

THESIS PROJECT PORTFOLIO

ESWATINI SUSPENDED FOOTBRIDGE DESIGN

**URBAN REVITALIZATION: HISTORICAL GENTRIFICATION'S IMPACT ON
CURRENT PLANS**

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

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Department of Engineering Systems and Environment

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Sociotechnical Synthesis

Flooded rivers plunge entire communities all over the world into isolation for months at a time. Impassible rivers require community members to either put themselves in danger to cross or prevent them from reaching markets, schools, churches, and healthcare (EIA, 2021 A). Aside from ensuring that community members can safely cross the river at all times, footbridges have been found to have a number of other benefits. Access to safe and reliable transportation networks has been proven to increase enrollment in schools by 12%, farm profits by 56%, and women in labor markets by 75% (EIA, 2021 B, p2). In Maphoveleni, Eswatini, the Mtilane River floods year round. As a result, the community has requested the assistance of Engineers in Action to build a footbridge. Engineers in Action is a non-profit striving to support the development of sustainable systems and infrastructure within underserved communities (EIA, 2021 A). University of Virginia is partnering with EIA to design a suspension footbridge and create a construction and safety plan.

This project will be located in the municipality of LudzeLudze & Zombodze Umphakatsi of the department of Manzini, Eswatini. This bridge will help the people from the Zombodze and Boyane community to cross the Mtilane River, and it will allow access for these communities to reach the city of Manzini. EIA outlines a number of requirements necessary for a standard design. These design requirements along with their seven design objectives, safety, durability, serviceability, maintainability, constructability, economy, and aesthetics (EIA, 2021 B, p5), governed our design process. Notable features include a span length of 111.4 meters, achieved freeboard of 3.02 meters over the highwater line satisfying the gorge requirements, a construction sag value of 2.968 meters, and custom nonstandard 3 tiered abutments on each side

of the river to optimize material usage and labor. The decision was made to use a nonstandard abutment and anchor design in order to optimize design. In addition to a finalized design, our team created construction and safety plans. The construction plan outlines the schedule for a nine week build along with training that needs to be done prior to the beginning of construction and material acquisition plans and costs. The safety plan is based on EIA's Culture of Safety which includes six foundational elements: leadership, education, communication, planning, evaluation and modification, and reinforcement. The plan outlines how safety should be monitored on site, the chain of communication for reporting incidents, and a risk management plan for certain situations such as falls and snake bites.

Though the suspended footbridge may change the community of Maphoveleni, Eswatini for the better, gentrification can have negative implications for cities across the globe. Gentrification is a process of changing a neighborhood. Different economic productivity, changing education levels, and other demographic changes as a result of gentrification has the potential to greatly impact an area in multiple ways. In this paper, I examine how past and current plans for urban renewal balance utilitarian and rights-based ethics in a socially and racially just manner. Two cities, Cincinnati and New Orleans, were explored. Past redevelopment projects in each city, the West Side and the French Quarters respectively, were analyzed to determine how the area was impacted, former residents were displaced, and the overall community of the area was transformed. Next, urban redevelopment plans current in use in each city were examined for mentions of rights-based concepts and economy-based concepts. This along with current projects illustrates how cities currently prioritize different goals during redevelopment.

The West Side renewal and highway construction and the French Quarters redevelopment both resulted in prior residents being displaced. Both communities were majority black prior to being gentrified, illustrating that past urban development projects tended to target minority and low-income areas and gentrification historically led to large increases in the cost of living (Hurley, 2006). In Cincinnati, a different neighborhood could have been the site of the construction in order to impact less individuals and achieve a more just outcome. Plan Cincinnati, the current urban development plan, does not directly address low-income or minority neighborhoods. Plan for the 21st Century in New Orleans does discuss demographic differences and past ethical shortcomings, but the primary emphasis is on economic growth. The primary motive for current redevelopment projects is to make the area more attractive for the greatest number of people and increase economic productivity. Although a large portion of the city is benefitting, by not taking into consideration minorities and low-income residents it is difficult to see these developments as entirely ethical.

ESWATINI SUSPENDED FOOTBRIDGE DESIGN

A Technical Report submitted to the Department of Engineering Systems and Environment

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Haley Dues

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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

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Introduction

Maphoveleni, Eswatini is in high need of a footbridge over the Mtilane River due to long periods of flooding which occur throughout the year. In the past three years, six people have been injured attempting to cross the temporary log bridge currently in place. The log bridge is not an adequate height above the top of the river, has insufficient railings or other safety features, and becomes very slippery when wet. Crossing the river is necessary for the community to access numerous educational, health, and economic resources. Children must cross the river daily to attend school. During exam season, children are held at school for up to four weeks in order to ensure attendance, which puts a financial strain on the school and prevents the children from completing their chores at their homesteads. The community is primarily made up of agriculture and industrial workers, making it imperative that they cross the river to access local markets and work in the nearby city.

The bridge will benefit almost 2000 individuals including 1200 children who will have safe access to school all year round. This will not only increase overall education in the area, but also ensure students are able to return home during exam periods in order to help and be with their families. The bridge will indirectly serve the communities of Zombodze and Boyane. People coming from Manzini, the capital city of the department, will also be benefited. In addition, economic conditions for farmers and their families will be improved through more consistent market access.

Our team is tasked with developing a detailed design for a suspended cable footbridge to help provide year-round access to resources and services located across the Mtilane river from Zombodze and Boyane. There are seven desired objectives for the ultimate bridge design (listed in order of decreasing priority): safety, durability, serviceability, maintainability, constructability,

economy, and aesthetics. Major components of the bridge design include a detailed drawing set (with plan, section, and profile views of the design), verified calculations of load capacity, geotechnical foundation analysis, hydrological erosion analysis, and more. In addition to the design of the bridge, our team is responsible for delivering an in-depth construction plan and schedule to provide guidance for the construction of the bridge in-country. This also includes materials sourcing as well as a safety plan which will provide important safety measures and information pertinent during the construction, operation, and maintenance of the bridge.

Site Information

This project will be located in the municipality of LudzeLudze & Zombodze Umphakatsi of the department of Manzini, Eswatini. This bridge will help the people from the Zombodze and Boyane community to cross the Mtilane River, and it will allow access for these communities to reach the city of Manzini, which is the closest city to the bridge with a travel time on foot of 30 minutes. The bridge is approximately 16 km away from the heart of the city of Manzini.

The proposed alignment is shown below in Figure 1. The abutment area is mostly clear with no signs of erosion and big rocks along the proposed centerline. The technical assessment completed on site shows that there are no obstructions within the horizontal or vertical clearance areas along the proposed center line for the suspended bridge. There appears to be some vegetation and tree cover located both downstream and upstream, but the proposed centerline is free of both, as it is located within open fields on both the right and left side of the bank. Some larger rocks are located in the river at the location of the proposed center line, but they do not appear to be large enough to interfere with the construction of the bridge.

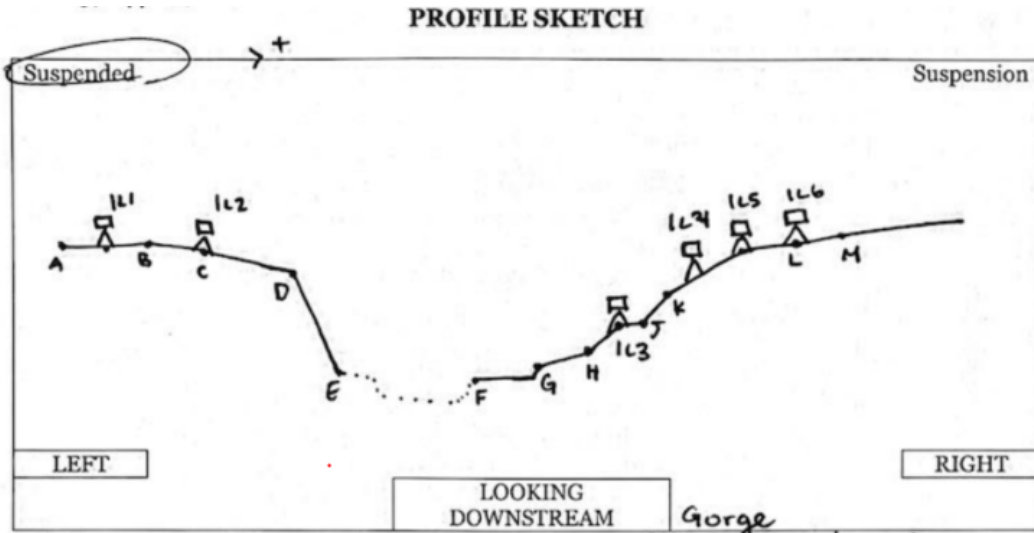


Figure 1. Surveying points provided in Technical Survey

There are no anticipated land ownership issues on the right embankment. A small amount of land on the left embankment belongs to the edge of a field owned by the Khumalo Homestead; however, the field is not cultivated and access issues are not anticipated. The proposed centerline exists downstream from the current crossing. This centerline has been proposed by the community members and avoids a significant amount of existing vegetation and erosion. No information has been provided to suggest that sewer, electrical, or potable water lines will need to be avoided in design or project construction. If any indication of such utilities become apparent to the team, this information will be promptly communicated to the Bridge Corps mentors to preserve the structural integrity of the design.

The proposed centerline of the Maphoveleni footbridge is downstream of the existing wooden structure crossing the Mtilane River. The channel shape can be seen in the survey provided by EIA which is roughly trapezoidal with a steep bank on the left hand side of the river. While the lower portion of the site on the right hand side of the river resembles a floodplain, the flow will be classified as a gorge due to the steepness of the bank on the opposite side. Designing

to meet the specifications of a gorge will be a more conservative approach and the team will need three meters of available freeboard.

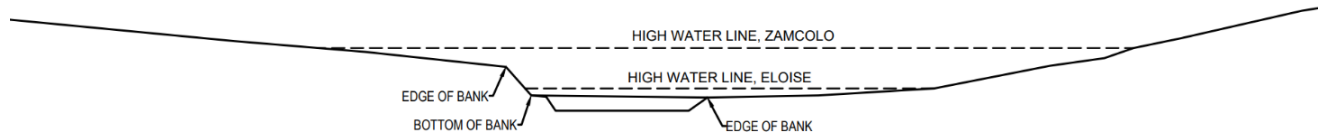


Figure 2. Elevation view of river, from survey provided by EIA

Additionally, two high water lines were provided in the technical report for Cyclones Zamcolo and Eloise. Cyclone Zamcolo, which occurred in 1984, caused record-breaking rainfall in Eswatini, resulting in 100-year flooding (Wikimedia Foundation, 2021). The Zamcolo high water line is the higher of the two water lines seen in Figure 2. More recently, Cyclone Eloise struck Eswatini in 2021, causing 20-year floods that again damaged much of the existing infrastructure (ReliefWeb, 2021). In order to maximize the longevity of the bridge and account for increase in water levels due to climate change, the team moved forward designing for the Zamcolo high water line.

Design Process

EIA outlines a number of requirements necessary for a standard design. These requirements may be viewed in the figure below. All of these standard design requirements were met. The decision was made to use a nonstandard abutment and anchor design in order to optimize design.

Design Requirements
Foundation must be 3.0m from edge of bank in soil
Foundation must be 1.5m from edge of bank in rock
Foundation must be placed behind an angle of internal friction (35 degrees in soil, 60 degrees in rock)
The ground profile slope in soil must be less than 10 degrees
The height difference between cable saddles shall not exceed 4% of the span [$\Delta(H) \leq L/25$]
The minimum walkway cable saddle elevation above the ground is 1.4m and the maximum elevation is 3.4m
Freeboard in floodplains $\geq 2.0m$, in gorge 3.0m
Keep foundation out of floodplains

Figure 3. Design requirements from EIA

The team used the seven design objectives presented by EIA in Section 2.1 of the Bridge Builder Manual Volume 2a, these objectives are ordered by relative importance: Safety, Durability, Serviceability, Maintainability, Constructability, Economy, and Aesthetics. Our primary objective is to guarantee the safety of the bridge and those who use it. As such, our design must maintain structural integrity and incorporate features critical to the safety of users, such as the safety mesh. The second objective is durability, which includes proper weatherproofing of the bridge materials to maximize the structure's lifespan. Serviceability includes coordinating design features to reduce bridge sway and bounce and ensure adequate approach ramp angles. Maintainability includes ensuring that the structure can be maintained by the community at manageable rates and costs for years to come. Constructability involves focusing on materials that are feasible to acquire, prefabricate, and install. The sixth objective is economy, which involves making design decisions to reduce the overall cost of the bridge. The final design objective is aesthetics, which aims to create a structure that compliments the natural environment and surroundings of the communities. Our team followed the recommended progression of design laid out by Engineers in Action.

Design Progression

Our team participated in three review calls with alumni advisors as well as Engineers in Action staff to provide updates to our team's work on the project. Over the course of these review calls, our design changed dramatically.

Our design for review call one used standard design elements and only met standard design checks. These standard design checks, which are specified by EIA, include: cable tensile capacity, suspender force analysis, tower overturning, foundation bearing pressure, anchor sliding, and anchor uplift. This design was also created to meet freeboard requirements based upon the shorter of two high water lines provided from surveyors. The primary goal of our design process was to minimize the span of the bridge—this relates to the constructability of the bridge as well as the cost of the bridge's superstructure. The profile of that design is shown in the figure below:

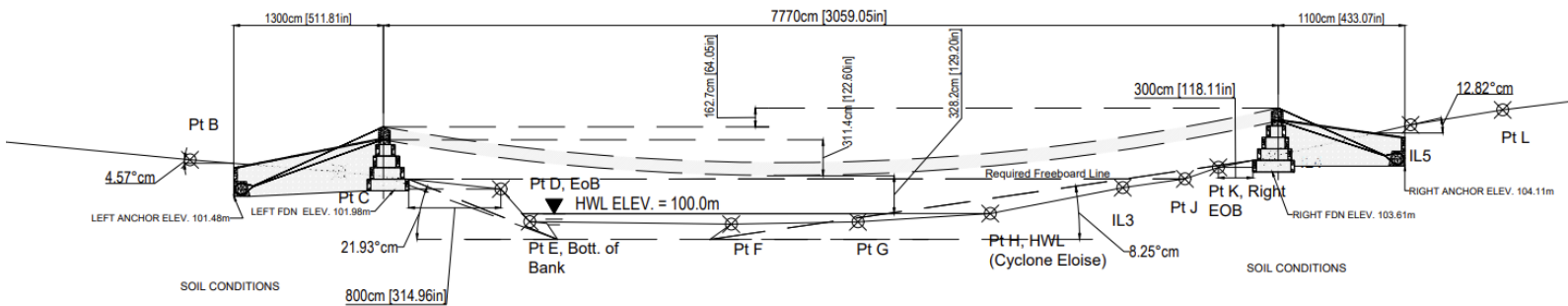


Figure 4. Preliminary design for Review Call #1

This design needed to be further analyzed structurally using the design checks that would later be outlined in EIA's advanced bridge design module. These advanced design checks include an advanced anchor sliding and uplift check, dead load calculation using bridge materials, component design checks for timber bridge decking and steel cross beams, soil shear analysis, tower eccentricity, tower moment capacity, biaxial loading capacity, tower minimum reinforcing

requirements, and early-set concrete capacity. Additionally, our team recognized that we would likely need to develop nonstandard designs for certain bridge elements, such as the bridge abutments, in order to further optimize the design and reduce the amount of time and material required for the bridge's construction.

Comments from review call one as well as conversations with EIA personnel in January revealed that in addition to minimizing bridge span, reducing the amount of fill material and excavations required for bridge abutments should also govern design thinking. Our team took this into consideration before review call two. Our team created a design with a slightly longer bridge span than our previous one but it required smaller abutments. This reduction in abutment size was significant enough to make this new design more optimal than the previous one despite having a longer span length. A profile view of the design our team presented in review call two is shown below:

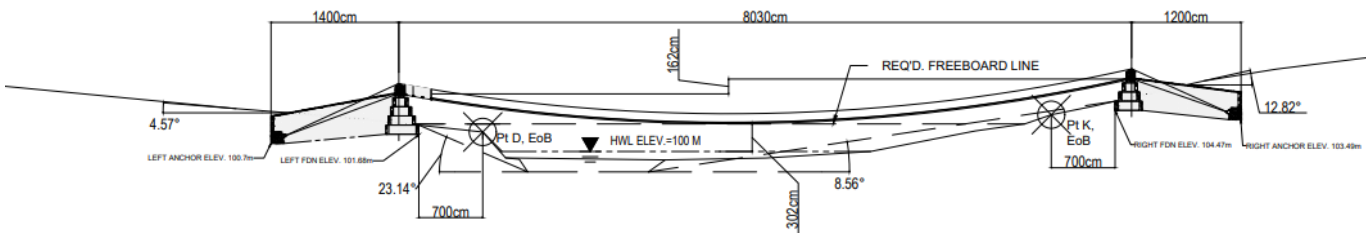


Figure 5. Design for Review Call #2

Comments and discussions from review call two prompted significant changes to the bridge design process. First was the recommendation to change which high water line our team was using for our bridge design. Citing climate change and also a desired increase in design robustness, EIA staff strongly encouraged our team to redesign our bridge for the higher storm mark that was provided to our team. This required new geometric layouts to be tested to ensure standard requirements were met. Our team was also presented with a call to further optimize the

bridge abutments used in our design, mainly in terms of excavation depth reduction. With these changes in mind, our team set out to create a new design that was presented in review call three.

A profile of that design is shown below:

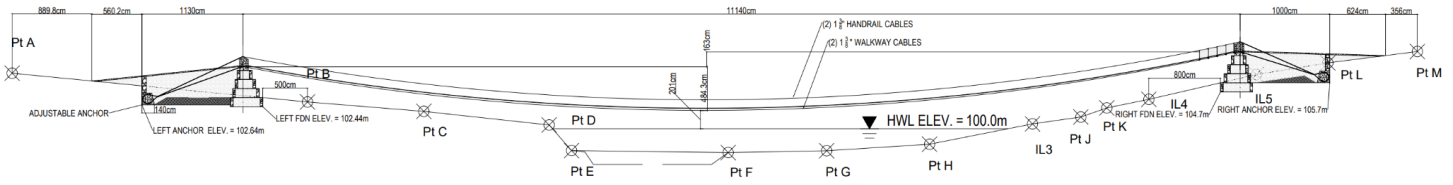


Figure 6. Design for Review Call #3

Final Design Summary

Our final design is described in the table below:

Table 1. Final Design Geometric Conformance Summary

		Value	Units	Condition
Bridge Layout				
	Span, L	111.4	m	Sufficient
	Deck Width	1.04	m	
	River Type	Gorge	-	
	Left Foundation Elevation	102.44	m	
	Right Foundation Elevation	104.07	m	
	High Water Elev., HWL	100	m	
	Number of Tiers on Left	3.0		
	Number of Tiers on Right	3.0		
	Left Abutment Setback	5.0	m	Sufficient
	Right Abutment Setback	8.0	m	Sufficient
	Left Angle of Internal Friction	11.28	degrees	Sufficient
	Right Angle of Internal Friction	9.00	degrees	Sufficient
	Left Ground Slope Profile	5.49	degrees	Sufficient
	Right Ground Slope Profile	7.13	degrees	Sufficient

Height Difference			
	Maximum Allowable Height Difference	4.46 m	
	Actual Height Difference	1.63 m	Sufficient
Freeboard			
	Dead Load Sag	5.570 m	
	Distance from Lower Saddle to Lowest Point of Cable, f	4.78 m	
	Actual Freeboard	2.02 m	Sufficient

The achieved factors of safety for the various design checks on our bridge are shown below:

Table 2. Factors of Safety for Design Checks

Design Check	FS Required	High Side Achieved	Low Side Achieved
Cable Design	3.0	3.03	
Suspender Design	5.0	15.23	
Tower Overturning	1.5	4.78	4.30
Bearing Pressure	2.0	2.46	2.44
Tier 2 Anchor Sliding	1.5	1.76	2.02
Tier 2 Anchor Uplift	1.5	1.55	1.56
Calculated Dead Load less than Design?	-	Yes	
Timber Decking Check	-	Yes	
Steel Crossbeam Check	-	Yes	
Soil Shear Analysis	1.5	1.72	1.95
Tower Eccentricity within Range?	-	Yes	No
Tower Moment Capacity Check?	-	Yes	Yes
Tower Minimum Reinforcing Check?	-	Yes	Yes

Biaxial Loading Design Check?	-	Yes	Yes
3-day seat Early Concrete Moment Capacity/Reinforcement Check?	-	Yes	Yes
14-day set Early Concrete Moment Capacity/Reinforcement Check?	-	Yes	Yes
Construction Sag Requirement	=	2.968	meters

Our bridge design met all required factors of safety with the exception of the low side tower eccentricity. This value, only 2.2 cm away from the required 45 cm of allowable eccentricity, was deemed acceptable during meetings with alumni advisors and EIA staff for two main reasons. First is that EIA assumptions for calculating allowable eccentricity conservatively assume only reinforced concrete sections of the tower can resist biaxial loading, specifically bending, and not the masonry that is also part of the tower. This likely is not entirely true, meaning the allowable eccentricity is likely higher than 45 cm. Additionally, the value for belt friction used in calculating cable forces acting on the tower (following AASHTO's guidelines for belt friction) is conservatively valued at 0.2. If this value is reduced slightly to 0.18, which is still within the AASHTO acceptable range of values, then the eccentricity requirements for the tower are met.

Construction and Safety Plans

With a finalized design, we moved forward with developing the construction and safety plans using EIA and Bridge EDU resources. OSHA safety standards and ISO material testing standards were considered and followed in preparing these plans.

Construction Schedule

Site Preparation

Site Preparation is the initial work that has to be done before the construction project starts. Site preparation increases productivity, safety, and reduces the unnecessary repetition of construction tasks. Several considerations have to be taken into account in order to have the site prepared for construction work: where the materials and tools should be stored, the exact location of the centerline so trees and rocks can be removed, how much space excavated soil will occupy, establishment of work areas, and safe pathway and river crossing to be used during the bridge construction.

Construction Phase 1

1. Material Collection:
 - a. 2-6 weeks: Exact amounts for each material can be found on the bill of quantities. Materials needed at the start of construction are the rocks, gravel, sand, and concrete. These materials are being transported to the site by tractors, trucks, and the people on-site (i.e., volunteers, laborers, students, etc.). Materials will be stored on site. Remember to maintain proper “housekeeping” to avoid having to move large amounts of materials and to ensure quantities and materials are

organized. This eliminates many potential hazards in the workplace and helps get the job done safely and properly.

2. Foundation and Tiers:

- a. Construction Layout: 1-2 days: This step involves transferring the design from the drawings to the ground. It is necessary to establish the bridge centerline and mark where the foundations, abutments and anchors will be placed. It is necessary that the centerline is not moved throughout the entire construction process.
- b. Excavation for Abutments: 1-2 weeks: The time to complete this task varies depending on the manpower available, type of soil, and depth of foundation.
- c. Construct Tiers: 2-3 days per tier: The time to complete this task depends on the number of tiers per abutment, manpower available, and collection of rocks. This bridge has 6 total tiers, so construction will take approximately 3 weeks to complete.

3. The Towers:

- a. Construct Towers: 1 week: This step is composed of three major construction stages: the base level masonry perimeter, the towers, and the cast walkway hump, with the installation of the T03 cable guide bars. Anchor and ramp excavations need to start while the towers are being built.

Construction Phase 2

4. Anchors:

- a. Install Anchors: 3-5 days: There are 7 steps involved in this process: assemble anchor reinforcing, unspool cable, drape cables over the abutments through walkway hump tubes, place the anchor cage in the designated location, clamp

cables at fixed anchors, pour concrete at the fixed anchors, and install adjustable anchors. Rocks can be used to help place the anchor cage.

- b. Simultaneously, construction of ramp wall foundations should begin. It is important to have the ramp foundations completed before hoisting the cables.
5. Cable Hoisting:
- a. Position Cables to Hoist Sag: 3 days: This process is one of the most dangerous, so it must be done with a lot of precaution. There are 7 steps involved in this process: hand hoisting the cables, establishing and marking the f-value, placing the auto level, attaching winch to the hoisting loop in the main cable, hoisting cables again, and relaxing them. Cables need to be adjusted, clamped, and coated.
 - b. Ramp Wall Construction: 1-2 weeks: The whole approach ramp, including the foundations, needs to be constructed and brought up to height.
6. Superstructure:
- a. Construct Walkway: 1-2 weeks: This step includes constructing the bridge deck and safety fencing with suspenders. Once the decking is installed, it is very important to grout the cables.
7. Bridge Celebration:
- a. We have to reserve a day to celebrate the finalization and inauguration of the bridge. It is the best part of the project when the whole community gathers to witness and use their new bridge, which they helped construct, for the first time.

Safety Protocol

Creating a culture of safety is of the utmost importance for any construction project. The safety system for this project is comprised of six elements:

1. Leadership

A culture of safety is a function of leadership and operates in a trickle-down system. By having a safety manager on site to enforce safety at all levels, and rewarding workers for operating safely, a safety manager should inspire others on site to want to work safely.

The enforcement of safety policies must be consistent and expectations should be set early on with the team. This can be done through the institution of a daily safety plan.

The daily safety plan should identify team objectives and strategies for minimizing risks/hazards for workers for daily on-site safety. Created by the safety manager, this planning should be completed daily and consider hazards related to the specific tasks to be completed that specific day. Frequent inspections of equipment, materials, and the job site should be completed by the safety manager daily. A safety review should be conducted at the conclusion of every work day to evaluate the project.

2. Education

Educating worksite employees and volunteers is critical to preventing incidents. Safety is a team activity and cannot be achieved without the assistance of all participants. Each individual should be able to effectively identify hazards and implement strategies to mitigate risk. Project managers in conjunction with the safety manager should organize training sessions to ensure all workers on site understand the hazards associated with common tasks. Workers should be trained in personal protective equipment safety prior to beginning work. This includes wearing hard hats on site, safety glasses when dust is

present or cutting metal, face shields when exposed to dust or cutting reinforcing bars/ cables and when using a grinder, hearing protection, foot protection, and hand protection. Hand and power tool safety should be reviewed and best practices such as inspecting tools prior to use, tying off tools to prevent falls, and ensuring guards are used when necessary. A meeting should be held with all workers on day 1 of construction to provide an overview of when PPE should be worn and best practices for operating hand and power tools.

3. Communication

Communication is critical to creating a culture of safety. It is likely that a language barrier will exist between workers and the visiting volunteers, and miscommunication poses high risks of safety incidents. Signage in both the traveling teams and in-country language should be distributed/ posted throughout the site regarding proper use of PPE. The safety manager should organize safety briefing and discussions specific to the task at hand and communicate this in the local language to all participants. The safety manager is responsible for ensuring all workers are aware of the risks associated with each task and how to mitigate their risks.

4. Planning

Creating a safety plan that is project specific is essential to creating a safe work environment. The two goals of any safety plan should be to eliminate incidents and to increase efficiency through a safe work environment. Work Zone safety should be utilized and a work zone perimeter should be established. The perimeter will protect not only members of the construction team, but also members of the community. Personnel entering the perimeter should be trained in PPE as well as risk mitigation measures.

Activity level safety planning should also be performed consistently in unison with the daily safety plan. Workers should never work alone and evaluating the hazards of each activity performed daily will prevent injury. Fall protection should be discussed with all workers and a rescue plan should be drafted for emergency situations.

5. Evaluation and Modification

Continually evaluating conditions and actions on a work site is essential to creating a culture of safety as well as creating a safe work environment. Daily site inspections should occur to evaluate any changed site conditions due to inclement weather or incident, as well as the quality of materials in storage and conditions of equipment should be inspected prior to every use. Daily excavation inspections should occur to mitigate any hazards and identify any changes in conditions from the prior work day. Fall protection inspection should be performed to prevent incidents and avoid implementing the rescue protocol. This includes evaluating the condition of harnesses, D-rings, and anchorage points. Creating a construction checklist with safety protocols for each stage of construction will help reduce oversight and ensure work site safety. Additionally, creating a photo inventory for comparing conditions throughout the project will provide essential information for safety and hazard reduction. By continually evaluating conditions, safety plans can be continually improved and modified to create a culture of safety.

6. Reinforcement

Reinforcement is critical to ensuring individuals participate in creating a culture of safety. This is often through either positive reinforcement or consequences of actions. Workers should receive feedback from the safety manager and from other participants to cultivate this culture. An end of day review should be conducted to evaluate any safety incidents as

well as any positive safety behavior that occurred on site. By encouraging workers who are operating safely, it is likely that these behaviors will continue and will be spread throughout the site. Additionally, incident reports should be completed for any safety hazards or incidents to document behaviors. Workers operating in unsafe manners should be disciplined and a zero-tolerance policy for non-safe behavior should be implemented.

Using this as a framework, we began to develop the safety plan starting with our plans for implementation. The safety manager of the traveling team will be in charge of safety. Safety concerns will be discussed with the community daily through safety briefings before and after the workday. All team members and community members should know about the elements of the culture of safety: commitment, communication, planning, education, evaluation, and reinforcement. All team members should exemplify good safety practices at all times: on site and away from site. Certain members of the team should be trained in wilderness first aid and be confident to act or communicate proper care when needed. Clear and frequent communication with all people involved in the project is essential in order to ensure safety is a top priority.

Each traveling team member is responsible for bringing their own safety glasses, work gloves, steel toe boots, hard hats, pants, and long sleeve shirts. These items are required at all times while on the construction site. The traveling team should decide if any of this PPE will be purchased in-country. Community volunteers will be responsible for their own shirts and pants along with work gloves. Other necessary PPE including hard hats and safety glasses will be provided as needed. Additional PPE will be required for certain activities. Safety harnesses, hearing protection, and face shields will be purchased in-country.

Next, we completed our Risk Management Plan which can be seen below:

Risk	Monitoring Frequency	Scenario	Remedial Action	Responsible Party
Saturated soil conditions	Daily	Grade 1: Standing water in excavation pits only following major rain event	No action needed; bridge design accounts for saturated condition once or twice per rainy season per B2P Manual	Bridge Engineer
		Grade 2: Standing water always in excavation pits, indicating high water table	Verify design capacity accounting for buoyant force. Consider installing drainage or possible redesign.	
Lack of community participation	Daily	Grade 1: Fewer workers than expected at job site	Convene Bridge Committee, adjust schedule	Construction Manager
		Grade 2: Insufficient workers during critical points in construction	Engage EIA mason or Project Manager for full evaluation of community's willingness and ability to contribute; Recruit workers from nearby towns; Suspend project	
Injury/loss of teammate	Continuous	Grade 1: Injury that cannot be treated on-site with first aid	Transport teammate to hospital in Diramba (see Table 8); Reorganization of team roles & responsibilities	Safety and Operations Manager
		Grade 2: Teammate can no longer work on project/returns home	Permanent reorganization of team roles & responsibilities	
Injury to community worker	Continuous	Injury that cannot be treated on-site with first aid	Transport community member to hospital in Diramba (see Table 8)	Safety and Operations Manager

Municipality fails to provide transportation for rocks	Weekly	Rocks are collected but municipality does not provide truck	Use community members with trucks (one identified over fall break); Depending on time-sensitivity, consider hiring Marvin or Fruto's truck	Safety and Operations Manager
Insufficient quantities of rock collected	Weekly	Grade 1: Sufficient quantities of river rock for structural work, insufficient quantities of rock for fill	Expand scope of collection zone; Contact local quarries to collect rock fragments and debris	Safety and Operations Manager
		Grade 2: Insufficient quantities of river rock for structural work, insufficient quantities of rock for fill	Expand scope of collection zone; If inadequate, purchase rock from regional supplier	
Severe weather	Continuous	Grade 1: Intermittent inclement weather	Cover excavated areas and curing concrete during heavy rains; inspect integrity of excavations	Construction Manager
		Grade 2: Ongoing or consistent inclement weather	For afternoon storms, adjust workday start; Optimize critical tasks for predicted breaks in weather; Inspect integrity of excavations – suspend work and shore if needed	

Conclusion

The final bridge design created by the team will be used in part or in full to construct a new bridge for the given site. The Maphoveleni bridge will greatly impact the lives of the

surrounding community members and ensure new economic and educational opportunities to the people. More than just the bridge design, this capstone also focused heavily on other aspects of a bridge like construction, material acquisition, and instilling a culture of safety among team members. This document provides an outline for the process of the bridge design and many other important factors tied to building a bridge or any other structure.

One member of the team will be traveling this summer to a different bridge site with EIA to be part of the construction team. While no one from the team will be going to the Maphoveleni site in Eswatini, the final plan set for the bridge will instruct the team that will be traveling to this site on how to properly build the bridge. The efforts put in by the design team this year will have a tangible impact on real people which is ultimately why the team was so excited to be part of this project.

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**URBAN REVITALIZATION: HISTORICAL GENTRIFICATION'S IMPACT ON
CURRENT PLANS**

A Research Paper submitted to the Department of Engineering and Society

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Haley Dues

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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

Advisor

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Introduction

Cities across America have been cleaning up for years, but what happens when that becomes cleaning out? Gentrification appears to be a simple process of changing a neighborhood, but it has many different layers. This includes economic change in historically disinvested neighborhoods and demographic change including increased education levels of residence and shifts in racial majorities (Chapple et al., 2021). Gentrification has historically increased the cost of living in neighborhoods, resulting in lower-income residents being displaced. Jacob Vigdor and co-authors (2002) illustrate this pattern with an analysis of Tract 708 in Boston, Massachusetts. Between the years 1970 and 2000, the average income of the neighborhood grew above the citywide average and non-hispanic whites, a majority of which held college degrees, claimed the racial majority when the area had previously been 83% black. The population density of the area remained the same; the former black residents were forced to relocate. This example illustrates “basic stylized facts associated with gentrification” where socio-economic and racial tensions are unavoidable (Vigdor et al., 2002, p138).

Support of gentrification accepts the displacement of low income and minority residents in favor of wealthier and whiter residents and communities. Support on the basis of utilitarianism views gentrification as a necessary step towards making the city more enjoyable for the majority of people. Utilitarianism “seeks the greatest balance of happiness over suffering in society as a whole” (Staub, 2021). However, when attempting to appease the majority, minorities are often overlooked. Cities and urban planners have historically failed to balance rights-based and utilitarian ethics. By continuing to do this in their current urban development plans, revitalization efforts remain unethical as minorities and low-income neighborhoods are unproportionally negatively impacted.

Methods

Historical gentrification has had long lasting effects on minority and low income communities, and current urban revitalization has the potential to do the same. In this paper I will examine whether current plans for urban renewal balance utilitarian and rights-based ethics in a socially and racially just manner. To begin, I will analyze historic cases of gentrification which provide evidence of disregard and destruction of neighborhoods in two cities: the West End of Cincinnati (Hurley, 2006) and the French Quarters in New Orleans (Campanella, 2013). These projects will be examined in order to determine social injustices, long term negative consequences, utilitarian benefits, and rights-based ethical impacts of these decisions. This analysis will show how American cities weighed utilitarian benefits against social justice in the past. These cities were chosen as they are similar in population and representative of two different regions within the United States: the midwest and the southeast. In addition, the differences in demographics, culture, and histories of the cities will allow for interesting comparisons to be made.

Moving forward, both cities have an urban development plan produced by the city and used to guide the direction of current and future urban renewal projects: Plan Cincinnati and Plan for the 21st Century. After looking through the plans, coding will be used to determine the quantity and context of mentions of certain words such as diversity, minority, and ethics in contrast to those of economic growth and cleanliness within each of the plans. This evidence will be used in conjunction with recent urban development projects including Over the Rhine in Cincinnati (Vu, 2012) and the Post Hurricane Katrina urban renewal in New Orleans (Campanella, 2013) in order to determine how cities are moving forward and what they value

while doing so. Legal structures and policies such as NEPA (Bryant et al., 1983, p46) and the 1949 Urban Renewal Act (Fullilove, 2001) will be examined in order to provide evidence on how displacement, housing loss, and costly developments are legally permitted and possibly encouraged or even required. This evidence will come together to determine how American cities balance utilitarian and principle ethics and whether this is socially and racially just.

Results and Analysis

Cincinnati

Gentrification impacted cities throughout the country in the mid twentieth century in order to make way for highway systems. Areas marked for urban renewal were predominantly made up of minority and low income individuals such as Cincinnati, Ohio's West End. The West End was cleared in the 1950s in order to build I-75, a housing development, and an industrial park. Although the area had a thriving business life and dense population, it was 97% black (Hurley, 2006). This led to urban planners viewing the area as "slums" and 25,000 people being displaced. Similar views of black communities were shared across the country following the 1949 Urban Renewal Act. During this time, 66% of residents being displaced were black while black people only made up 10% of the total U.S. population (Fullilove, 2001). The disproportionate number of black individuals being displaced despite having thriving communities points to racially motivated decision making.

Interstate I-75 has without a doubt benefitted many; however, there were other routes the interstate could have taken in order to produce the most ethical outcome. Queensgate, the industrial area and housing development built in place of the West End, currently has a population of 8,015 which is 82% black (city-data.com, 2019). The industrial buildings mostly

sit empty, covered in graffiti. Significantly more people were displaced during this urban renewal project than directly benefited from the updated neighborhood, suggesting that the decision to demolish the West End was not even the most utilitarian ethical decision that could have been made when compared to originally less populated and dense neighborhoods.

Plan Cincinnati is the city's current urban development plan. Created by the Cincinnati City Council in 2012, the plan highlights the city goals, city visions, and how these fit into existing geographical areas of the city (Cincinnati City Council, 2012). The first initiative for the city is to enhance economic competitiveness. In parallel, issues of homelessness and poverty are only addressed once in the plan in relation to Mill Creek, a "targeted area for future economic growth" (Cincinnati City Council, 2012, p77). Historic trends show that targeting this area will lead to more displacement of low-income residents. Minority and low-income neighborhoods are not directly addressed in the plan.

The plan discusses Over the Rhine, or OTR, in great detail. An area targeted for urban renewal in Cincinnati in the early 2000's, Over the Rhine has experienced an economic upturn but not without social consequences. Social-mixing, the mixing of lower and higher income residents, is a response to gentrification many city planners hope for; however, the experience in OTR shows that this is not always a positive outcome. Psychological barriers including a lack of shared experiences and physical barriers such as the cost of using new developments prohibited the individuals living in the renewed OTR from forming a cohesive neighborhood (Vu, 2012). The overall result of the OTR renewal included prior low-income residents feeling as if they no longer belonged and former residents no longer being able to afford to live there. By not noting how low-income and minority people factor into neighborhoods in the plan document, they are not thoroughly considered as a factor when urban renewal decisions are made. In the worst case

scenarios, this leads to large amounts of people throughout the city being displaced without a new place to move to.

New Orleans

Moving to the southeast region of the United States, New Orleans, Louisiana has experienced gentrification motivated by and as a result of different factors. In the 1920s and 1930s, the French Quarters of the city was occupied by writers and artists due to its affordable rent and abundant alcohol despite Prohibition (Campanella, 2013). Through the 1940s, the older buildings were slowly restored and wealthier, educated new residents began to move in. Gentrification of the French Quarters continued through the 1970s and spread up and down the river. The cost of living quickly rose in the area, and the working-class Sicilian and black Creole natives were replaced. During this time, New Orleans was the largest shrinking city in the region “losing 170,000 residents between 1960 and 2005” (Campanella, 2013).

Similar to Cincinnati, the loss of minorities in the city and replacement of them with wealthier individuals illustrates that the urban developments were not socially ethical. The very soul that makes the city such a large tourist attraction was replaced. The urban renewal of the area increased the cost of living in the neighborhoods and economic productivity as more business and rental units popped up. The city advanced with this plan in order to help the city grow in economic competitiveness. Within city planning, the greatest happiness often heavily aligns the greatest monetary gain. As such, the gentrification of these neighborhoods in New Orleans could be argued to be a utilitarian just decision; however, the large decrease in residents of the city suggests that the people of New Orleans were not benefited by the development as much as the city itself.

The urban development plan for New Orleans is titled Plan for the 21st Century and was approved as a city charter amendment in 2008. The plan focuses solely on urban development up until 2038 and was updated in 2018. Similar to Plan Cincinnati, the plan has a set of visions or goals that they seek to achieve: enhance quality of life that preserves the city's character, expand opportunity with equitable chance for everyone to share the benefits, and sustainability and creating a more resilient city (City of New Orleans, 2010). The plan was developed after Hurricanes Katrina and Rita, and a main goal throughout is still focused on repairing the city. The plan begins by addressing Post-Hurricane Katrina housing facts, fully acknowledging that homeowners received insufficient funds to cover rebuilding costs, 80% of affordable housing suffered major damage, and housing costs increased while median income adjusted for inflation remained flat (City of New Orleans, 2010, p31). Unlike with Plan Cincinnati, the Plan for the 21st Century more thoroughly discusses demographic differences and past shortcomings in certain neighborhoods. Homelessness is mentioned in the plan 36 times with an emphasis on creating more affordable and transitional housing. Poverty is addressed 13 times, with most mentions centering around children in poverty and statistics on poverty and income; however, Iberville Housing is mentioned explicitly. This housing development is New Orleans' "most desirable public housing complex" but suffers from violence and effects of poverty. The plan proposes Iberville be redeveloped as a mixed income development (City of New Orleans, 2010, p196). As explained earlier, social mixing does not always produce the intended effects and could lead to racial and economic tensions in the neighborhood.

Despite the attention the plan gives to equity and the acknowledgement of different demographics, a more prevalent topic throughout the plan is the improvement and development of businesses in the city. Business is mentioned in the plan 340 times and economic is mentioned

241 times. As discussed above, increased economic activity in the area has the potential to benefit many different parties; however, prioritizing economic growth over livability of an area has many adverse effects. The plan prioritizes the development of “public-private business partnerships” (City of New Orleans, 2010, p63). The recommended action to achieve this is establishing a section of a neighborhood to organize commercial district businesses. By allocating areas of neighborhoods for business development, the population density of the area is decreased.

Through all of the development in New Orleans, they have strived to retain the original culture of the city as it is the foundation of not only their residents, but also public interest. As such, it has remained a city popular for tourism. This tourism creates the need for various lodging accommodations including “home hotels” like AirBnBs. In many neighborhoods “especially working-class and majority black” areas, an average home hotel can make significantly more than a typical long-term rental unit (Robertson et al., 2020). As a result, in some neighborhoods, a significant portion of rental units have been converted into home hotels. One neighborhood that this has widely occurred in is Treme. The longtime cultural center for New Orleans’ black community has risen in popularity. This has resulted in rapid development of short term rentals which has disrupted the daily life of permanent residents and turned the neighborhood into a “ghost town” (Perkins, 2019). Although tourism has increased the economic production of the area, it disrupts the lives of the residents and arguably decreases their quality of living. This requires the consideration of how socially ethical the decision to continue this development is. Many of the original residents of the area have been displaced due to the increases in housing costs and decreases in the number of long-term rental units. Although the

city as a whole is benefiting from these developments, the neighborhoods that were slated for redevelopment, typically black cultural hubs, are now devoid of their original glory.

Discussion

As a result of urban renewal, communities are being transformed. Ultimately, the city's intend to benefit the greatest number of people, but do not often take into account minority and low-income individuals. Demographics of neighborhoods being slated for redevelopment are not being adequately considered in order to ensure all groups within the city are being equally impacted. In Cincinnati and New Orleans, displacement rates are higher for black individuals simply because their neighborhoods are not viewed as economically beneficial to the city.

Utilitarian ethics used to develop urban renewal plans cater toward enabling wealthier residents to inhabit an area. This is because the priority on benefits to the city as a whole are normally viewed as higher income and economic productivity. A counter argument within utilitarianism would be that the largest variety of people or the most amount of demographics are not being benefited by urban renewal. By simply targeting areas and neighborhoods with limited economic production, only certain demographics are negatively impacted and possibly displaced as seen in the black communities of the West End and French Quarters. Decreasing diversity in a city negatively impacts the culture of certain neighborhoods and feelings of inclusivity. In addition, the balance between utilitarian ethics and rights-based ethics is severely skewed. By not accounting for different demographics in current urban plans, minorities and low-income residents are disproportionately negatively impacted.

In addition to urban renewal plans, there are many laws in place, both at the federal and state levels, that enable gentrification to continue. The National Environmental Policy Act of

1969 (NEPA) requires all agencies of the federal government to prepare an environmental impact statement for “all major Federal actions significantly affecting the quality of the human environment” which requires all individuals receiving block grants to participate in the environmental review process (EPA, 2021). If the review finds the environmental impact exceeds the allowable criteria, the problems must be rectified in order for the building or home to remain in use, often requiring an extra expense some residents cannot afford. As a result, in the name of minimizing environmental impact, NEPA provides allowance for revitalization and housing rehabilitation to cause potential “substantial displacement and housing loss” (Bryant et al., 1983, p46). In addition, many cities have pushed for an increase in green infrastructure. New York City’s High Line is an example of green infrastructure that has had many underlying consequences on the West Side and Manhattan. Although the High Line is environmentally beneficial, it has had a societal negative effect as rent has increased throughout the area and lower cost units are being replaced due to the new appeal of the area, causing original residents to be displaced (Maiello, 2019). Despite noble intentions, environmental law and advances continue to facilitate displacement and housing loss, providing a route for unethical urban redevelopment.

Similarly, urban renewal in the name of historic preservation has had adverse effects on cities. Historic neighborhoods have been “aestheticised” making them popular for tourism and favorable areas for living causing housing prices to skyrocket (De Cesari & Dimova, 2019). Heritagization is the processes and dynamics of creating or recreating cultural and historic meanings and identities (IGI Global, 2022). Heritagization helps turn stigmatized historic city neighborhoods, traditionally inhabited by working classes, minorities, and immigrants, into desirable places for middle-class individuals. Policymakers worldwide accept that increased

heritage and culture can help grow socio-economic development especially via tourism (De Cesari & Dimova, 2019). International organizations such as UNESCO and World Bank have endorsed this approach to urban renewal. As a result, the standard has been to capitalize on these historic neighborhoods by fixing them up and changing the nature of the neighborhood as former residents are often displaced. Policymakers have not yet successfully found a balance between historic preservation and social ethics.

In response to these case studies and analysis of set laws and policies, changes need to be made in order to ensure racially and socially just treatment of all individuals in areas slated for urban renewal. In order for this redevelopment to become more socially ethical, plans need to be altered to focus on equity instead of economic pursuit. In both cities examined in this paper, economic growth and the formation of businesses is at the forefront of future and current plans. Nothing is wrong with this as it benefits the city as a whole, but protective laws or measures need to be put in place in order to ensure decisions are made fairly. Low income neighborhoods are often the ones redeveloped which impacts an unproportionate amount of minorities and working class individuals. Redevelopment should instead look at demographics and ensure the impact is being felt equitably.

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ESWATINI SUSPENDED FOOTBRIDGE DESIGN

**URBAN REVITALIZATION: HISTORICAL GENTRIFICATION'S IMPACT ON
CURRENT PLANS**

A Thesis Prospectus Submitted to the
Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

Haley Dues

Fall, 2021

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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.

Signature _____ Date _____

Haley Dues

Approved _____ Date _____

Jose Gomez, Lecturer of Civil Engineering, Department of Engineering Systems and Environment

Approved _____ Date _____

Rider Foley, Associate Professor of STS, Department of Engineering and Society

Eswatini Suspended Footbridge Design

Introduction

Flooded rivers plunge entire communities all over the world into isolation for months at a time. Impassible rivers require community members to either put themselves in danger to cross or prevent them from reaching markets, schools, churches, and healthcare (EIA, 2021 A). Aside from ensuring that community members can safely cross the river at all times, footbridges have been found to have a number of other benefits. Access to safe and reliable transportation networks has been proven to increase enrollment in schools by 12%, farm profits by 56%, and women in labor markets by 75% (EIA, 2021 B, p2). In Maphoveleni, Eswatini, the Mtilane River floods year round. As a result, the community has requested the assistance of Engineers in Action to build a footbridge. Engineers in Action is a non-profit striving to support the development of sustainable systems and infrastructure within underserved communities (EIA, 2021 A). University of Virginia is partnering with EIA to design a suspension footbridge and create a construction and safety plan.

Problem Statement

Maphoveleni, Eswatini is in high need of a footbridge over the Mtilane River due to long periods of flooding that occur throughout the year. In 2021, four people died during Cyclone Eloise and six people have been injured attempting to cross the temporary log bridge currently in place (EIA, 2021 C, p2; NASA, 2021). The log bridge is not an adequate height above the top of the river, has insufficient railings or other safety features, and becomes very slippery when wet (EIA, 2021 D, p2). Crossing the river is necessary for the community to access numerous

educational, health, and economic resources. Children must cross the river daily to attend school. During exam season, children are held at school for four weeks in order to ensure attendance, which puts a financial strain on the school and prevents the children from completing their chores at their homesteads (Brooks et al., 2017, p5). The community is made up primarily of agriculture and industrial workers, making it imperative that they cross to access local markets and work in the nearby city. (EIA, 2021 E, p1)

The local municipality and the community have requested the assistance of the Engineers in Action (EIA) Bridge Program to assist in the implementation of a suspended pedestrian bridge (EIA, 2021 E, p1). The project group is responsible for the design of the suspended footbridge. The bridge will be designed using local materials and steel cables. Construction of the bridge will include members of the community, chapters from other universities, and potentially members of the capstone group.

Project Scope

Our team is tasked with developing a detailed design for a suspended cable footbridge to help provide year-round access to resources and services located across the Mtilane river from Zombodze and Boyane. There are seven desired objectives for the ultimate bridge design: safety, durability, serviceability, maintainability, constructability, economy, and aesthetics (EIA, 2021 B, p5). The project design will include the design of timber deck, wire rope, reinforced concrete, masonry, and soils. In addition to design, a hydrologic study of the surrounding catchment area will be performed. Our team is responsible for delivering an in-depth construction plan and schedule to provide guidance for the construction of the bridge in-country. This also includes materials sourcing as well as a safety plan which will provide important safety measures and

information pertinent during the construction, operation, and maintenance of the bridge. (EIA, 2021 F, p57-62).

Progress and Goals

During the fall semester, our schedule focuses on completing the different education modules provided by EIA and completing Review Call 1. The different modules will help us develop a bridge design for our site. All team members have completed the Bridge Introduction, Virtual Capstone Suspended Bridge Design, and Project Management modules at this time. In addition to the modules, the team has met with our professional advisors biweekly to discuss progress and challenges we have met. Design of the bridge and the concept definition report have recently been started in order to prepare for Review Call 1 after which EIA will grant our team permission to move forward.

As project manager, I am responsible for ensuring we are adhering to the schedule, being point communicator between all parties, and ensuring all team members are feeling valued in their work on the project. Personal goals for the project include completing a video about the project mission, fundraising for construction and materials, and exploring the possibility of the team traveling to build the bridge. In addition, I am a member of the design team. We have used a profile created by Engineers in Action in AutoCad to determine the location, span length, and height of the bridge. Design goals for the remainder of the semester include determining the type of abutment to be used, anchor details, and suspension cable design. Ultimately, the main goal of this bridge project is to provide the community members of Maphoveleni with a reliable transportation network.

Urban Revitalization: Historical Gentrification's Impact on Current Plans

Introduction

Though the suspended footbridge may change the community of Maphoveleni, Eswatini for the better, gentrification can have negative implications for cities across the globe.

Gentrification is a process of changing a neighborhood, including economic change in a historically disinvested neighborhood and demographic change including education levels and race (Chapple et al., 2021, p1). Gentrification has historically increased the cost of living in neighborhoods, resulting in lower-income residents to be displaced. Vidgor, Massey, and Rivlin (2002, p135) summarize this with an analysis of Tract 708 in Boston in which between the years 1970 and 2000, the average income grew to surpass the citywide average and non-hispanic whites, a majority of which held college degrees, claimed the racial majority of an area previously 83% black. This example illustrates “basic stylized facts associated with gentrification” where socio-economic and racial tensions are unavoidable (Vidgor et al., 2002, p138). This paper will examine how urban development decisions, past and current, balance right-based ethics with economic and competitive growth.

Problem Development

Gentrification impacted cities throughout the country in the mid twentieth century in order to make way for highway systems. Areas marked for urban renewal were predominantly made up of minority and low income individuals as seen in Cincinnati's West End. The West End was cleared in the 1950s in order to build I-75, a housing development, and an industrial park resulting in over 25,000 people being displaced. Although the area had a thriving business life

and dense population, it was 97% black (Hurley, 2006, p62). This led to urban planners viewing the area as “slums.” These views of black communities were shared across the country following the 1949 Urban Renewal Act in which 66% of residents being displaced were black while black people only accounted for 10% of the U.S. population at the time (Fullilove, 2001, p74). The disproportionate amount of black individuals being displaced despite having thriving communities proves that early gentrification practices were unethical due to racial motivation.

Support of gentrification accepts the displacement of low income and minority residents in favor of potentially better-off residents and communities, arguing for gentrification on a basis of utilitarianism. Utilitarianism “seeks the greatest balance of happiness over suffering in society as a whole” (Staub, 2021). Within city planning, the greatest happiness often heavily aligns the greatest monetary gain. This can be seen in Plan Cincinnati (Cincinnati City Council, 2012, p99), the city of Cincinnati’s plan for future urban development, in which the first initiative for the plan is economic competition. In parallel, issues of homelessness and poverty are only addressed once in the plan in relation to Mill Creek, a “targeted area for future economic growth” (Cincinnati City Council, 2012, p77).

Another area targeted for urban renewal in the early 2000’s, Over the Rhine (OTR), has experienced an economic upturn but not without social consequences. Social-mixing, the mixing of lower and higher income residents, is a response to gentrification many city planners hope for; however, the experience in OTR shows that this is not normally the case. Psychological barriers, including a lack of shared experiences and physical barriers such as the cost of using new developments prohibited the individuals living in the renewed OTR from forming a cohesive neighborhood (Vu, 2012, p6). The overall result of the OTR renewal included prior low-income residents feeling as if they no longer belonged and former residents no longer being able to

afford to live there. The West End borders OTR to the north and is slated for redevelopment as well. Queensgate, the industrial area developed out of the West End, currently has a population of 8,015 which is 82% black (city-data.com, 2019). A professional soccer stadium was built in Queensgate with plans to continue development and make it a “destination neighborhood,” causing current residents to fear an increase in the cost of living or a cultural change in the neighborhood (The Enquirer, 2021). Further developing the West End and creating possibility of further displacement of black residents suggests little consideration of unjust past consequences when moving forward with urban redevelopment.

In addition to urban renewal plans, there are many laws in place, both federal and state, that enable gentrification to continue. The National Environmental Policy Act of 1969 (NEPA) requires all agencies of the federal government to prepare an environmental impact statement for “all major Federal actions significantly affecting the quality of the human environment” which requires all individuals receiving block grants to participate in the environmental review process (EPA, 2021). If the review finds the environmental impact exceeds the allowable criteria, the problems must be rectified in order for the building or home to remain in use, often requiring an extra expense some residents cannot afford. As a result, in the name of minimizing environmental impact, NEPA provides allowance for revitalization and housing rehabilitation potentially to cause “substantial displacement and housing loss” (Bryant et al., 1983, p46). In addition, many cities have pushed for an increase in green infrastructure. New York City’s High Line is an example of green infrastructure that has had many underlying consequences on the West Side and Manhattan. Although the High Line is environmentally beneficial, it has had a societal negative effect as rent has increased throughout the area and lower cost units are being replaced due to the new appeal of the area, causing original residents to be displaced (Maiello,

2019, p4). Despite noble intentions, environmental law and advances continue to facilitate displacement and housing loss, providing a route for potentially unethical urban redevelopment.

Research Question and Methods

Historical gentrification has had long lasting effects on minority and low income communities, and current urban revitalization has the potential to do the same . Do current plans for urban renewal balance utilitarian and rights-based ethics in a socially and racially just manner? Research will be conducted using historical case studies in conjunction with current urban development plans and legal structures to answer this question. The case studies will be used to provide evidence of the disregard and destruction of past neighborhoods, as seen in the West End of Cincinnati (Hurley, 2006, p62). They will be examined in order to determine social injustices, long term negative consequences, utilitarian benefits, and rights-based ethical corrections made to past mistakes. This analysis will show how American cities weighed utilitarian good against social injustice in the past. Current urban development plans along with recent projects will show how cities are currently moving forward to better America's cities and what they value while doing so. Economic growth, green infrastructure, increased public recreation, and betterment of low income housing are all potential options, but what do cities value and how do their actions reflect that? Legal structures will be examined in order to provide evidence on how displacement, housing loss, and costly developments are legally permitted and possibly encouraged or required. This evidence will come together to determine how American cities balance utilitarian and principle ethics and whether this is socially and racially just.

Conclusion

The technical project will result in a comprehensive design and construction and safety plan for a suspended footbridge to be built in Eswatini. This footbridge has the potential to directly impact 2,000 individuals, providing community members with reliable, safe transportation to and from the city year round. Possible secondary benefits include increased enrollment in schools, greater crop yields, and more women working in the nearby city, all of which have the potential to boost the area's economy.

The STS research project will provide a comparison between ethics of past urban development and current plans and legal structures. This research will answer the question about the balance of utilitarian and rights-based ethics in urban development and determine if urban revitalization is truly helping our cities and its residents prosper.

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