

# Maternillo Smart Community Design

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## Abstract

This project has proposed a new modern smart city for the Maternillo Community in Fajardo, Puerto Rico. In the present, the community has low economic resources, suffers from natural hazards, and has been neglected for years. It is situated in the coast and has much potential to grow and contribute to the socio-economical wealth of Fajardo and all Puerto Rico. The project consist of completely changing the infrastructure, offering new schools, homes, commercial centers, stores, parks, streets and more. It is believed that providing these necessities, the Maternillo Community will thrive; such as with education, tourism, local economy, emplacements, and overall, many opportunities to make it grow and become an ideal, ecological, smart, and healthy city. The project depicts each step, design the phases and produces a cost estimate to promote the project and its bidding.

## Introduction

The group of students have been tasked with seeking modern and new ideas to renovate the community to provide new opportunities, while, practicing and developing skills that a Civil Engineer will face during their profession. This project contemplated all the areas of Civil Engineering, such as Water Management, Transportation, Structural Analysis, Project Management and Geotechnical Engineering, along other skills that are developed along the way, such as leadership and teamwork; this to make a very real project. Along with the tasks to upgrade the city, studies pertaining to demographic data was obtained, to understand the community; such as it having approx. 29,000 citizen as per preliminary CENSO done in 2019. As well as, transportation, with existing conditions of about 7,900 Average Daily Traffic, as per 2017. Geotechnical Evaluations to understand the subsoil, which meet conditions of stiff to hard soil and more. Also, water management, such as knowing that half of the community has septic systems, that would be changed. Inventory of the present structures was also done and determined that new structures such as pharmacies, schools and parks are needed. With this, new water systems were proposed, new exits and repairs of streets, new structures to serve for homes, school, and more up to code with the latest technology that will make it sustainable and eco-friendly, such as renewable energy taking advantage of the coast.

## Objectives

Evaluate the existing conditions of the community to upgrade and mitigate against natural hazards that contribute to its deterioration social-economically. Provide a channel and retention ponds to mitigate against the floods and storm surges, either caused by storms or out of typical rains, due to the Rio Fajardo's storage of passage. Another objective is to demolish existing structures and homes that are out of code and are in the way of the new site construction to build the new homes, commercial center and schools. Upgrade the streets from potholes and deterioration caused by storms and proximity to salty sea water and river water, which advance the corrosion process. In green areas, construct a park for pets, and citizens to enjoy. Overall, reconstruct the Maternillo Community to transition it to a smart and ideal community for Puerto Rico.



Figure 1: Maternillo Community, Fajardo, Puerto Rico

## Methodology

- Investigate smart cities and new technologies.
- Obtain local information regarding the Maternillo Community and new cities.
- Study and explore the typical natural hazards that the community is vulnerable to.
- Download and/or obtain structural building codes, transportation manuals and other tools.
- Develop a design for a new and sustainable city to grow in social-economically.
- Divide task among classmates and rotate them to each be exposed to different topics.
- Present designs and calculations to professor and classmate, evaluate their value, efficiency, sustainability, and engineering value.
- Evaluate cost estimate and proposed designs' construction schedule.
- Provide an analysis, conclusion and recommendation based on results and outcome.



Figure 2: Proposed Site Plan

## Data

After all the new designs were done, submitted, evaluated and analyzed, a construction cost estimate was done to present and promote the construction of this project. With this information, it can be bid, and the community could begin its process of transition. The project will be done in 5 phases, which include demolition, construction and inauguration. All of the cost estimate were done based of market research, RS Means and past projects. After the market was researched for prices of construction projects, supplies, labor and much more. A cost estimate was elaborated for each phase, the table below includes the phase descriptions and cost estimate.

Table 1: Phases and Construction Estimate

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Phase Descriptions:	Permits, Finances, Employees and Contracts	Channel and Retention Pond	Construction of: a. Housing b. Commercial Center/Park c. School	a. Transportation Pavement and Parking b. Landscaping and Markings	Finances, Debts, Employees, Permits and Inauguration
Cost Estimate:	\$3,776,695.4	\$10,393,567.44	\$70,463,740	\$6,549,148.06	<b>Approximate Total: \$85-90 Millions</b>

Each construction on the phases have one of the following structural design elements such as; beams, columns, walls, and foundation. Along with the calculations of reinforcements. Figure 3, for example depicts a structural details of the commercial center foundation.

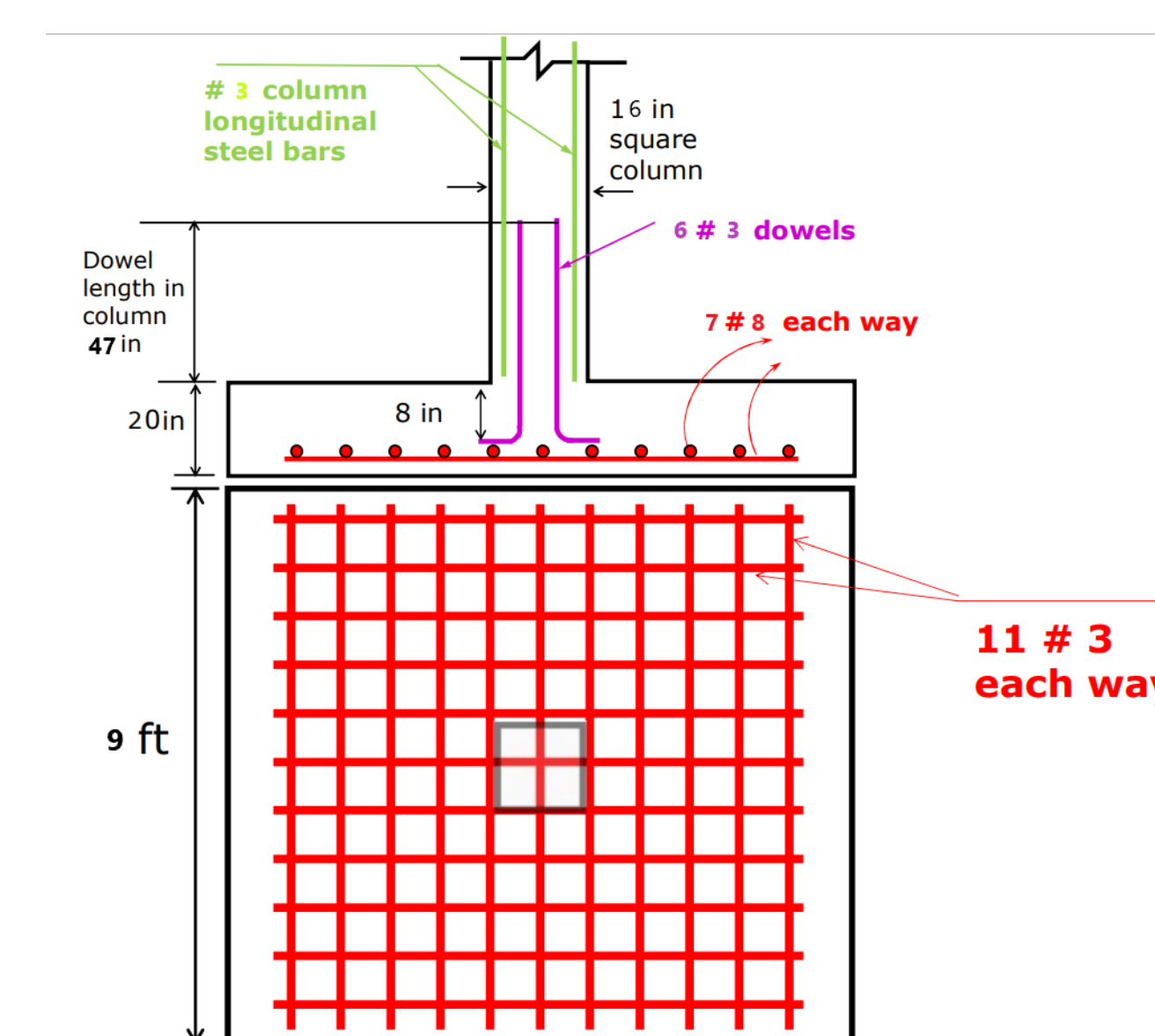


Figure 3: Foundation Detail Commercial Center

## Analysis and Results

If the project were to be done, it will provide the Maternillo Community with a lot of growth, employment opportunities, better education, local and foreign tourism and so much more. It is understood that the proposed project has a massive potential and value to Fajardo and all of Puerto Rico. Following the correct Civil Engineering Codes, Transportation Manuals, Environmental Guidelines and other regulations, this project will be a successful impact for the good of Puerto Rico. Figure 4 shows the new housing structures proposed that the citizens will much enjoy. This is a complete project that includes all the phases of civil Engineering and will develop jobs, before, during and after the transition phases.



Figure 4: Proposed Housing Structure

## Conclusion

The group is pleased to present the project of Maternillo Community Smart City Transition to the Department of Civil Engineering and mentor. This is an elaborated project that evaluates all the Civil Engineering routes, as are lectured in the Polytechnic University of Puerto Rico. The classmates hope this project's ideas such as the creation of a new and innovative school, with approximately 72 classrooms, library, offices and sports court will add value to the community in the social and economic way, this will provide tools for the community to flourish. Similarly, the new Commercial Center, 6 story building, that will include restaurants, stores, doctor's offices and much more will generate money, employments, opportunities; as are the other aspects of the new site constructions. New housing structures, a townhouse concept with approximately 90 homes with sustainable resources. The channel and the retention ponds will help the community with the floods and storm surges to allow for a safer and resilient community and avoid reliving tragic storm events. All these objectives comply with the Civil Engineering Ethics Code to provide a safe, efficient and research project for the use of the citizens.

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