

**Engineers in Action: Eswatini Suspended Bridge**  
(Technical Paper)

**How implementing modular houses in Honduras benefit the social and economic standards  
of the country's population**  
(STS Paper)

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By  
Yamal Andonie

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Technical Team Members:

John Smith T  
Haley Dues  
Gabrielle Jennings  
Bryson Thomas  
Mackenzie Beavers  
Jose Raul Castro  
Kathryn Wagner  
Yamal Andonie

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**

Bryn Seabrook, Department of Engineering and Society

Jose Gomez, Department of Engineering Systems and Environment

## **Introduction**

Infrastructure is an essential part of society, affecting almost every aspect of individuals' day-to-day life by providing the very structures that sustain them. Building dictates the lives and actions of the very individuals that use them and it is fair to say that structures are quintessential for society's well-being. That is why the technical and STS topic presented in this research paper will analyze and tackle both the influence and impact a structure can have on a community.

The capstone project in this proposal is to design a footbridge for the community of the Maphoveleni region on Eswatini in Africa. The current bridge is made from logs; it is dangerous to cross and is often inaccessible due to the frequent flooding of the Mtilane River. Six people have already been injured over the course of three years due to the poor quality and hazards the bridge poses (EIA, 2020). The current log bridge is a critical aspect of the community because it is the only way, without swimming across the river, to reach the urban community, where individuals gain access to health, educational, and economic resources found outside of their immediate community. The non-profit, Engineers in Action (EIA), in-charge of removing the current bridge and constructing the new one, conducted a study that showed that the new bridge will directly benefit approximately 2000 individuals and indirectly benefit more than 5000 (EIA, 2020). Building the bridge is therefore necessary and will benefit these people significantly by increasing the overall stability, welfare, and development of the community.

In the same way the new bridge design can improve and give a community more opportunities and access to different necessities and commodities, the STS research will explore and analyze how providing people with shelter and access to housing can improve a third world country's socioeconomical status. The second proposed project is the STS research paper, for which the question is the following: "how does the implementation of modular houses benefit the

social and economic standards of Honduras' population?" The goal of this research is to analyze the short and long-term social and economic impacts of prefabricated houses. Through the research, this paper will prove that providing inexpensive housing to displaced families will improve, in the long run, the country's economy, literacy, crime and unemployment rates, among many other social problems threatening Honduras and other third world countries. The theories of technological fix and technological determinism will be demonstrated through the analysis of case studies, using supporting evidence of several research studies with the ultimate goal of motivating non-profits to implement this technique to improve their country.

### **Technical: Eswatini Suspended Bridge**

The Capstone project will be designing a footbridge to help an isolated community in Eswatini, Africa. The current log bridge is not an adequate height above the top of the Mtilane River's water, has insufficient safety features, and becomes very slippery when wet (EIA, 2020). Crossing the river is necessary for the community to access numerous educational, health, and economic resources. The community comprises of agricultural and industrial workers, making it imperative to cross the bridge to transport crops, access local markets, and work in the nearby city (EIA, 2020). Moreover, during exam season, children are held at school to ensure attendance, which puts a financial strain on the school and families that rely on kids to do house chores while parents are at work. The construction of this bridge is essential and the team has to complete several deliverables in order to achieve the goal of the new bridge design.

The team will focus on the proposed bridge's structural design and develop a construction schedule to be followed accordingly when the bridge is under construction on Summer 2022. Since the team members are all civil engineering students, they are being guided through the process by Engineers in Action (EIA) and two graduate UVA mentors. EIA is an organization that does

charitable work every year with the end goal of helping out communities around the world. Last year, they constructed a similar footbridge in Bolivia with a group of UVA students. Also guiding the team through the process are Leo Fernandez and Rupa Patel, Thornton Tomasetti engineers, who attend biweekly meetings as mentors and have already offered a layout for the meetings with advice on approaching the bridge design project. Their mentorship throughout this process will be essential because they have experience with similar work that will be crucial to designing the best possible bridge. The ultimate bridge design has seven objectives: safety, durability, serviceability, maintainability, constructability, economy, and aesthetics (EIA, 2020). Major components of the bridge design include a detailed drawing set (with the plan, section, and profile views of the design), verified load capacity calculations, geotechnical foundation analysis, hydrological erosion analysis, and more.

My responsibilities include being the construction manager within the group. For this task, I have to coordinate construction schedule with the people of Eswatini. Moreover, I have to lead the construction team in the process of construction and make sure everyone is following schedule and attend the needs related to the construction. I decided to choose this manager role because it gives a sense of what the job will entail and demand from me in the future. Being born and raised in a third-world country, Honduras, I know how significant the impact of this project can be for the community of Eswatini. The capstone team has been working on some introductory and suspended bridge design modules that the EIA provided in order to better understand the project and help with the calculations when designing a suspended footbridge.

By the end of the fall semester, the team will have most of the assigned EIA modules completed. The completed EIA modules will include Virtual Capstone Bridge Design Module, Project Management Module, Fundraising Module, and Advanced Design Module. The team will

prepare and present Review Call #1 to the EIA and all of the work done in the fall semester to the Bridge Program Education Manager to ensure members are on the right track. Review Call #1 will include general information about the construction site, geotechnical data and hydrological conditions, and the initial structural design ideas. The team will be ready to begin designing the bridge and preparing construction documents in the spring 2022 semester. With these, a construction, health and safety plan will also be ready. The team will additionally be creating a fundraising video in order to support the completion of the bridge. These will allow the team to present the work on Review Calls #2 and #3 to EIA. After all the deliverables mentioned before are completed by Spring 2022, EIA will receive the team's bridge design alongside other design submission made by other teams from different universities, and the best will be chosen for construction. Whether or not UVa's team design wins or not, the team has the opportunity to travel to Eswatini on the Summer of 2022 to help with the construction of the new bridge.

### **STS Topic: Implementation of modular houses in Honduras**

Honduras has the second highest poverty rate in the Caribbean and Latin American region, with 4.8 million people, which constitutes to almost half of its population, living on less than US\$5.50 per day (The World Bank, 2021). One out of five Hondurans live in extreme poverty with approximately less than US\$1.90 per day (The World Bank, 2021; Chapman, 2018). Whole families can be seen in the street begging for money as you are in the traffic lights waiting for them to turn green. Members of these families range from very old citizen to new born babies. Sadly, mothers take advantage of the fact that children are more likely to receive charity form people so they use their new born babies and toddlers as a way to gain more cash because of their necessity. Poverty, amongst other severe issues, characterize third world countries and their poor socioeconomic status, that is why Honduras is a good candidate to base this research.

This research paper will analyze how the implementation of modular houses would improve the social and economic standards in Honduras. The main focus of the paper will be the country of Honduras. This paper will provide research that could be replicated and applied to countries of similar socioeconomic status as the one being analyzed. As a citizen of Honduras, I can testify to the impact of homelessness rates in the urban areas of Honduras. It is not surprising to see entire families, including newborns and children, living under bridges, riverbanks, and streets, as they have no other shelter (Children International, 2021). It is also very common for entire communities to live in extreme precarious conditions in houses made out of metal sheets, wood remaining, carton boards, and other scrap materials (Kennedy, 2020). Not only are these houses not stable and easily destroyed by harsh weather, but they are also not fit to house as much people as entire families. As a result, families end up living clustered together and often under unsanitary conditions, which further contributes to unhealthy and poor living situations (BBC, 2020).

One potential solution to these unstable houses is the implementation of modular homes. A modular house is a cheaper prefabricated unit that is easily installed in any desired location (Karmod, 2013). Depending on the model and size, a modular can fit up to 8-12 people. Additionally, the prefabricated homes can be made out of biodegradable and reusable materials (Porta-King Building Systems, 2021). This type of housing can be assembled in almost any surface regardless of the type of soil composition it is sitting on, which makes them more affordable and accessible for non-profit organizations as an option to fight homelessness (Karmod, 2013). This research will try to provide evidence that implementing this type of housing Honduras will help improve the country's economic and social situation by reducing unemployment, poverty, and

crime rates, while simultaneously increasing alphabetization rates, GDP, and overall wellbeing (Dolan, 2021; Taylor, 2015).

The STS frameworks that will be applied in this research paper are technological determinism and technological fix. In his essay “Technological Determinism in American Culture,” American historian Merritt Roe Smith defines technological determinism as the way in which society is shaped by technology (Smith, 1994). He emphasizes how the 19<sup>th</sup> century was a turning point in the American society as the American Civil War was characterized by immense technological progress, some examples being the development of electricity, railroads, telegraphy, etc. (Smith, 1994). For the purposes of this research paper, technological determinism will be used to analyze how the implementation of modular houses can shape society in Honduras. The second STS framework used in this research paper is technological fix. Alvin M. Weinberg was the first author to introduce this concept. According to Newberry, Weinberg’s “technological fix” refers to “the use of technology to respond to certain types of human social problems that are more traditionally addressed via political, legal, organizational, or other social processes” (Newberry, 2005). As alluded by both authors, it is likely for detrimental and unforeseen side effects to emerge as a result of technological and social fixes (Newberry, 2005; Weinberg, 1978). There is controversy around whether technological fixes can be considered an absolute solution to a problem (Newberry, 2005; Weinberg, 1978). However, even if these fixes are not seen as absolute solutions, they can help improve the situation for at least a certain period of time or until a permanent solution can be provided. For this reason, this framework is relevant to this research paper, which aims to analyze and prove that by implementing modular housing the overall socioeconomic situation of a third world country can be improved.

Poverty and homelessness are prevalent across third world countries. There are approximately 152 developing countries in the world (Worlddata.info, 2021). This means that there are millions of people who do not have adequate homes or shelter, and that at best live in precarious conditions in any near place they can find. This research is important because it provides proof that suggests that the implementation of modular houses not only contributes to solving the homelessness issue, but it can also improve the overall social and economic wellbeing of Honduras. This research is worthy of attention as its evidence can serve as motivation to non-profit, so that they take action by helping the people who live in poverty with the purpose of making third world countries thrive.

### **Methodologies**

The research question of this paper is: “how does the implementation of modular houses benefit the social and economic standards of Honduras?” This question will be answered through documentary research, supported by a historical case study, and auto-ethnography.

Documentary research will provide evidence to support that improving the living standards of people who live in precarious conditions will have a positive impact in the overall social and economic status of the whole country. The keywords used to find the research were those that discuss third world country socioeconomic issues, the impacts of living standards on the economy, and the benefits of modular housing. A historical case study about the implementation of modular houses and its impact on society will be used to back up the research found. Moreover, the use of auto-ethnography will provide personal experience which gives insight to first-hand information that cannot be accessed through research.

### **Conclusion**



The technical project and STS research paper chosen for this portfolio are meant to show the impact and importance of infrastructures. For the technical project, a bridge design will be drafted to compete against other designs to be chosen by a non-profit organization, EIA, to help a community in the Maphoveleni region in the country of Estawini in Africa. The impact this bridge will have in the community is significant because it will provide safer and better access to schools, agricultural and industrial markets, medical care, bus stations, and many more services nearby. Moreover, it will be proven to impact the socioeconomic circumstances of around 2000 individuals directly, and around 5000 individuals indirectly.

The STS deliverable will provide evidence to support that by implementing modular housing in poor areas of the country of Honduras, the overall socioeconomic status of the country can be improved, as the theories of technological fix and determinism suggests. The aim of this project is that the findings motivate non-profit organizations to help communities living in precarious conditions by replicating the methodologies of this study in other third world countries.

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