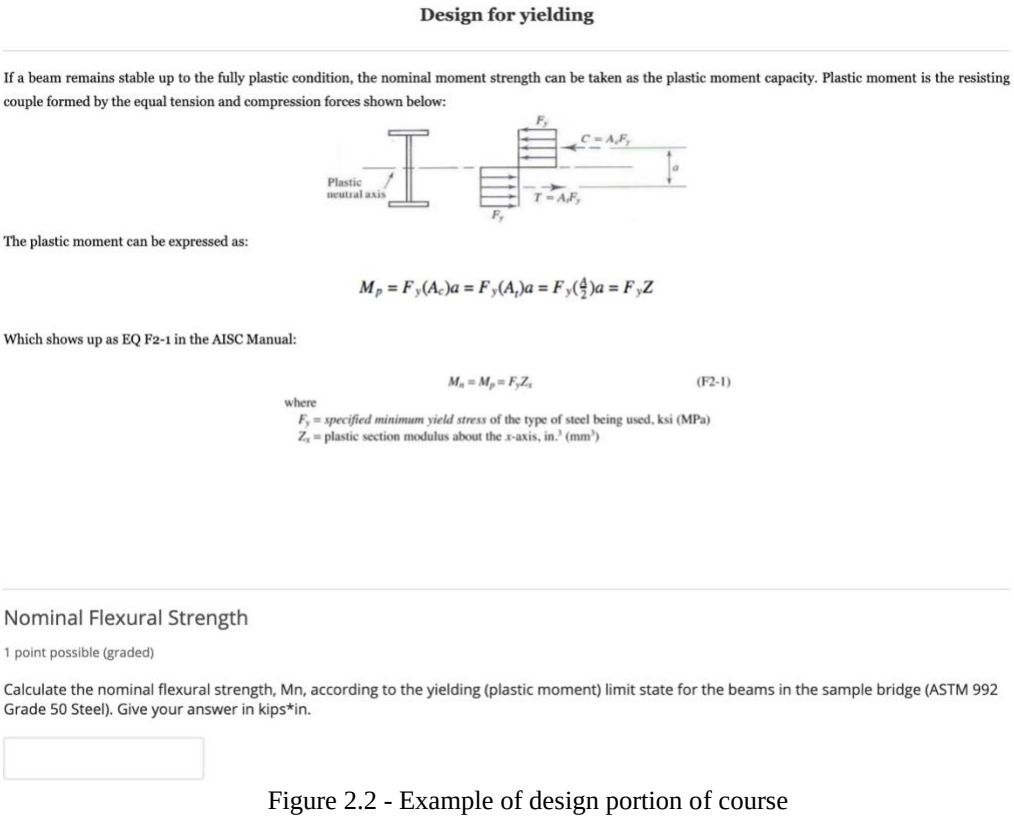

Figure 2.2 - Example of design portion of course

This step in the project is where the largest resistance was seen. Working on a team only known to each other through virtual meetings proved to defeat true teamwork. The dedication to such courses could not match the dedication to the members' dedication to their school courses. As a result, progress on this course was low and ultimately resulted in no completion of the course. However, at this time, it was realized that this course is without purpose if there is no team to send to travel. With no support for the school to fund travel and uncertainty within the team, there were no suitable solutions to send a team member to travel. This uncertainty was spurred by COVID-19 as members sought out for a job instead of committing towards a project in which funding was low.

This point created the largest obstacle of the project as I needed to insure it sustains through the years as a chapter that affiliates with Cal Poly, and continues to grow in size and ability. With the goal of receiving the position as an Instructionally Related Activity, and communication with the Engineers in Action Bridge Program, a series of events were scheduled to insure the club sustains. These events included a series of activities which were planned to keep members involved over the summer break, and allow for greater communication between the new chapter and the EIA faculty throughout the future.

Lessons Learned

While the project did not succeed to the level in which I hoped, there was no shortage of lessons learned. The first lesson learned was that while a goal can drive immediate action, it is best practice to understand the full scope of work before engaging in the details. This was taught to be by both the quantity of work required to create a team, design a bridge, fund it, then plan the logistics of sending student travelers to build it. This was especially important in a time like the pandemic, due to the amount of restrictions installed by the nation, as well as state entities.

The next lesson learned was that communication at all points throughout a project are crucial to success. Several times the team was behind due to prioritizing school work. Communication within the team was strong, as within our meetings, we would check up on each other mentally and I would insure as the project manager, that this was not to impede on anyone's academics and other extracurriculars. This is because a team will not function unless each member within it is willing to work. In relation to this lesson, I have learned that the best team is interdisciplinary. This is because each person provides their own unique perspective, and with the diversity of Cal Poly majors, the future success of this club will rely on students in more than three majors.

Finally, another lesson learned is that it is okay to fail. In my eyes, I feel that because we were unable to find a student to travel, the success of the club was non-existent. However, after reviewing with our team, we found that it was a multitude of factors mainly including the restrictions set on by the COVID-19 pandemic. At the beginning, the restrictions prevented the chapter from presenting to classes, putting up physical flyers and advertisements, and having team meetings. These proved to be detrimental to expansion of members due to the limited exposure. The four members in the chapter then took the workload that is designed for a team three times the size.

Conclusion

The project to create a chapter of Engineers in Action Bridge Program at Cal Poly was not as successful as originally intended, but brought a lot of knowledge and experience to the chapter's members. As the project manager and team president, the researcher tried to keep morale high through every obstacle, and keep the momentum moving after each achievement no matter the size. The lessons learned throughout this project will prove to be life lessons in which the team will always be able to reflect on.

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