

ORIGINAL ARTICLE

## Safety Based Cross Sectional Study of Infrastructure and Associated Problems among Undeveloped Neighborhoods

TONY YOUNG<sup>1</sup>, MAHMUD HASAN<sup>1\*</sup>, JORGE SANCHEZ<sup>1</sup>, PAUL NNAMDI<sup>1</sup>

<sup>1</sup>Computer Science and Engineering Technology (CSET) Department, University of Houston-Downtown (UHD), Houston, Texas-77002, USA

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### ABSTRACT

Infrastructure is important in a neighborhood that can be observed through survey conducted by independent people who are not part of that neighborhood. The present study aimed to determine well organized survey to list well defined infrastructures in neighborhoods that fulfills basics needs of neighborhoods' people to ensure safety. A safety and engineering related survey has been conducted to identify infrastructure problems in an undeveloped neighborhood. The studied neighborhood has lacked so many modern and updated infrastructures. NNS (Near Northside) neighborhood infrastructure is failing or becoming older because of lack of engineering and safety knowledge among the community people to have awareness to improve the infrastructure. There exists a need to understand the infrastructure deficiencies that currently is apparent within the community of Near Northside. This work addressed those issues and would encourage the people to have a better infrastructure which could help to improve their neighborhoods.

**KEYWORDS:** NNS (Near Northside), Infrastructure, Storm Drainage System, FTA, Sidewalk

### INTRODUCTION

Since ancient times, people used to live in groups and they wanted to stay in places where they could get all kinds of amenities around [1]. Since then people tried to build or construct certain items that could help develop their living places. A small neighborhood became part of so many other neighborhoods which made a rural area or suburb, then a group of those rural areas formed town, then a group of those rural areas formed city, and it just moved on. A neighborhood can be defined in a number of ways. So far, research communities could not agree on the

proper definition of a neighborhood, but the following may serve as a vital point. According to Schuck et al: "Neighborhood is generally defined spatially as a specific geographic area and functionally as a set of social networks. Neighborhoods, then, are the spatial units in which face-to-face social interactions occur—the personal settings and situations where residents seek to realize common values, socialize youth, and maintain effective social control." [1]

From the point of safety view, a neighborhood may comprise various types of infrastructure and it also depends on different aspects [3-5]. However, from basic engineering and safety aspect, a neighborhood should

*Corresponding author: Mahmud Hasan*

*E-mail: [hasanm@uhd.edu](mailto:hasanm@uhd.edu)*

have certain infrastructure e.g. modernized design of stormwater system if hurricane and aftermath flood-prone area, the proper road system in addition to nighttime lighting, stop signs on the intersection, proper security, etc. These things are necessary especially near a very rich and developed city because not having those infrastructures in undeveloped neighborhoods can cause major damages or destructions to the developed neighborhood. In this work, Houston downtown is considered a very rich and developed city. For comparison purposes in this work, NNS (Near Northside) is considered an undeveloped neighborhood.

This NNS neighborhood is located near downtown Houston which is the largest energy corridor in the world and the headquarters of a lot of companies are located here. Work for this survey occurred within the Near Northside neighborhood. The boundaries were: I-610 N (north), US-59 (east), I-10 excluding UHD properties (south), I-45 (west).

Risk control hierarchy dictates different types or steps. From initial to end of control need to follow on any safety aspect. Any type of plan needs to have anticipation/prediction of what could exist as a risk [6]. After that, a survey is needed to be conducted [7]. Once the survey has been conducted the identification of risks is very important. After that assessment, prioritizations are needed to be conducted and then a plan should be developed. Once the planning stage is completed, the implementation of the plan needs to start. In the end, a follow-up/monitoring is needed to be considered which is a continuous process [8].

The identification of the problems includes community outreach, and interviewing the residents about the conditions of the affected areas. The analysis includes the reduction of the identifiable issues. The assessment phase includes predictive aids to suggest the pre and post conditions of Near Northside and its residents.

According to the risk control stages, the survey is a very important stage especially if it is involved in a neighborhood infrastructure development. In the present study, a novel survey method is discussed and implemented for an undeveloped neighborhood to improve the infrastructure development plan.

### **Objectives of this Work:**

The present study aimed to determine the lack of or old infrastructures in NNS neighborhoods which are economically not well neighborhoods. Comparison is also made how to improve the neighborhoods.

This study utilizes FTA (Fault Tree Analysis) techniques. This provides a supplemental visual layout, present an overview of the problems analyzed, plus potential future difficulties. The result of this paper is to analyze current and future hazards, inefficiencies, and vulnerabilities identifying or detailing how to address each.

Work is needed on development and implementation of a neighborhood survey to identify and prioritize the needed infrastructure improvements in this NNS. This work can guide for proper listing to identify and prioritize development needed in undeveloped neighborhoods. The students who surveyed tried to measure the plausible impact on the issues that exist.

### **METHODOLOGY**

According to Oakley, most important components of an investigation program are: a formal written investigation policy, training in investigation, an investigation kit [9]. Students were trained over the years to conduct the surveys, to make investigation forms, to write important information related to investigations, to collect evidences etc. Interviews were conducted on the spot where infrastructures have problems and people could visualize past events to share more information. Open ended questions were asked in a relaxed mood. In addition to survey those neighborhoods printed blank forms, cameras to take photographs, recorder to record interviews, cars to drive to those neighborhoods etc. are used.

### **DISCUSSION**

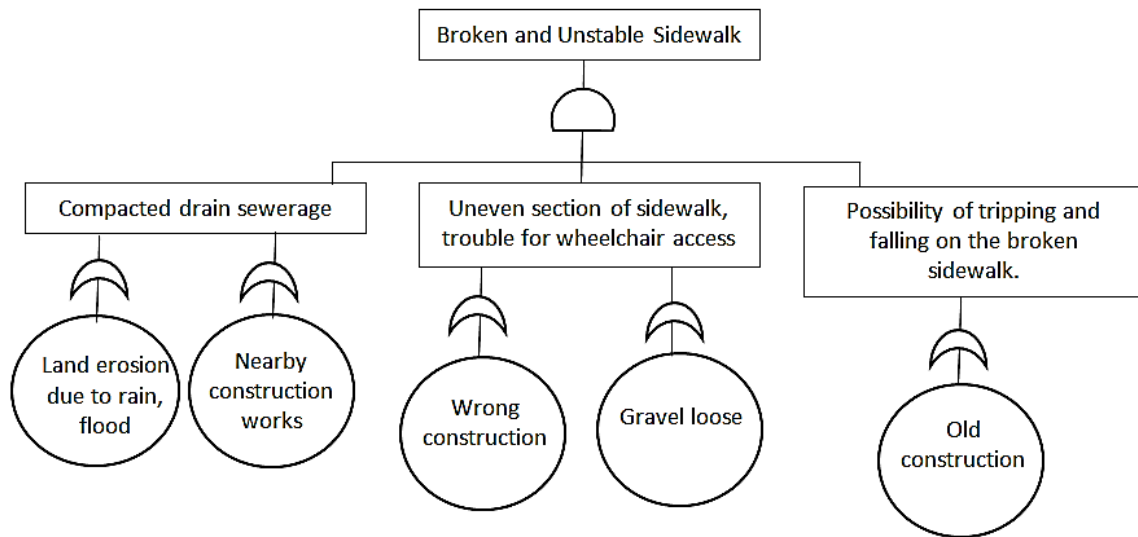
A few of the infrastructure problems that are pointed in this work are sidewalk, dark streets at night, lack of security, crowds of people solicit in front of businesses, and stormwater protection.

#### **Sidewalks:**

Lack of sidewalks is a big problem in this neighborhood. From the North Freeway to Fulton east and from Quitman to 610 North, private contractors

and city workers have received funds to combat this problem, but no one was benefited. Figure-1 shows FTA (Fault Tree Analysis) basic and intermediate events that lead to the final event of broken and unstable sidewalk as a Flow Chart.

The new curbs and some sidewalks were installed, but those are filled by the dirt. The compacted drain sewerage has been presented in Figure 2.



**Fig 1.** FTA of broken and unstable sidewalk



**Fig 2.** This sewer drain has been made useless with hard mud and debris, which might have been avoided with sidewalks to hold back the land erosions.

Any work that has been done before is needed to be redone, the need for sidewalks is a true necessity in the Near North Side community. A lot of the people who reside in these streets and homes can't afford their own personal motorized transportation, so they are forced to walk from point A to point B. They do well until the time of the day that automobile traffic reaches its peak. Monies had been spent to fortify the sidewalks in these neighborhoods.

A federal law, the Americans with Disabilities Act (ADA), requires most businesses and facilities to provide reasonable access and accommodation for all disabled customers, clients, and members of the public. The ADA applies to almost all businesses that are open to the public, regardless of their size. The students conducting the surveys ventured into the neighborhood in order to know how these residents felt about not having usable sidewalks, and they were met with quiet disdain. Figure 3 shows an uneven driveway.



**Fig 3.** Uneven section of sidewalk is un-passable for some elderly and those that are wheel-chair bound

They talked with a lady, whom we will mention as Sue, in order to protect her privacy. Sue told them that she was raped by two men after tripping and falling on the broken sidewalk while trying to evade her attackers. The students were later told not to be caught outside once the sun went down because the crime rate goes up. The aforementioned situation is only one of the drawbacks of not having useable sidewalks. People who were wheelchair-bound were stuck and caught in a downpour of rain because of the lack of sidewalks. There was one mail carrier who was tripped and busted his knee-cap while walking on a banged-up sidewalk.

Then there are newly turned alcoholic people who need to travel over those.

Some people residing in the Near North Side community mentioned to the students that sometimes they were held hostage by fear and low morale. The fear of walking from point A to point B in the streets. A feeling of being used for target practice by anyone with access to an automobile. Figures 4, 5, 6, and 7 showing more sidewalks problems.



**Fig 4.** This picture is very common on the Near North Side. These items are blocking sidewalks. Its location is a short distance on Morris St. and Fulton



**Fig 5.** This curb is covered over by mud. Which makes it unusable for some. Able body occupants should take the time out to try and keep this and other curbs clear of trash and mud.



*Fig 6.* A path made of dirt. When it gets rain it accumulates mud.



*Fig 7.* Some of the streets of the NNS contain iron horse, which is blocking the sidewalks



**Fig 8.** Clearing ground to install new sidewalks.

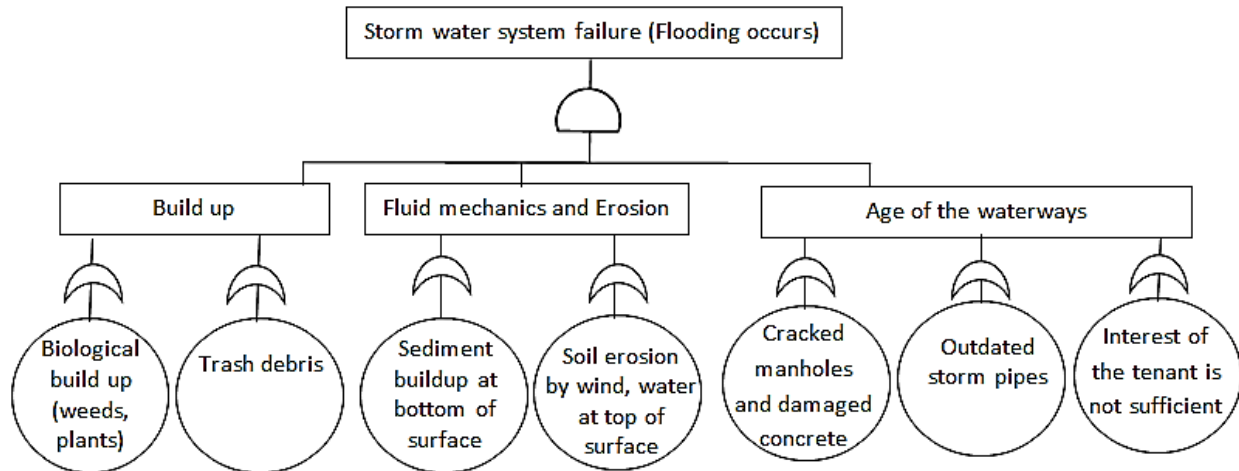
There have been slow progress on cleaning sidewalks and making new sidewalks, as shown in Figure 8.

For comparison purposes, Houston downtown which is considered a very rich and developed city does not have these kind of infrastructure problems related to sidewalks.

#### **Storm Water Protection:**

The force of water at the bayous is very strong in NNS and has observable changes to the streams and

waterways. Houston and the nearby cities and neighborhoods have too many bayous which run to reservoirs and dams. The force of water depends on the average area, the stream length, and the coefficient of friction for the bottom of the stream touching the surface, the time traveled, etc. Figure 9 shows FTA analysis basic and intermediate events that lead to the final event of stormwater system failure which causes flooding in NNS as a Flow Chart.



*Fig 9.* FTA analysis of storm water system

If one navigates through the various communities within the Near Northside area, the lack of proper stormwater infrastructure is apparent. The budget for the Storm Water Fund assesses the needs of many of the affected areas to prevent flooding. Many

neighborhoods had drains and ditches that could not sustain an increased flow due to debris or sediment buildup. Figure-10 shows a drain system is stuck by weeds, plants, and debris, etc.



*Fig 10.* Plants, weeds, and debris over drainage

This type of buildup would cause the flow of water to halt or even clog the drains that empty out into the reservoirs. On top of the already existing problems, this will strain the pipes if much of the trash is built up at the drain entrance. All the ditches have some sort of flow line that is gradual in order to reach the drains. The surveying students also noticed that many of the ditches were filled with sediments and trash that would

disrupt the flow line. The other obvious infrastructure deficiency is the age of the waterways structural integrity. There are many cracked and collapsing manholes and damaged concrete casting. This is not safe for the public and can lead to other costly repairs in larger storm drains. Figure 11 is showing a hole in a block of concrete that can cause damage to the nearby bridge.





*Figure 11.* Holes on concrete

There are two main areas that showed the greatest need for repair. The first one was the area of White Oak Bayou at North Street and Main. This area has deep erosion by the sides of the bayou which is not stable during higher levels of runoff water. If the walls of the waterway erode, this will affect the flow line due to the accumulation of sediment during the flow of water. During an emergency or sudden flooding, an inflow of excessive water would lead to water retention. This is how the whole communities got trapped due to the record rainfall of Hurricane Harvey (57.8 inches). Many Near Northside residents can recount the days with flooded streets due to the outdated storm pipes and funneling of water into inadequate drains which failed to support the most recent trends in sudden flood formations.

The second area is located at Elysian and Collingsworth Street. It has a bottleneck effect in draining the surface runoff water. This area does not contribute much to the taxes that in turn lead to the maintenance and repair of stormwater infrastructure.

The residents of these communities live mostly below the poverty line which is treated with an “out of sight, out of mind” mentality.

These neighborhoods have outdated ditch systems with narrow concrete pipes that lead to even smaller drains. This bottlenecking put lots of pressure on the drain systems and waterways. Under this enormous pressure and the eroding factor, the infrastructure is constantly under siege whenever there are huge amounts of rain. Many residents here were renting and did not own their homes. This leads surveying students to conclude that the interest of the tenant is not sufficient to improve the ditch conditions even in their own stretch of property.

There are many factors to consider when tasked with infrastructure projects. Due to many barriers in processing the funding for such construction projects, it is important to have priority in the list of repair or maintenance of these draining systems. If you take away all the factors that could affect a draining system (causal factors), disruption to the flow of water is primal to the function of these systems designed to

carry surface water out to sea. Equally important is the innovation or repair of the existing drains. Many of the

current infrastructures have huge gaps due to erosion. Figure 12 shows erosion of the drainage system.



**Figure 12.** Erosion of the drainage system

To address the impasse of water, one must look onto the various ways these waterways get stopped up. These areas do not have priority to funding for improvement projects, as a result, much of the trash and tree debris end up altering the flow line for water to drain. At first, there is sediment build-up, which allows an obstacle for trash to collect, grass, and plants to germinate, ultimately creating an impasse. Many of

these waterways are left with huge repairs needed but due to the bid process to contract these remedy projects. After reaching out to the community members for information regarding the frequency of maintenance, it was found that many had never seen crews who did anything other than cut the grass every six months. Figure 13 shows grass and weeds grow near waterways.



**Fig 13.** Grass and weeds grow around the year and very less time the grass is cut

The issue of outdated infrastructure can be observed along the white oak bayou that runs along North Street. Lots of stretch of this waterway is yet to see any rebuilding of its walls. Erosion is always at work whether it is from the wind or from the flow of water. When the community was asked, they sighted negligence from the city to correct the conditions of these waterways. Again the causal factors not only include deficiencies but limited resources allocated to the area resulting from minimal tax paid for their repair.

The limited access to the reasoning or delays for such remedy projects to the Near Northside area can have many braches as to why no real improvement existed before and after Hurricane Harvey in 2017. The agency that is responsible for the waterways is the Harris County Flood Control District (HCFCD). They are the group that surveys the conditions to propose the maintenance log accuracy, in order to develop a budget for each fiscal year. With no real influx of tax revenue from the community, the city has to subsidize much of the budget or push it into a future fiscal budget, which is uncertain to get the funding. Those factors can be considered but often are not reliable because of the uncertainty of receiving funds for those projects. What can be changed is the bid process for contracting these infrastructure programs. The city could reach out to the community for contractors that in turn would offer competitive rates in the bidding of contracts.

The city has recently passed bayou beautification programs that use criminal community service or inmate participation, as a way to reduce the amount of trash that can obstruct the flow of water. These types of programs could certainly help the Near Northside area. To address the buildup along ditches, the city could incentivize their clean-up. This could be in the form of a tax cut or credit. Assuming the funding was approved, regular maintenance for erosion could improve the effectiveness of the draining systems. Upon approval, newer larger drains for stormwater could be integrated at strategic points to alleviate the pressure of the flow of water, one of the greatest stressors to the systems. By installing larger draining ducts, the flow of water will greatly increase, so the incorporation of water reservoirs might help reduce or slow the rate of the water that passes through these drain systems.

There exists a need to understand the infrastructure deficiencies that currently are apparent within the community of Near Northside. A conglomerate of issues exists, from demographics to location. Identification of the problems will include community outreach, and interviewing the residents about the conditions of the affected areas. The analysis includes the reduction of the identifiable issues. Many of the remedies are out of the control of the residents and may have to wait until the area receives more development and affluence.

For comparison purposes, Houston downtown which is considered a very rich and developed city does not have these kind of infrastructure problems related to storm water.

### **Poor Lighting, Lack of Security, Crowds of People Soliciting in Front of Businesses:**

For this work, the students chose to conduct a survey over few streets in the third ward area of Houston to understand better why crime continues to thrive in this particular area of Houston. The students chose the third ward near streets such as Emancipation, Lockwood, and Cullen for survey purposes because they have noticed the adjacent share some common factors. First of all, there are always dark streets, blind spots, and poor lighting around the neighborhood. Secondly, the students have noticed a lack of security overnight and less police presence resulting in higher crime rates, homeless camping around the area, and crowds of people soliciting in front of businesses. The students believe all of these factors contribute to the increased crime rate and lower moral value of the neighborhood as a whole.

The Third Ward is an area of Houston, Texas, United States that evolved from one of the six historic wards of the same name. It is located in the southeast Houston management district. Additionally, the third ward area located inside the 610 Loop is immediately southeast of Downtown Houston and to the east of the Texas Medical Center. Over the years the ward became the center of Houston's African American community. The Third Ward area is also nicknamed "The Tre".

For surveying, the students choose to personally drive around the third ward area of Houston for about thirty

minutes on three occasions to visually scope the area. The students used their cellphones, cars, cameras, and GPS to perform the survey.

These surveying works were important because the students have always heard bad reports about the areas and surveying helped them to look at the factors that might have contributed to the increased crime rate in the area.

The surveying students were able to note a few different concerns such as the poor lighting on the streets and in the parking lots. They also noticed that the lack of police presence around the area was an important issue that hampered safety. There were people soliciting in front of the business establishments. Individual security measures for these properties could also help to reduce crime in the area. Thirdly, the students noticed a lot of run-down buildings old scraps off buildings scattered around the area, street signs that have fallen down and could cause slips trips, and falls. Finally, the students would have liked to see more neighborhood watch signs or signs reminding people to lock their car door after they exit the vehicle.

When considering the overall safety of the people of the third ward area the students had to keep in mind, how much lighting the streets offer to the residents. Investing in more lighting sources on the streets and in the parking lots will be helpful to eliminate the number of car break-ins that occur every day in the area. Poor lighting could also lead to other crimes in the area such as rape, assault, and drug-related crimes. It is an evident need to add adequate lighting for the streets and the parking lots in the third ward area to increase the overall safety.

Furthermore, in these areas, there are too many vacant buildings and establishments that have closed but never been properly demolished in the third ward area. These areas often create a hazard to residents due to the criminal activities taking place inside these places as well as slips, trips, and falls (STF) near the building people routinely access. Brainstorming on ways to improve the safety in the third ward recommends these areas to be cleaned up immediately for safety concerns.

Additionally, the Buffalo Bayou flows around the third ward area, and in some areas of the third ward, neighborhoods are still at risk for flooding due to the design of their homes in relevance to the bayou. To protect the great people of "THE TRE" a bigger emphasis should be put on flood control around these areas. A lot of the areas in the third ward that were restored after Hurricane Harvey faced the same problem. Additional safety measures were never taken after the rebuild, so there are risks of a flood if another hurricane approaches.

Advancements and updates are necessary to make this area safer ultimately. All these factors together contribute to injuries and crime. From a safety point of view, all of these factors such as shortage of lighting, lack of security, and police force are just a few of the reasons the third ward area holds its reputation as "ghetto 'or the " hood". Figures 14, 15, 16, and 17 show that the roads have no paint or the paint has disappeared over the years- this may lead to traffic accidents. These roads need paints for better markings and safer traffic.



Fig 14. Some of the roads do not have paints or traffic signs



**Fig 15.** Traffic signs are damaged.



**Fig 16.** No paints on the road



**Fig 17.** No paints on the road and roads need repair works

Some measures can be taken in order to improve the present situation of the Near Northside area neighborhood such as improving the poor lighting with additional light posts, an increased to the police presence in the area, remodeling and renovating the area. More security to the individual property can be

added by installing surveying cameras, appointing security personnel, and more police patrol around this area. These could slow down the rate of crime. The law enforcement in this area needs to make it clear that prosecute crime and is always patrolling in an effort to clean up crime. Therefore, investing money to

improve lighting around the gas stations, the streets, businesses, adding more patrol, and security for private property.

For comparison purposes, Houston downtown which is considered a very rich and developed city does not have these kinds of infrastructure problems related to poor lighting, lack of security, crowds of people soliciting in front of businesses, etc.

## CONCLUSION AND CHALLENGES

The survey has been conducted in a neighborhood near to the university. Fault Tree Analysis (FTA) is conducted for two different types of infrastructure in NNS to find out possible reasons for different infrastructure problems. The survey results revealed so many items not updated or might have become old. Modernized systems will be needed to update those listed infrastructure problems. The City and the community people need to address those above-listed items as early as possible. Driving in those neighborhoods and taking pictures were challenging due to the facts discussed previously. Civil engineering especially structural analysis and cost estimation is needed to overhaul the entire neighborhoods.

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