

**SUSTAINABLE HORIZONS: EXPLORING DESIGN INITIATIVES TO SHAPE
VIBRANT COLLEGE TOWN, GREENVILLE, NC.**

by

Oasis Lopez

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Oasis Lopez

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Approved by:

Dr. M. M. Lekhon Alam

ECU College of Engineering & Technology, Department of Technology Systems

Sustainable Design and Its Impact on Cities

Oasis Lopez

East Carolina University

Faculty Mentor: Dr. M. M. Lekhon Alam

East Carolina University

ABSTRACT

This project explores the balance between architectural innovation and ecological consciousness. Sustainable design revolves around many professionals working towards solutions that are environmentally responsible, economically viable, and socially equitable. The goal of sustainable design is to meet all the needs of the present generations, without compromising the ability of future generations of meeting their own needs. We will learn the significance of sustainable design in urban environments and its profound impact on communities and the environment. The benefits can be categorized into three areas; quality of life, health and wellbeing. With sustainable design, there is an increase in job satisfaction, health, and productivity. Improved traffic with less congestion, pleasant commutes, and alternate modes of transport. Building and construction methods that incorporate green design create less waste, use less energy, and less water consumption. In turn, this would reduce the need for more landfills, more energy plants, water treatment plants, and fossil fuel pipelines. The utility buildings we already have would also be more efficient with sustainable design. Through a combination of real-world examples and case studies, we delve into the advantages and

challenges associated with implementing sustainable design principles in urban planning and design decisions. This journey toward a more sustainable future takes us from green cities like Freiburg, towards a closer examination of Greenville's BUILD Projects (at least two sections of West 5th Street Streetscape, and Town Common Connector Street Section, Greenville, NC). Greenville is the home of East Carolina University, the third largest university in North Carolina state (~28,718 enrollment), and the sites in the Uptown district were selected carefully within the recreational hub, considering the most frequent movements of the massive, diverse student population. This qualitative research studies Jane Jacobs's masterpiece, "The Death and Life of Great American Cities," to create analysis rubrics, features, and the necessary criteria to conduct more in-depth assessments. Researchers also discuss some of the key features of city planning and sustainable design from the selected case studies, highlighting the importance of urban form, diversity in neighborhoods, importance of Mixed-Use developments, green infrastructure, and renewable energy. Ultimately, the study concludes that simultaneous cultural, contextual, and technological interpretations can potentially suggest more sustainable urban settings for a community, offering many benefits for the environment, society, and the economy.

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INTRODUCTION

Sustainability is a concept that has gained increasing significance in recent years, and for good reason. Sustainability refers to the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable design is a way of thinking about the design and development of buildings, cities, and products, with an eye toward minimizing their impact on the environment and creating healthier, more livable spaces. It involves using resources efficiently, reducing waste and pollution, and prioritizing the well-being of people, communities, and the planet. Jane Jacobs' seminal work "The Death and Life of Great American Cities," published in 1961, was a groundbreaking critique of urban planning and a passionate defense of the vitality and diversity of city life. Throughout this paper, we will be referencing the points she makes towards what makes cities successful or vice versa, failures.

Today's world is an especially important time to work towards sustainability. We are starting to feel the more extreme consequences of our neglect. The impacts of rapid unsustainable urbanization are water stress, scarcity, and consumption, sanitation, wastewater, water pollution, greenhouse gases (GHGs) emissions, air pollution, noise pollution, cultivated land depleted, urban sprawl, hazardous wastes, destruction of habitats, high energy consumption, traffic congestion, soil pollution, and deforestation (*Abdulkarim Hasan Rashed*, 2023). In a UN report called "The Weight of Cities: resources requirements of future urbanization," they reported that in 2010 the material consumption of global cities was 40 billion tonnes, and by 2050 it will increase to nearly 90 billion tonnes where the resource consumption per capita is

estimated 8 to 17 tonnes in 2050 (*Abdulkarim Hasan Rashed, 2023*). We are constantly using our planet's resources. There are many companies and organizations that are striving to be more sustainable. Tesla is a leader in sustainable transportation. Manufacturing electric vehicles (EVs) and promoting clean energy solutions. The Nature Conservancy is a nonprofit organization that works to protect natural habitats and address global environmental challenges. They collaborate with various partners, including businesses, to advance sustainability and conservation efforts. There are many more examples, however, even with these efforts there is still much work to be done. Every year the world's population increases. In 1950 the proportion of the world population living in urban areas was 30%. In 2018 that proportion increased to 55%. By 2050 the projected increase is 68%. Our footprint increases every year, this makes sustainability even more critical.

Understanding Jane Jacobs' Concept of City Development

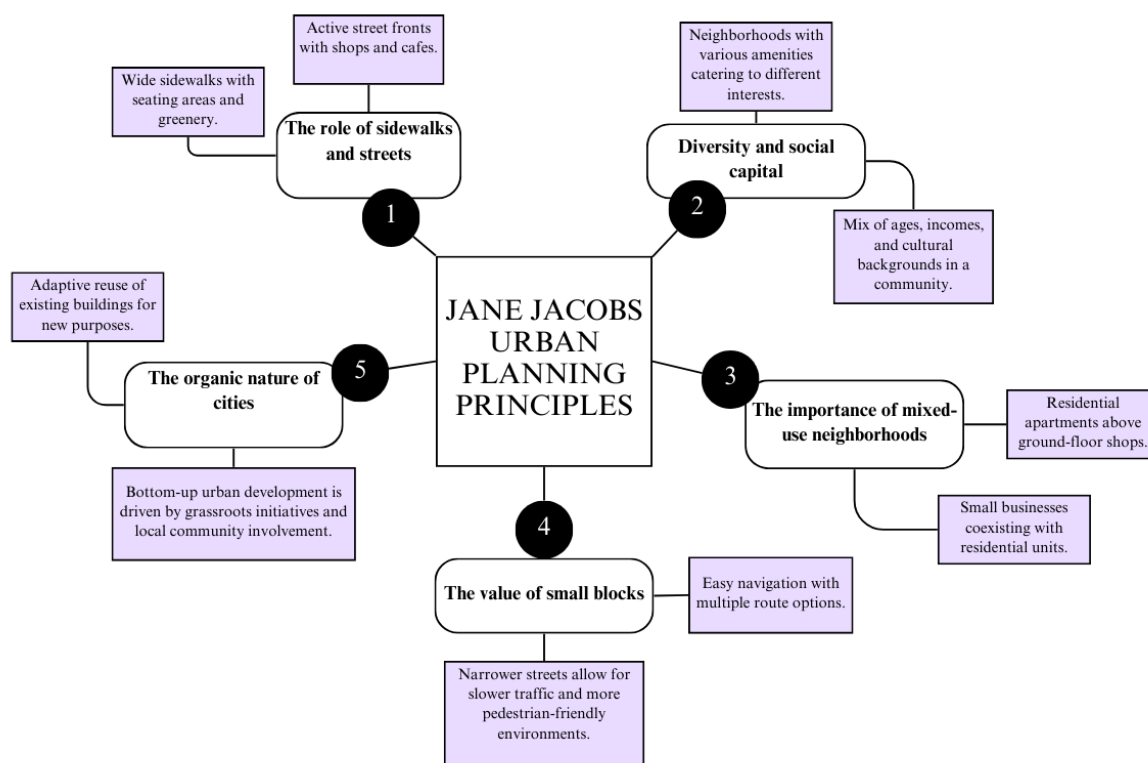


Figure 1.1 Jane Jacobs Urban Planning Principles

Incorporating Jane Jacobs' methodology in, "*The Death and Life of Great American Cities*" into my research paper regarding "sustainable design and its impacts on cities" represents a pivotal step in clarifying the intricate relationship between urban development, community resilience, and environmental stewardship in our modern-day era. Jacobs' book provides many insights into the dynamics of city life, which were gained through her observations in urban neighborhoods. "*The Death and Life of Great American Cities*" will serve as a foundation for this paper. By delving into her work, I aim to apply the key principles that underlie the success of great American cities to contemporary urban planning and sustainability efforts.

Central to her vision is the concept of mixed-use neighborhoods, where residential, commercial, and industrial activities coexist harmoniously. Jacobs argued that such diverse land uses create dynamic urban environments that not only foster economic vitality but also facilitate social interaction. These mixed-use neighborhoods are the stage upon which her other ideas come to life. Jacobs highlights the role of sidewalks and streets as essential public spaces in these mixed-use neighborhoods. She stressed the importance of well-designed streets that invite people from various backgrounds to engage in spontaneous social interactions. Safe and active streets, in her view, were pivotal for building strong communities, with "eyes on the street" becoming a cornerstone of her philosophy. Jacobs believed that populated streets, bustling with a mix of people and activities, enhanced safety and engendered a sense of community, as residents naturally watched over public spaces.

Jacobs' critique of urban renewal policies further reinforces her argument for mixed-use neighborhoods. She pointed out that top-down planning approaches often disregarded the organic growth of cities, leading to the destruction of historic neighborhoods and the displacement of

low-income residents. Her advocacy for small city blocks dovetails with this, as smaller blocks, encouraging multiple routes and increased foot traffic, create a stronger sense of place and community compared to large, monotonous blocks that discourage pedestrian activity. In line with her emphasis on diverse communities, Jacobs celebrated the role of small, local businesses in creating vibrant neighborhoods, seeing them as integral components of the urban fabric. Her perspective on cities as complex, self-organizing systems resonates with her call for urban planners to work with the natural order of cities, rather than imposing rigid plans from above.

Furthermore, Jane Jacobs' vision reinforces the need for citizen engagement in urban planning. She believed that those who lived in and used the city were best equipped to shape its future. Engaging citizens in the planning and decision-making processes not only empowers them but also fosters a greater sense of community ownership. Diversity and social capital complement her broader vision. She contended that diverse communities, encompassing individuals from different backgrounds, income levels, and age groups, are not only more socially rich but also more resilient. Her celebration of the "mosaic of subcultures" within cities underscores the idea that embracing and nurturing many unique subcultures enriches the urban experience, contributing to the vibrance of city life.

Jacobs' has 10 main points, however, our study has narrowed down to explain the five highlighted points above.

- The importance of mixed-use neighborhoods
- The role of sidewalks and streets
- The value of small blocks
- The organic nature of cities

- Diversity and social capital

Lesson learned from different case studies around the world

Freiburg, a city in Germany, serves as a great example of Jane Jacobs' points and embodies many of the ideas she advocated in "The Death and Life of Great American Cities." The city's design reflects a commitment to sustainability, community engagement, mixed land uses, and the celebration of diverse subcultures.

Freiburg is renowned for its mixed-use neighborhoods, where residential areas blend seamlessly with commercial and industrial spaces. This balanced land use encourages a dynamic and vibrant urban environment, reducing the need for long commutes and promoting economic vitality. This approach aligns with Jacobs' vision of mixed-use neighborhoods as hubs of social interaction and economic activity.

Freiburg's well-designed streets and pedestrian-friendly infrastructure are integral to its success. The city's extensive network of bike lanes, wide sidewalks, and green spaces has created an environment where people from various backgrounds come into contact and engage in spontaneous social interactions. "When moving into Vauban (southern district in Freiburg), 57% of the households that previously owned a car decided to let their car go. All in all, 70% of the inhabitants live without a car in Vauban," Abellard reports (*smartcitiesdive*, 2017). Mirroring Jacobs' emphasis on active and safe streets as the foundation of strong communities.

Freiburg's streets are populated with a diverse mix of people and activities. This "eyes on the street" concept contributes to the city's overall safety and sense of community, as residents

actively participate in the daily life of their neighborhoods. Like many suburban neighborhoods in the USA which participate in neighborhood watches.

Unlike many cities that embraced destructive urban renewal policies, Freiburg took a more holistic approach to development. It avoided the destruction of historic neighborhoods and displacement of low-income residents, which Jacobs vehemently criticized. Vauban, Freiburg was developed from a squatted community that did not want to be removed by developers, who took the future into their own hands (*smartcitiesdive*, 2017). Freiburg's planning prioritizes preservation, working with the existing urban fabric rather than imposing top-down redevelopment. Changes come from the bottom up via grassroots activism which then causes change at the top in legislation and planning.

Freiburg's city layout incorporates smaller blocks and a pedestrian-friendly design, encouraging people to explore the city on foot or by bike. Freiburg's citizens are known for their love of cycling, with over 400 km of cycle paths, separate bike paths, and over 9,000 bicycle parking spaces (*smartcitiesdive*, 2017). Pedestrian and bicycle paths form a highly connected, efficient, green transportation network with every home within walking distance of a tram stop, and all schools, businesses, and shopping centers located within walking distance (*smartcitiesdive*, 2017). This smaller block structure fosters a stronger sense of place and community, keeping in line with Jacobs' vision of urban environments promoting pedestrian activity and community engagement.

Freiburg places a significant emphasis on local businesses, and the city's commitment to supporting small, local enterprises aligns with Jacobs' belief that these businesses provide essential services and contribute to the unique character of a neighborhood. Shops and offices are

on the ground floor of apartment buildings. This allows for easier access to residents' needs. This approach supports economic sustainability and community cohesion.

Freiburg's urban planning reflects an understanding of cities as self-organizing systems. The city respects and works with the natural order of its environment, integrating green spaces, sustainable transportation, and environmental conservation into its planning. There are 5,000 hectares of forestry surrounding the town. The forestry is managed sustainably and organically with certification from the Forest Stewardship Council. The city contains over 600 hectares of parks and 160 playgrounds providing greenery, recreation, and biodiversity (*smartcitiesdive*, 2017). On the outskirts of the city, there are small privately owned garden strips where the residents can grow their own food.

Freiburg is known for actively involving its citizens in the urban planning process. Two residents named Michael Gies and Jörg Lange came up with the idea of a peoples' forum. The forum would make sure the residents would be able to have their opinions heard and play a part in determining their future. This participatory approach allows residents to shape the city's future. Keeping with Jacobs' advocacy for greater citizen participation in urban planning and decision-making processes.

Freiburg's diverse and inclusive community is a testament to the value of diversity and social capital. The city's ability to accommodate people from different backgrounds, income levels, and age groups enhances its resilience and social richness. Reflecting that diverse communities are more vibrant and sustainable.

Freiburg is celebrated for its vibrant and diverse cultural scene. By nurturing and celebrating various subcultures, the city thrives and fosters a strong sense of identity, in

accordance with Jacobs' idea that cities prosper when they embrace a multitude of unique subcultures, each contributing to the urban tapestry. In sum, Freiburg's urban design and planning are a testament to the enduring relevance of Jane Jacobs' ideas. The city's successful model demonstrates how Jacobs' principles can be translated into real-world urban development. Ultimately contributing to a more sustainable and livable city.

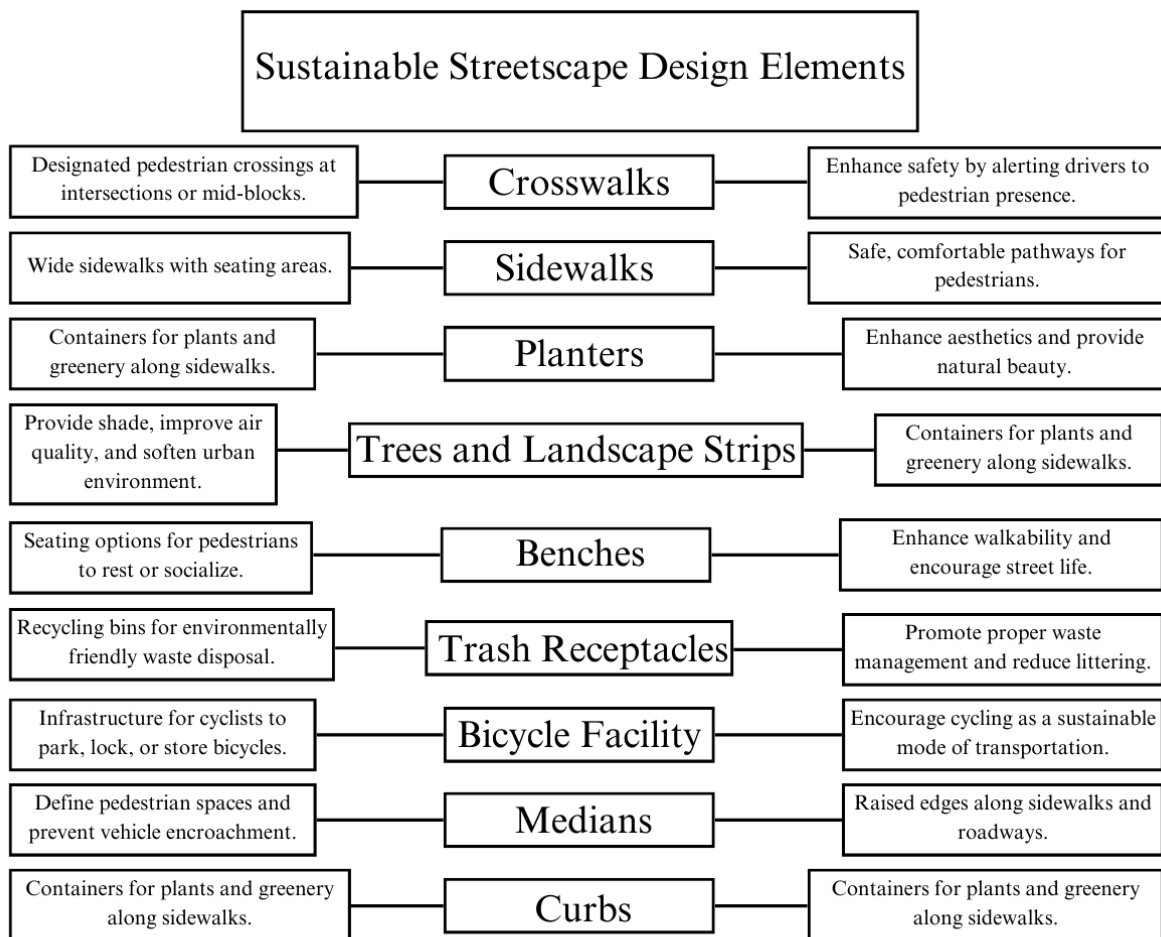


Figure 1.2 Sustainable Streetscape Design Elements

Greenville's B.U.I.L.D Project (Better Utilizing Investments to Leverage Development):

The BUILD Project is comprised of four greenway and sidewalk projects and three streetscape projects (*BUILD Project / Greenville, NC, 2019*)

Streetscape Improvements:

Figure 2.1 Project C — West 5th Street Streetscape Phase II



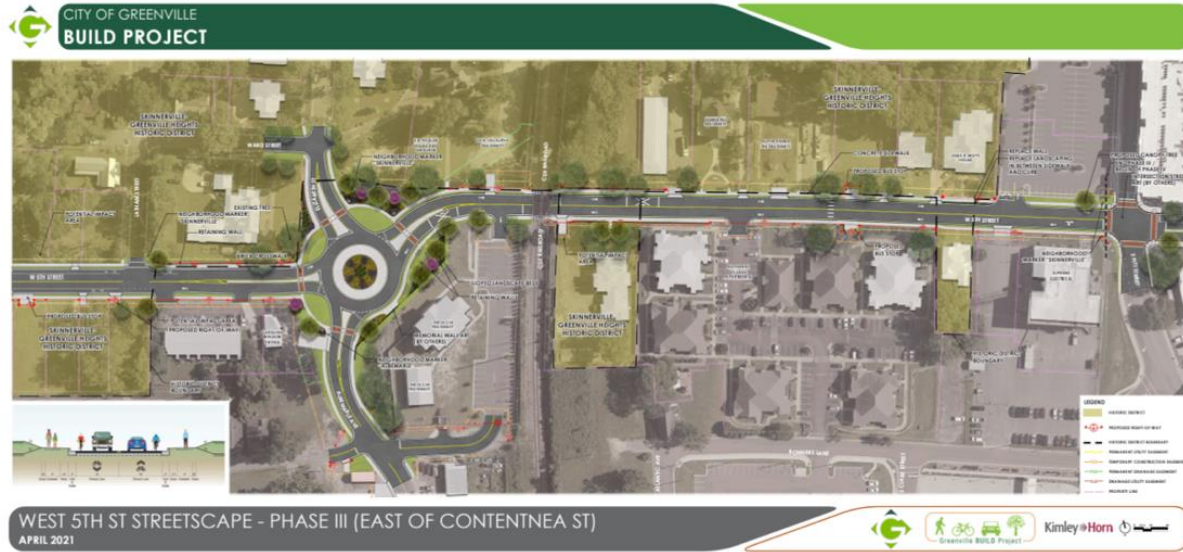


Figure 2.2 Project D — West 5th Street Streetscape Phase III

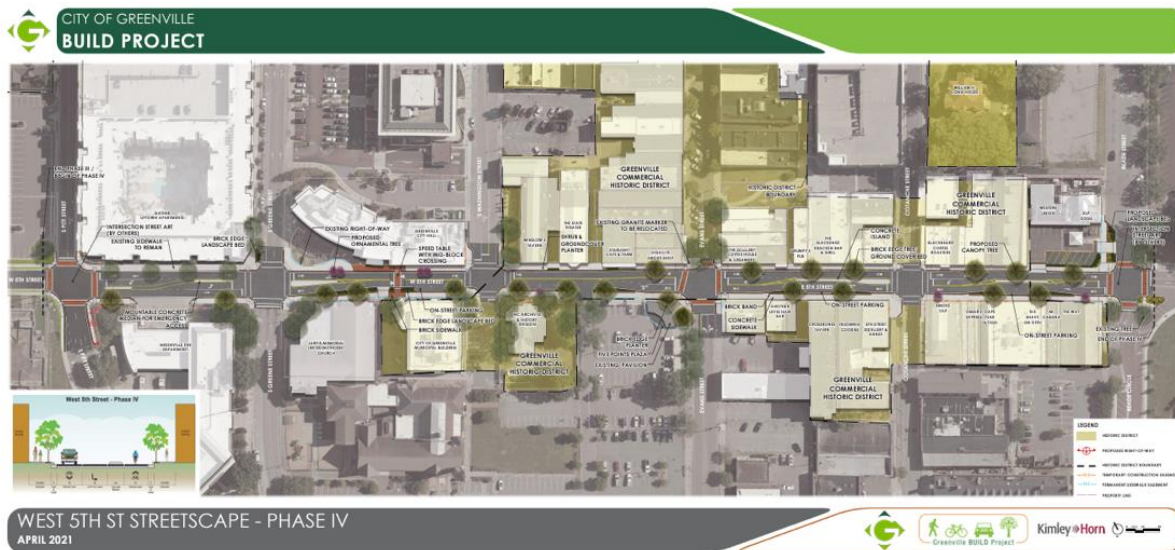


Figure 2.3 Project E — West 5th Street Streetscape Phase IV

Greenway and Sidewalk Improvements:



Figure 2.4 Project G — Town Common Connector



Figure 2.5 Greenville Greenways

Why is Greenville emphasizing greenway development and expansion?

Greenways play a crucial role in reshaping urban environments and promoting sustainability. Greenways are akin to linear parks. These pathways are filled with greenery and designed for both recreational and ecological purposes. Greenways have become an integral component of sustainable urban planning (*Chin & Kupfer, 2020*). As we delve into the multifaceted benefits of greenways through quantifiable aspects of greenways, examining empirical data and figures. We will be able to see just how much they contribute to creating more sustainable and livable cities (*Greenways, Inc. - Benefits of Greenways, 2023*).

Greenways are often considered urban lungs and have been quantifiably proven to enhance biodiversity, improve air quality, and contribute to carbon sequestration. Studies show a 20% increase in biodiversity along greenways, acting as ecological corridors (*Urban Greenways and Biodiversity: A Comprehensive Analysis, 2019*). Urban areas with well-established greenway networks experience a 15% reduction in particulate matter concentration (*EPA Green Infrastructure Report, 2020*). The carbon sequestration potential (process of storing carbon in a carbon pool) is substantial, with urban greenways sequestering an average of 50 metric tons of carbon per hectare annually (*Quantifying the Carbon Sequestration Potential of Urban Green Spaces, 2018*). The additional Greenville greenway developments would be about 1.5 miles. We can estimate that a 10' wide greenway with moderate tree density and a mix of vegetation could sequester approximately 6,096 pounds (3.05 metric tons) of carbon dioxide per year.

Greenways not only provide environmental benefits. They also influence the health and well-being of urban residents. The correlation between greenway proximity and reduced stress-related illnesses is evident. A longitudinal study reported a 25% decrease over five years (*Longitudinal Health Impact Assessment of Urban Greenway Development, 2021*). Furthermore,

well-connected greenway networks foster a sense of community, as seen in a study reporting a 30% increase in social interactions and community engagement (*Quantifying Social Connectivity: A Comparative Analysis of Greenway Networks*, 2019).

Greenways assist in the economic department as well. According to a real estate analysis, properties near greenways experience an average increase of 10% in market value (*The Impact of Greenways on Urban Property Values*, 2018). Additionally, there are economic impacts related to tourism and local businesses, with cities reporting a 20% increase in tourist spending and a 15% boost in revenue for businesses along greenway routes (*Greenways and Economic Development: A Case Study Analysis*, 2019).

Greenways have effects on walking and cycling journeys and are essential in encouraging sustainable mobility. According to a transportation study, communities with interconnected greenway networks saw a 25% increase in these alternate forms of transportation, which resulted in a 10% decrease in total traffic congestion (*Sustainable Transportation Impacts of Urban Greenway Networks*, 2021).

Greenways represent a realistic solution to the challenges posed by urbanization. Their environmental, social, and economic benefits, bolstered by the previous data, make a compelling case for their integration into urban planning strategies. The data speak volumes, reinforcing the idea that greenways are not just recreational spaces but valued components for building resilient, healthy, and economically vibrant urban spaces.

Sustainable streetscape design paves the way for green urban development

In our era of rapid urbanization and climate change, the design of urban spaces has become critical in shaping sustainable and resilient cities. A major component in this design is

the streetscape. “Streetscape is used to describe the natural and built fabric of the street and defined as the design quality of the street and its visual effect, particularly how the paved area is laid out and treated. It includes buildings, the street surface, and the fixtures and fittings that facilitate its use— from bus shelters and signage to planting schemes (Sustainable streetscape as an effective tool in sustainable urban design, Rehan, 2013)”

Streetscape elements are often overlooked in day-to-day life. Rehan states in his article that there are 16 elements of sustainable streetscape. However, in this paper I will focus on 9.

Components of sustainable streetscape

- Sidewalks
- Planters
- Trees/Landscape strips
- Benches
- Trash receptacles
- Bicycle facilities
- Medians
- Curbs
- Crosswalks

Sidewalks are designed to give pedestrians a safe, comfortable, and attractive space to get around on. Paving material plays an important role in sidewalks. Using high albedo pavement material helps to reflect more sunlight than low albedo. Using photocatalytic cement allows the cement to remove air pollutants, providing clean air in our cities. The use of permeable pavement allows rainwater to seep through its surface, facilitating natural groundwater recharge. This

process minimizes surface runoff to prevent water accumulation on the surface that could otherwise lead to flooding.

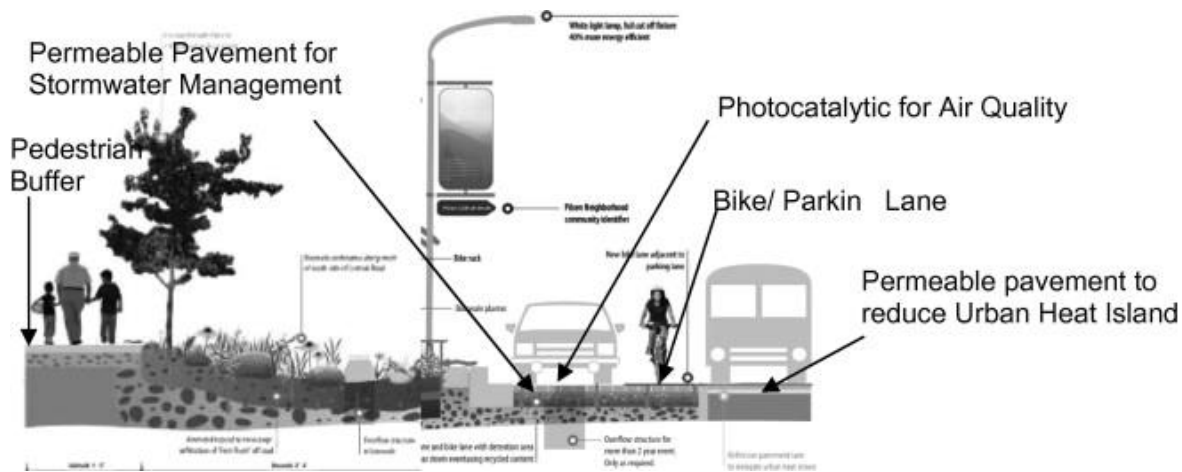


Figure 3 Chicago's Sustainable Streets Pilot Projects

Plants promote biodiversity, especially trees that act as canopies. Trees have a visual character to them while maintaining an esthetically attractive look. The shade provided by canopy trees during spring and summer helps to keep the sidewalks cool and minimize the negative impact of the street on climatic change. “Planting trees reduces the urban heat island effect by shading sunlight from hard surfaces (Omaha, 2008)”. Shade also allows for more walkability. Having shade where there is high pedestrian activity can give people rest from the heat.

Planters add a splash of life to the streetscape. They add color, aroma, and greenery to the sidewalk. Planters act as natural rain gardens, absorbing and filtering rainwater runoff from sidewalks and streets. Planters provide habitat and food sources for birds, insects, and other wildlife. They create green corridors and stepping-stones for wildlife movement in otherwise

built-up environments. We are constantly finding ourselves sharing more space with wildlife, it is important to consider them in our designs.

Medians act as a tool to make streetscape safer and more usable for pedestrians. Medians have three main functions according to Rehan. The first function is to provide a divide for vehicles. It separates traffic going in opposite directions to avoid accidents. They also give you space to plant trees or other vegetation. Lastly, they give pedestrians a place to stop when crossing a road.

Resting areas allow for more circulation. Utilizing public transportation is a method to be greener. Pedestrians are encouraged to use these resources when they have a place to sit, and that is also out of the elements. “The purpose of seating is for waiting and resting and areas along walkways provide welcome relief to pedestrians, and a place to sit together, interact, and observe (Otak Inc).” Having a bench and bus shelter next to the bus stop will greatly increase the number of people using the bus and other public transit. These bus shelters could have a green roof atop to be more sustainable.

Pedestrians need protection when they are walking and crossing streets. Curbs are overlooked but they help in this regard by acting as a barrier to prevent vehicles from riding upon to the sidewalk. Crosswalks are also there for pedestrian safety. Crosswalks designate a safe place to cross the street. Utilizing other streetscape elements can enhance the visibility of crosswalks and make motorists more aware of pedestrians.

You can find trash everywhere. That is why trash receptacles are so important. Placing them in strategic spots helps reduce pollution and littering. They should conveniently be located

for pedestrian traffic near benches, bus stops, and other activity nodes. When people are waiting, talking and eating, then they can throw away their trash.

Other common modes of ecofriendly transportation are bicycles. Bike lanes, racks, and other facilities encourage people to choose biking over driving. Biking is an excellent form of exercise, and having bike facilities encourages people to engage in physical activity, leading to better public health. A major complaint of major cities is traffic congestion. Bikes alleviate traffic congestion, leading to smoother traffic flow and reduced travel times for both cyclists and motorists (*American Planning Association*, n.d.). Incorporating facilities to house bikes, scooters and other transportation methods into the streetscape has a major role in green streetscape.

Greenville Projects Breakdown



Figure 4.1 Project G — Town Common Connector

The Town Common Connector project will construct a new, approximately 0.4-mile long, 10-foot-wide paved greenway from East 1st Street to East 5th Street. This will connect the Town Common Park to the East Carolina University campus and downtown. There will be a

timber boardwalk approximately 300 feet from 1st Street leading to 3rd Street. Any of the existing pavement will be replaced and widened to meet the 10 feet width. Canopy trees and bushes will be placed alongside the greenway. The city of Greenville is adding improvements for safer pedestrian crossings at 1st, 3rd, and 4th Streets. On 1st Street, the addition of a crosswalk and planter medians will greatly improve the safety of pedestrians coming to and from the Town Park. The city will also redesign the parking lot between 3rd and 4th Street. Allowing for more parking spaces while removing an existing exit driveway. The removed exit driveway will stem traffic flow allowing pedestrians safer crossing on the new crosswalk. A pavilion will be placed on 4th Street across from St. Pauls Episcopal Church. This project provides pedestrian and bicycle connectivity between the Town Common Park, the east side of downtown, the East Carolina University Downtown District, and East Carolina University Main Campus.



Figure 4.2 Sidewalk Improvement Image



Figure 4.3 Project E – West 5th Street Streetscape Phase IV

Phase IV of the West 5th Street Streetscape project includes roadway and streetscape improvements from South Pitt Street to Reade Circle/Street (0.3 miles). The city plans to widen the sidewalks, add brick crosswalks, site furnishings, and street trees. The existing on-street parking will be left as is. The crosswalks at the Evans Street, Pitt Street, and Reade Street/Reade Circle intersections will have brick accents. The accents will create a consistent visual to the streetscape at the Yugo Uptown apartment complex. The remaining crosswalks will be standard striped crosswalks. An existing crosswalk at the mid-block crossing will be replaced with a raised brick crosswalk to improve the safety of pedestrians. It will serve as a crossing and both a small speed bump. They will add new planters and landscaping accents to improve the street's appearance. A larger landscape bed will be placed on the street side of Sup Dogs, a popular chain for students to eat and hangout. The addition of concrete mediums helps drivers distinguish the correct lanes. The mediums will also create some protection from opposite oncoming traffic.

Future Suggestions

The BUILD project presents an opportunity for the city to not only enhance its infrastructure but also to integrate sustainable practices that can mitigate environmental impact, increase resilience, and improve overall quality of life for its residents. By drawing upon techniques and strategies observed in other cities and successful case studies, the BUILD project can be enriched with innovative solutions aimed at promoting sustainability. Here, we explore how permeable paving, native plant landscaping, LED lighting, and pedestrian safety measures can be integrated.

One of the focuses for the BUILD project is the construction of new sidewalks and street alterations. Introducing permeable paving can significantly enhance stormwater management. Traditional impermeable surfaces exacerbate stormwater runoff, leading to flooding and water pollution. Permeable paving allows rainwater to infiltrate into the ground, reducing runoff and relieving pressure on drainage systems. This approach not only improves water quality but also replenishes groundwater resources (*U.S. Geological Survey, 2020*).

The use of high albedo paving can mitigate the urban heat island effect. High albedo surfaces reflect more sunlight, reducing the absorption of heat and helping to maintain cooler temperatures in urban areas. This can lead to decreased energy consumption for cooling, thereby lowering greenhouse gas emissions and enhancing urban comfort.

Landscaping with native plants and flowers is another crucial aspect of sustainable urban development. Native plants are well-adapted to the local climate and soil conditions, requiring minimal irrigation, fertilizers, and pesticides (*GardenNP, 2020*). By prioritizing native species, the BUILD project can promote biodiversity, support local ecosystems, and reduce maintenance costs.

To sustainably irrigate these plants, utilizing gray water from existing underground piping systems is a smart solution. Gray water, which includes water from sinks, showers, and washing machines, can be collected, treated, and reused for irrigation purposes. This closed-loop system conserves freshwater resources while reducing the strain on municipal water supplies.

Using LED lights for the new greenway offers several advantages. LED lights are highly energy-efficient, consuming significantly less electricity than traditional lighting technologies. They also have a longer lifespan, reducing maintenance costs and waste (*Inspire Clean Energy*, 2024). Additionally, employing full cut-off fixtures helps to minimize light pollution. By directing light downward and preventing it from scattering upward, full cut-off fixtures reduce glare, enhance visibility, and preserve the darkness of the night sky. This creates a more pleasant and sustainable urban environment while protecting the habitats of nocturnal wildlife.

In addition to the new median and planters, I would recommend adding crossing lights on 1st Street. These lights provide visual cues to drivers, alerting them to pedestrian crossings in advance and prompting them to slow down. The visibility from either side of the street is not the clear. This change would make it safer for pedestrians and drivers.

Conclusion

In conclusion, the integration of sustainable techniques and strategies into the BUILD project is paramount for creating resilient, resource-efficient, and livable urban environments. Permeable paving, native plant landscaping, LED lighting, and pedestrian safety measures represent just a few of the many opportunities to enhance sustainability in urban development. By prioritizing these approaches, the city can build a better future for its residents while preserving the natural environment for generations to come.

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