ENGINEERS IN ACTION FOOTBRIDGES

IMPACT OF PEDESTRIAN FOOTBRIDGES ON ISOLATED COMMUNITIES

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By
Tim Maxwell

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Technical Team Members:
Civil Engineering Undergraduates – Sarah Besecky, Glen Broderick, Katherine Foley, Gabby Ford, Cooper Hamby, Terence Moriarty, Wyatt Yoder

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

ADVISORS

Rider Foley, Department of Engineering and Society

Jose Gomez, Engineering Systems and Environment

INTRODUCTION: THE NEED FOR PEDESTRIAN FOOTBRIDGES

Of the rural Bolivian population of over 3.6 million people, 52% of those people do not have safe access to essential services such as markets, schools and hospitals during the rainy season (Bridges to Prosperity, 2018). This means that around 1.9 million people in Bolivia are prohibited connection to basic necessities during 4 months of the year, as Bolivia's rainy season runs from November to March (Exoticca, 2022). Oftentimes this is because the communities that these people live in are isolated by rivers, and "lack [the] vital transportation infrastructure," such as pedestrian footbridges, necessary to pass over these obstacles (Wood, 2020). As such, citizens are obligated to either stay isolated in their home community or risk the dangers of crossing a treacherous rushing river. This problem is not limited to Bolivia and these decisions have to be made in countless rural communities around the world. In fact, the NYU Dispatch (2017) reported that in one study, "around 18,000 children die from drowning each year" in rural Bangladesh. Many of these deaths are likely due to children being forced to cross rivers to get to school or get food. Sitting back in the comfort of their community is hardly an option either. In rural Bolivia, one out of every 3 children will be stunted in their growth and nutritional status if they don't have access to proper amounts of nutritious food and health services (Heaton & Forste, 2009). The economy of these villages also suffers during the rainy season. In a study conducted in northern Nicaragua, Brooks and Donovan (2021) found that a flooded riverbed not only lowers wage earnings by 18% of the normal wage total when flooded rivers aren't an issue, but also increases the chance that villagers earn nothing during the flood due to extreme cases where rivers can to be too dangerous to cross at all times. Because farmers are unable to get to markets to sell their crop and purchase quality fertilizer, poverty is exacerbated.

Engineers in Action (EIA) has made it their mission to solve these problems by helping underserved communities develop sustainable systems and infrastructure (EIA, 2022). The not-for-profit organization identifies isolated communities in countries like Bolivia, Eswatini, Nicaragua and Haiti and works with university teams and the communities themselves to construct pedestrian bridges within each selected village. In this particular case, EIA chose the community of Coilolo in Bolivia to build their next pedestrian footbridge. According to a project social assessment of the area surrounding the proposed bridge site, roughly 800 inhabitants who experience 180 days of difficulties trying to cross the Coilolo River will benefit from the bridge (Galvez, 2022). The perks that this community will see from the addition of this bridge will be substantial and include an economic boost, an increase in the labor market and better education among many other factors. In this paper and through the framework of technological determinism, it will be examined just how beneficial this footbridge will be to its community, and how it will lead to social prosperity, just as so many bridges have done in the past.

TECHNICAL TOPIC: DESIGN AND CONSTRUCTION OF A PEDESTRIAN FOOTBRIDGE IN COILOLO

My capstone team will be working to produce design and construction documents for a pedestrian footbridge that will go over the Coilolo River for Engineers in Action with the help of sponsors Leo Fernandez and Rupa Patel. As a part of the remittance note the community must sign and to help guide us in the design of the bridge, EIA (2022) gave us a visual in the form of an elevation and plan view of a standard bridge design at the Coilolo site, see Figure 1. The footbridge will feature two abutments made of stone from the community, steel cables and hardwood planks. My capstone team is tasked with taking this standard design and adjusting it to

achieve the most cost-efficient bridge, while also conforming to the standards required of a bridge passing over the Coilolo River.

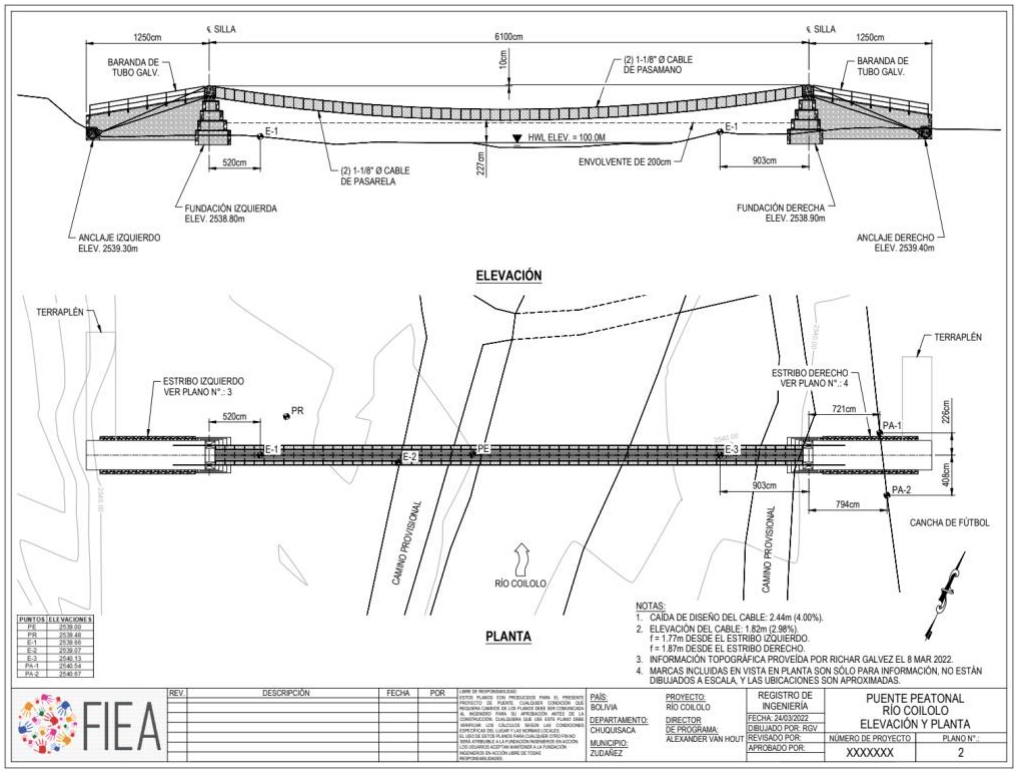

Figure 1. Elevation and plan view of a standard bridge design at the Coilolo site (EIA, 2022)

The Coilolo River cuts directly through the community of Coilolo and its surrounding homesteads and agricultural fields. See Figure 2, an annotated snapshot from Google Earth (2017) that shows a zoomed out look at the bridge site and its surroundings.

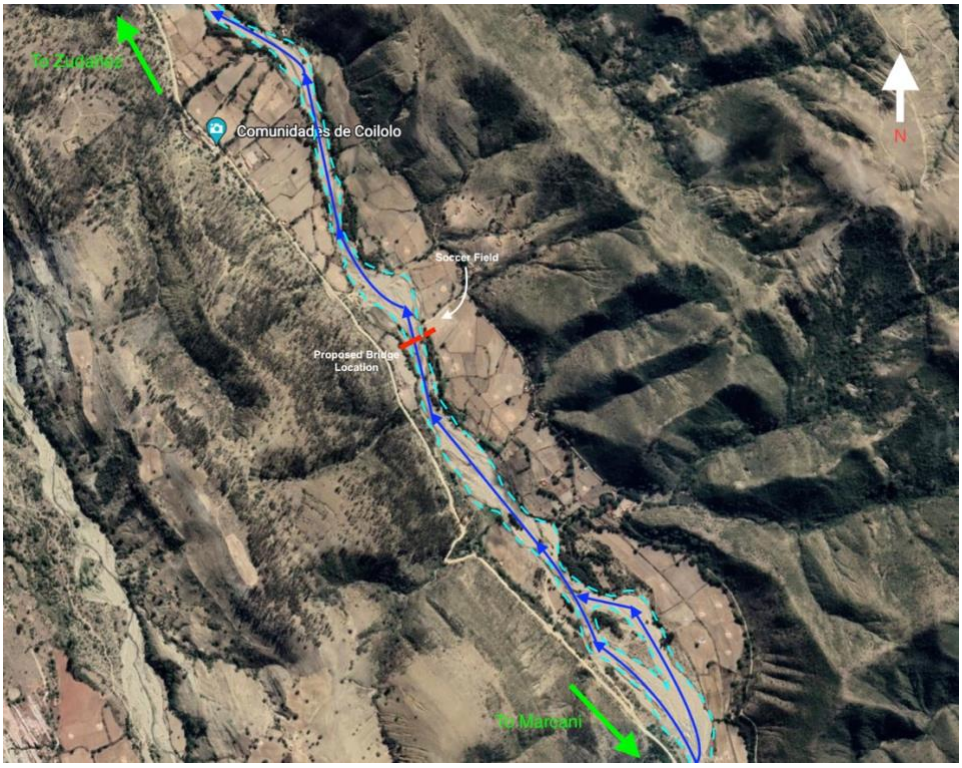

Figure 2. Plan view of the proposed bridge site and the surrounding community (Google Earth, 2017)

On the left, westernmost bank of the river and about one kilometer northwest from the bridge is the main community as well as a few homesteads, fields and a main road. On the right, easternmost bank of the river are more agricultural fields, a soccer field and a greater number of homesteads. When the river is flooded, as it is during 180 days a year, and is as full as it is Figure 3 below when EIA (2022) visited the site in April of 2022, farmers who live on the left side of the river cannot access the agricultural fields on the right side of the river and children who live on the left side of the river are unable to reach the soccer field. Further, those who live on the right side of the river are blocked from reaching the elementary school in Coilolo and have no access to the main road which can take them up to Zudañez which is seven kilometers northwest of the bridge site.

Figure 3. Coilolo River from the left bank looking at the right bank (EIA, 2022)

What these villagers of Coilolo currently have to go through is a lot like what others who are isolated because of rivers have had to go through. Dativa, a civilian who lives Gaseke, Rwanda, said in an interview conducted by Bridges to Prosperity (2018) that, “before the bridge, it would take me one hour to get to the market when it rained because it was too dangerous. Now it only takes me 3 minutes whether it’s raining or not.” Once the bridge is constructed in Coilolo, villagers will be able to cross the river in a matter of minutes, with less risk of injury or death. The savings in time and death are just two dividends in a long list of reasons why the construction of a pedestrian footbridge will influence social progress.

STS TOPIC: IMPACT OF BRIDGES ON SOCIAL PROGRESS THROUGH A TECHNOLOGICAL DETERMINISM LENS

Wyatt (2008) defines technological determinism in two parts. The first is that the technology must have been developed outside of social interests, and the second is that technological change determines social change. The world's first bridges were simple structures made from easily accessible natural resources and were likely made from simply placing a wooden log down to span a gap (History of Bridges, 2022). They were developed in the hopes that they would be able to get to the other side, without the vast socio-economic benefits in mind. Further, it is rooted deep in history and can even be seen on maps how the implementation of bridges and that technological change within cities and communities can determine social change. Because many cities are situated around water, "bridges… crossing urban waterways to rural areas encouraged more suburban growth" (Maryland DOT, n.d.). This suburban growth upon bridge construction can be attributed the newly gained ease of access to the city. Zhou and Zhang (2019) say that the geopolitical barriers bridges overcome greatly promotes social development, matching up with the second factor of the definition of technological determinism. In fact, it seems as though bridges are so common and embedded into the world's infrastructure that they have fallen victim to normative technological determinism in that political accountability is decoupled from the technology. In this way, we have accepted the bridges as such a "dominant force in society, that technocrats can justify their actions as merely being the outcome of rational, mechanical processes" (Dotson, 2015).

When looking at the benefits that pedestrian footbridges bring, it can be seen why the politics behind them are often disregarded. EIA (2022) states that footbridges result in a 12% increase in children in school and an 18% increase in healthcare treatment among other benefits.

By giving the citizens of Coilolo better access to education and health services, the footbridge is directly impacting social change within the community because future generations will be more educated and plentiful as they will be able to better treat illnesses. The economic increases initiated by the construction of a footbridge cannot be understated, as a study done by Bridges to Prosperity (2018) and the University of Notre Dame found that fertilizer investment increased by 45%, and farm profits increased by 75% in rural Nicaragua. In a survey and interview conducted by Munyaneza and Mbereyaho (2022) in a town called Gashyushya in Rwanda that just had a footbridge implemented, it was reported that there was a total economic benefit of 100% as a result of the bridge. Additionally, the survey found that 97% of respondents in the rural community of Rwanda confirmed that their social and financial livelihoods were being positively affected by the bridge. Boosting access to socioeconomic resources such as the ones listed above is the first step in developing a prosperous suburb of Zudañez in the rural community of Coilolo.

RESEARCH QUESTION AND METHODS

The research question I will be looking to answer is as follows: What influences do pedestrian footbridges have on the socioeconomic lives of citizens in disadvantaged, rural communities such as Coilolo, Bolivia? Although there are many small, isolated communities that have been given pedestrian footbridges to help their community gain access to essential infrastructure, there are still a countless number of other villages out there that need to be evaluated and assisted through the gift of a bridge of their own. As it stands right now, there are only two large non-profit organizations, Bridges to Prosperity and EIA, who are helping solve this problem of rural isolation. As this paper laid out, the impacts that pedestrian footbridges can have on isolated communities cannot be understated. In order to help out as many people as

possible, the number of projects needs to increase and the only way to do that is to raise awareness of the problem and convey the benefits of the solution.

The best way to do this would be to survey and interview both isolated communities without a pedestrian footbridge and those with a newly constructed pedestrian footbridge. Data such as percentage of people with access to school, healthcare, and markets as well as time spent getting to these services before and after bridge implementation can be analyzed to see the benefits from community to community. Additionally, financial data of the two different communities shall be compared to establish the magnitude of success that a connecting bridge can have on the economy of a small, rural village.

CONCLUSION: A CALL TO ACTION

There is a vast number of rural communities in the world that are separated by rivers from places like markets, hospitals and schools, and the civilians of those villages are forced to wade through treacherous waters or find another way across. In fact, 16% of Bolivia's entire population is isolated from essential services needed to grow and sustain their rural communities during their rainy season of about 4 months. One piece of that large percentage will be aided when Coilolo, with the help of EIA and my capstone team, constructs a pedestrian footbridge that will socially progress the community by providing the villagers with reliable access to resources. My research paper will focus on raising awareness of the conditions of isolated communities that are in dire need of a way to get the services they need. The paper will help to initiate the bridge building process for other communities, just as those processes have begun for Coilolo, Bolivia.

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