A Research Proposal to Study Pedestrian Mobility in Newton, MA

Final Project Proposal

Sponsors:

League of Women Voters in Newton

City of Newton Planning and Development Department

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Abstract

The City of Newton, MA and Newton's League of Women Voters have sponsored this project for improving pedestrian mobility and access in four areas of Newton: Newton Centre, Newton Corner, Route 9 across from the Chestnut Hill Mall, and West Newton. The current conditions of these areas make access for some pedestrians, especially the elderly and disabled, difficult. We will use a Geographical Information Systems (GIS) map to visually identify obstacles at the four study areas of Newton. Then observations of pedestrians in Newton will help us identify pedestrian patterns which can help prioritize the obstacles from our GIS map that are of most concern. After this, we will conduct interviews with key stakeholders concerned with pedestrian mobility in order to collect information on how problems, such as snow removal, affect pedestrians. This information will provide us with ideas for increased pedestrian mobility through identifying issues and presenting prioritized improvement plans which are accommodating for the whole population of Newton.

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1 Introduction

Pedestrian facilities are any pedestrian-related infrastructures, such as crosswalks, intersections, and sidewalks. They provide the only mode of transit available to all people, able and disabled. Since pedestrian facilities are offered to everyone, they must be maintained so they can remain accessible for everyone.

If properly maintained, these facilities will offer pedestrian mobility, which provides clear, safe, and effective travel from place to place. It is an important part of everyday life; it is a common means of transportation for many people, especially those located in urban areas. In areas where mobility is impaired, many people feel the need to travel using other forms of transportation, especially cars, rather than walking to their destination (Tolley, 2003). In these areas, we want to improve mobility and access for pedestrians. This can be accomplished by improving the conditions of pedestrian facilities or building new ones. Good pedestrian mobility in cities will "save even more lives as more people walk and fewer people drive" (Tolley, 2003), and promote walking as a means of transportation.

Newton, MA is considered a "commuter suburb". Many of its residents partake in vehicular transportation on a daily basis, be it by car, subway, or bus, because, to them, the city seems inaccessible to pedestrian travel. Obstacles caused by poorly maintained pedestrian facilities in Newton have decreased the ability to travel safely and easily as a pedestrian. Poorly maintained facilities exist in four areas of Newton: Newton Centre, Newton Corner, Route 9 across from the Chestnut Hill Mall, and West Newton.

There are significant needs for improving pedestrian mobility in these four areas of Newton. These needs have encouraged Newton's League of Women Voters and the Planning and

Development Department to begin evaluating ways to solve this problem. Their hopes are to evaluate the conditions of current pedestrian facilities and policies. However, they need to know the information relevant to potential recommendations that can be made to improve the facilities in these areas.

In order to effectively improve pedestrian mobility in Newton, these groups are sponsoring us to gather the necessary information to provide them with recommendations for improvements. We will conduct background research on pedestrian mobility including case studies in order to help us identify and provide appropriate solutions for obstacles facing pedestrians in Newton. Through the background research, we are able to split the obstacles into two categories: physical, and implementation. Physical obstacles are those which pedestrians will face when traveling, such as snow removal and bad sidewalk conditions. Implementation obstacles are those which are non-physical, such as funding, regulations, and laws. We will evaluate and provide a map outlining the physical obstacles in need of improvement. To establish which obstacles are in drastic need of improvement, we will observe pedestrian patterns in the four areas in Newton. We also plan to interview people from key organizations that would have valuable input and information that we may not be able to gather through our own observations. We will then present our findings and recommendations to our sponsors and the city of Newton.

2 Background

In this chapter, we will define pedestrian mobility and the major obstacles that affect it. An understanding of these concepts is needed in order to develop methods that will produce useful recommendations.

2.1 Pedestrian Mobility and Hubs

Mobility is the "ease or freedom of movement; capacity for rapid or comfortable locomotion or travel" (OED, 2010). Therefore, pedestrian mobility can be described as the ease or freedom of movement on foot. Greater mobility can encourage pedestrians to walk in a particular area. In turn, this helps to provide a community with social and economic benefits (SANDAG, 2002).

2.1.1 Effects of Pedestrian Mobility

Pedestrian mobility allows people the opportunity to enjoy their city. It connects people to each other, shops, homes, and the city. As stated by Allan B. Jacobs "Great Streets";

> *"[Y]ou don't meet other people while driving in a private car, nor often in a bus or trolley. It's on foot that you see people's faces and statures and that you meet and experience them. That is how public socializing and community enjoyment in daily life can most easily occur. And it's on foot that one can be most intimately involved with the urban environment; with stores, houses, the natural environment, and with people"* (SANDAG, 2002).

In some European countries, "…the attractiveness of the areas, making them places where people want to visit, shop, and live," can be a factor in increasing mobility (Pedestrian Mobility Systems, 2009). Areas with high mobility provide a "better business environment" along with

the benefits of the social aspects (SANDAG, 2002). However, a city can only reap the benefits of pedestrian mobility if people are actively using its pedestrian facilities.

2.1.2 Causes of Pedestrian Mobility

The "creation and redevelopment" of high pedestrian mobility areas can "encourage people to walk rather that drive a private vehicle" (SANDAG, 2002). Walking is an inexpensive mode of transportation and, with good pedestrian mobility, it also can be convenient and time efficient. However, there are factors that negatively affect pedestrian mobility such as safety, conditions of facilities, and noise pollution (SANDAG, 2002).The benefits of pedestrian mobility will come with pedestrian facilities that are accessible to all people.

2.1.3 Pedestrian Hubs

Pedestrian mobility is significantly affected by the conditions and use of pedestrian hubs. A hub is "a center of activity" (Webster) and therefore, major pedestrian hubs are social, economic, and commercial areas where pedestrians congregate. These are typically in urban areas and include village centers, commercial centers, transit stations, schools, and hospitals. Pedestrians in these areas walk as a mode of transportation, meaning that they are accomplishing tasks, such as going to the grocery store or the bank, rather than walking for leisure.

There are four major pedestrian hubs in Newton: Newton Corner, Route 9, and West Newton, and Newton Centre. These centers are "intended to be strongly pedestrian-oriented areas, within them roadway and other infrastructure improvements and regulations are to be designed to maintain and improve the pedestrian experience" (MCPAC, 2007). The obstacles to pedestrian mobility, which recently are becoming important issues in Newton, are a product of

Newton's transit history (MCPAC, 2007). To understand how these obstacles developed, a brief history of Newton is needed.

2.2 Transportation and Pedestrian Mobility in Newton, MA

Newton was established in 1630 as a part of Cambridge, MA. It was renamed Newtown in 1688 and finally became Newton in 1766. In 1834, the Boston and Worcester railroads established railroad depots in what is now Auburndale and Newtonville, and in 1873, Newton officially became a city (AllExperts, 2010).

The City of Newton is located in Middlesex County, bordered by Waltham and Watertown, MA to the north, Needham and West Roxbury to the south, Wellesley and Weston to the west, and Brookline and Brighton to the east, as shown in *Figure 1* (City of Newton, 2010). It is bounded by the Charles River and Interstate 95 (formerly Route 128). Newton has an area of 18.1 square miles, with a population of 83,829 people. It is split up into 14 distinct "villages": Auburndale, Chestnut Hill, Four Corners, Newton Centre, Newton Corner, Newton Highlands, Newton Lower Falls, Newton Upper Falls, Newtonville, Nonantum, Oak Hill, Thompsonville, Waban, and West Newton.

Figure 1: Map of Newton (City of Newton, 2010)

Newton is the beneficiary of a long history of transportation improvements. In 1834, the Boston-Worcester Railroad was built to link the two cities, which now supports Auburndale, West Newton, Newtonville, and Newton Corner. The Charles River Railroad passes through Chestnut Hill, Newton Centre, Newton Highlands, and Newton Upper Falls. The Highland Branch connects Newton Highlands with Auburndale, currently known as the Riverside Line. With the invention of the automobile in the beginning of the 20th century, Newton constructed high capacity auto routes. As part of former President Roosevelt's Work Progress Administration, the Boston-Worcester Turnpike, known today as Route 9, became a four lane turnpike with many grade separations. In the 1950's, Route 128/Interstate 95 was created just outside of Boston and on Newton's western border, and in the 1960's, the Massachusetts

Turnpike was extended along the Boston-Worcester Railroad in order to accommodate express buses and commuters traveling from Boston to its various suburbs (Mayor's Comprehensive Planning Advisory Committee, 2007).

Since the 1960's, Newton has not had any major transportation improvements and traffic congestion has been steadily increasing. The increase in car travel from various suburbs to and from Boston has resulted in very large traffic volumes of approximately 150,000 vehicles per day along I-95, 100,000 along the Mass Pike, and 50,000 along Route 9 (MCPAC, 2007). This increased traffic congestion is a safety concern for pedestrians because many pedestrian-related accidents involve vehicles in pedestrian hubs (SANDAG, 2002). Also, many Newton village centers, which used to have their own schools, grocers, and other amenities, no longer have these services, causing people to drive outside of their neighborhoods to access such amenities (MCPAC, 2007).

2.3 Obstacles to Pedestrian Mobility

There are many factors that affect pedestrians' mobility throughout Newton. These factors can be separated into two areas, pedestrian and implementation obstacles, which will be discussed in this section.

2.3.1 Physical Obstacles

In order to fully assess and analyze aspects of pedestrian mobility in Newton, it is necessary to understand the physical obstacles pedestrians may face. There are many physical obstacles to consider when making recommendations for improving pedestrian mobility. Some

of these obstacles include sidewalk conditions, snow, crosswalks, and areas of high traffic danger. These obstacles negatively affect safety and the ease of walking.

2.3.1.1 Sidewalk Conditions

Towards the end of the nineteenth and beginning of the twentieth century, sidewalks were used for social, commercial, and political activities. In modern day, the sidewalk is used as a mode of transportation for pedestrians. Its purpose is to serve as the roadway for pedestrians and provide a safe and level walkway for all people. Mobility and accessibility of pedestrians using sidewalks can increase when there are improvements and repairs to sidewalk conditions (Knoblauch, 1987).

According to the Federal Highway Administration (FHWA), physical obstacles, such as sidewalk conditions, must be evaluated in order to find potential improvements and maintain accessibility for pedestrians. Maintenance of sidewalks is required in order to reduce the amount of damage done due to use and weathering. Common physical obstacles caused by poorly maintained sidewalks are cracking, broken concrete, settled areas that trap water, tree root damage, and spalled areas, where material is detached from the sidewalk (FHWA, 1998). These common problems can affect the mobility of pedestrians by impeding their ease or freedom of movement and, presents safety issues. For example, people with wheelchairs or strollers may find it difficult or impossible to travel on uneven sidewalks. Uneven sidewalks could also cause a tripping hazard, especially for those with difficulty walking, such as some elderly or visually-impaired.

To help keep sidewalk conditions maintained, many cities leave the responsibility of keeping sidewalks in good condition to the adjacent land owners, giving them the responsibility

to inform city officials so they can hire contractors to make improvements. They are also responsible for snow removal and subtle improvements, such as sweeping the sidewalk and keeping it clean from trash and dirt (FHWA, 1998). In the City of Newton, the Highway Divisions are responsible for the maintenance of streets and sidewalks as well as any other public property (City of Newton, 2010).

2.3.1.2 Snow and its Removal

A second problem that faces several modes of transportation is snowfall and its removal. This problem can seriously affect transportation if not handled properly. The areas that record snowfall could fall victim to poor transportation conditions leading to delays, cancellations, and even accidents. This increases the importance for an affective snow removal process that provides a safe and easily accessible transit route for all people.

During heavy snowfall, a large problem is the lack of space to put shoveled snow, both from streets and sidewalks. Some cities have designated areas where snow can be dropped off to provide clear travel paths both for pedestrians and vehicular traffic (The Sector Design and Assignment Problem for Snow Disposal Operations, 2007). Other ways to prevent obstacles caused by snow is to implement the use of sidewalk plows and sand or salt on public property.

The City of Newton has its own snow removal policy, which includes its pedestrian facilities. Once snowfall of a storm has recorded more than four inches of snow, the City will plow approximately sixty miles of sidewalk on major roadways. The roadways with these sidewalks possess heavy vehicular and pedestrian traffic. *Table 1* shows the other city ordinances that concern snow removal from sidewalks in certain districts (City of Newton, 2010).

Applicable City of Newton Ordinances

Ordinance	Description
Sec. 26-8	**Removal of snow and ice from sidewalks in certain districts** Owners and occupants of buildings abutting sidewalks in business districts must remove snow or ice from such sidewalks.
Sec. 26-9	**Putting snow and ice upon streets, sidewalks and bridges** No persons shall place or permit or cause to be placed snow or ice upon any street, sidewalk or bridge, except that snow or ice removed from a sidewalk may be piled up on the adjoining gutter.
Sec. 26-15	**Obstructing free passage on sidewalks** No person shall willfully or negligently obstruct the passage of pedestrians.
Sec. 26-16	**Vehicles on sidewalks, etc.** No person shall park upon or in any way obstruct a sidewalk so as to impeded snow clearance or pedestrian passage.

Table 1: Snow Removal Plan (City of Newton, 2010)

Although there is a current snow removal system in the City of Newton, pedestrian facilities are still affected by the snow. A better snow removal plan needs to be generated in order to ensure safety and maximum mobility to all people traveling using pedestrian facilities. Snow can cause traveling conditions to become dangerous because roads can become icy, and snow can accumulate on sidewalks. This can also prevent a person's ability to use pedestrian facilities for travel. Icy conditions can cause people to slip and fall, and too much snow on sidewalks make accessibility difficult or impossible, especially for those in wheelchairs.

2.3.1.3 Crosswalk Conditions and Effectiveness

In Massachusetts, when driving a motor vehicle, it is unlawful to pass a pedestrian attempting to use a crosswalk (Marked Crosswalks, N.D.). Crosswalks provide a simple way for pedestrians to travel from one side of the street to the other. If crosswalks are maintained and used properly, they also offer a safe means of crossing the street. In order to develop an effective

crosswalk, the area must be clearly marked so drivers are able to recognize pedestrians from a distance so yielding to them will not be a concern (Redmon and Boodlal, 2003).

Some obstacles that make crosswalks ineffective in relation to pedestrian mobility are the poor conditions of curb cuts and roads, faulty walking lights, and poor visibility. Curb cuts are ramps that allow an even transition from the street to the sidewalk. To allow ease of walking, the ADA requires curb cuts to be accessible at all times (SANDAG, 2002). The asphalt of the road must be maintained in order to ensure pedestrians a flat smooth surface with which to safely cross.

There are many faults associated with walking lights, but if properly installed and maintained, they can help pedestrians safely cross the street. One fault is insufficient time provided to cross safely. The average person walks approximately 3 feet per second. An inefficient light timer does not account for road conditions, weather conditions, and handicap accessibility, which would increase the time needed for a pedestrian to cross the street. This presents a safety issue to pedestrians when traveling across an intersection. If the light were to change while a pedestrian was using the crosswalk, it would put the pedestrian in harm's way to vehicular traffic. Another fault associated with walking lights is the inconvenience of light placement. A walking light should be within reach of the curb cut. If not, many may not have enough time to cross or even reach the walking light at all.

Another safety obstacle facing pedestrians at crosswalks is poor visibility from motorists. In order to ensure safety both crosswalks and pedestrians must be visible from a proper distance. A motorist may not have ample time to yield if crosswalks are not visible or if pedestrians are not seen until entering a crosswalk. Therefore, crosswalks must be routinely repainted to ensure visibility (FHWA, 1998). Two major types of paint are used for different road conditions. These

types are conventional paint and thermoplastic. Thermoplastic paints are used for high vehicle traffic areas which cause wear on crosswalks. This is because thermoplastic is more durable than conventional paint. However, thermoplastic is expensive, therefore, in the interest of saving money conventional paint is used. Conventional paint is used in areas that are not exposed to heavy traffic and other conditions that cause crosswalk visibility to fade quickly. This is because conventional paint is less durable and will last longer in areas with less wear (Sasidharan et. al, 2009). Pedestrians entering crosswalks must also be visible to motorists. This means that parking of motor vehicles should be limited near the intersection or crosswalk. Vehicles at intersections can inhibit a driver's ability to see pedestrians attempting to use crosswalks (FHWA, 1998).

Another issue is the fact that some drivers may opt to take advantage of a "right on red," which simply allows the driver to make a right hand turn on a red traffic light signal. A motorist who does not see a pedestrian crossing may make a right on red, placing the pedestrian in harm's way. Again, these areas should be well-marked in order to ensure the safety of pedestrians (FHWA, 1998).

2.3.1.4 Traffic Danger

Pedestrians often avoid areas that incur high traffic volumes because they are perceived as being unsafe due to traffic dangers. These include areas with high accident rates, high speed limits, or limited pedestrian facilities. In 2008, according to the National Highway Traffic Safety Association (NHTSA), in the United States there were over 69,000 pedestrians injured in traffic crashes. In addition to these injuries, 72% of pedestrian fatalities occurred in urban areas that exhibit traffic dangers (NHTSA, 2008). These obstacles affect mobility and accessibility to

pedestrians in several ways. They prevent safe access to pedestrian facilities and, because of this, many pedestrians avoid walking in areas with these dangers.

There are several strategies that can be used in order to help reduce traffic danger. Sidewalks can be built with a greater width to increase the buffer zone between the pedestrian and vehicles. Also, traffic signals and signs can be strategically placed to notify drivers of pedestrian crossings (International Scan Summary Report on Pedestrian and Bicyclist Safety and Mobility, 2009).

There is one strategy that has proven to be one of the most effective methods when dealing with traffic danger and that is traffic calming. Traffic calming refers to the slowing of vehicle traffic which helps promote the improvement of pedestrian mobility and accessibility (U.S. Traffic Calming Manual, 2008). This concept has been effectively adopted by some countries, including Sweden, Denmark, Germany, Switzerland, and the United Kingdom (International Scan Summary Report…, 2009). In these countries, once traffic calming strategies were established and put into action, the actual number of pedestrians traveling increased.

One way to "calm traffic" is to lower speed limits. There are other methods, however, that can calm traffic to improve pedestrian mobility. First, narrowing streets is a concept that can be used for traffic calming (U.S. Traffic Calming Manual, 2008). By narrowing streets, motorists are less apt to travel at high speeds. A second traffic calming measure is automatic camera enforcement. Mounted mainly at intersections, it photographs vehicles violating traffic laws such as ignoring red lights and traveling above the legal speed limit. Once the camera takes a photograph of the offending vehicle's license plate, a ticket is issued to the driver through the mail. This supplements the local police presence and makes drivers more aware of their surroundings. A third and popular method of raised crosswalks also promotes traffic calming.

Raised crosswalks force motorists to slow their vehicle which makes the motorist and pedestrian more aware of traffic laws. In *Figure 2* below, it shows an example of a raised crosswalk (International Scan Summary Report…, 2009). These are just some of the traffic calming measures we plan to focus on during our research.

This is an example of a raised crosswalk. The crosswalk is identified by large white stripes. Notice the two signs notifying motorists of the raised sidewalk (yellow sign) and also indicating that pedestrian travel takes place on the painted sidewalk (white sign).

Figure 2: Raised Crosswalk

The Federal Highway Association states that "when pedestrians and bicyclists are a common element in the street environment, motorists will expect their presence and take the necessary precautions at potential conflict points" (International Scan Summary Report…, 2009). Since traffic calming measures make pedestrian facilities visible "common elements", these measures will help motorists take the necessary precautions to account for possible encounters with pedestrians.

2.3.2 Implementation Obstacles

Many obstacles come into focus when attempting to increase mobility and access for pedestrians. The first obstacles that come to mind are the physical ones like those faced by pedestrians, such as poor sidewalk conditions and busy streets. However, when developing solutions to the physical obstacles we will encounter obstacles limiting how we can apply these solutions. For example when redesigning a pedestrian facility there are three factors that need to

be considered. The first factor is related to restrictions on where and how pedestrian facilities can be made or improved. The second factor is related to the availability of funding for improvements on increased pedestrian mobility. The third and final factor determines whether a facility is worth constructing based on its cost-benefit. The usefulness of improvement must outweigh the cost of the obstacles' improvement. For example, a pedestrian facility is only useful if pedestrians will use them for transit. This means we need to ensure that our recommended improvements will encourage people to walk. We define these three factors as implementation obstacles. These are discussed in the following sections.

2.3.2.1 Legal and Regulatory Requirements

When our group is considering how to design improvements for increased pedestrian mobility we must consider various guidelines and restrictions on how pedestrian facilities must be built and maintained. Restrictions and guidelines on how sidewalks and other transportation improvements must be made are defined by the Department of Transportation through laws such as the Americans with Disabilities Act. There are two organizations that are required to enforce the regulations given by the ADA. These are the Federal Highway Administration and the Department of Justice (ADA).

The Americans with Disabilities Act has regulations to ensure that all people, regardless of any disabilities they may have, can safely and conveniently use any public facilities in place. If public facilities are accessible to those with any disability they are also accessible to all able people. Therefore, ADA is the standard for designing and maintaining improvements to public facilities, including pedestrian facilities. Pedestrian facilities regulated by the ADA are curb cuts, sidewalks, paths, crossings, and accessible pedestrian signals. The surfaces of these facilities

need to be firm, stable, and slip resistant. When curb cuts are not placed correctly or built to the right specifications access to pedestrian facilities becomes impossible for those who need wheel chair accessibility or have other needs. Here we will outline the legal and regulatory requirements for various pedestrian facilities. Including sidewalks, crosswalks, curb cuts, and walking lights as outlined by the ADA. Some of the required dimensions of pedestrian facilities are displayed below, in Table 2.

Table 2: Required Dimensions for Pedestrian Facilities (ADA)

Required Dimensions for Pedestrian Facilities			
Facility	**Max Width (ft)**	**Grade (%)**	**Truncated Domes Required**
Curb Cut	4	8.3	Yes
Ramp Landing	4x4	2	Yes
Sidewalk	4	2 (Cross)/ 5 (Running)	N/A
Sidewalks/Driveways	3.5	2	N/A
Path/Trails	N/A	5	Yes
Crosswalks	6	N/A	Yes

Here are the requirements for constructing and maintaining sidewalks. When constructing a sidewalk, the ADA requires an unobstructed minimum width of three feet. In addition, there must be a ten foot long and five foot wide passing point at a maximum of every 200 feet of sidewalk. Passing points are required in order to allow comfortable travel for many disabled pedestrians. Places for resting are required for sidewalks with a steep slope, which is defined as exceeding a five percent grade. These are flat areas of sidewalks that must be spaced at a

maximum distance of 400 feet (SANDAG, 2002). The ADA also has considerations for maintaining the accessibility of sidewalks. All sidewalks and curb cuts must be clear of snow allowing at least the legal minimum width for travel. Additional concerns for sidewalks in place are cracks and uneven surfaces. Cracks or gaps in the sidewalk cannot be larger than a quarter inch. Also, changes in level have to be ramped if they exceed a half inch rise. Gaps and level changes must be repaired to avoid potential tripping hazardous and inaccessible conditions for the elderly and disabled (SANDAG, 2002).

The requirements for constructing and maintaining crosswalks are also described by the ADA. When painting crosswalk markings, sand should be added to the paint or thermoplastic to increase slip resistance. In addition, crosswalks need to remain visible and therefore they need to be routinely, depending on the how quickly they fade, repainted (Sasidharan et. all, 2009). Other than this, the design for crosswalks through medians should be at least six feet long (SANDAG, 2002). The ADA does not require but recommends that tactile warnings such as wayfinding strips, and tactile bumps are used along crosswalks. Tactile warnings are a "change in surface condition providing a tactile cue to alert visually impaired pedestrians of a potentially hazardous situation" (SANDAG, 2002). Wayfinding strips are grooves that lead can a visually impaired pedestrian through a crosswalk while tactile bumps are bumps used to define both of the edges of a crosswalk (SANDAG, 2002).

There are also many requirements for the design of curb cuts. When designing a median, curb cuts need to be included to allow access onto it when there is no crosswalk through it. These curb cuts should be a minimum of four feet wide. At each corner of an intersection, there are two curb cuts that must align with its own crosswalks. When placing curb cuts, storm drainage inlets should be placed on the uphill side of curb cuts to prevent pooling of water. Another

construction concern is if the slope of a curb cut exceeds five percent, handrails are required. The construction of curb cuts requires truncated domes. Truncated domes are pads on curb cuts which have "small domes with flattened tops used as tactile warnings" (SANDAG, 2002).

Finally, the ADA has requirements for accessible signal controls allowing all people the ability to use them despite any disability. Audible signals and Braille instructions are to be used at pushbuttons. The placement of the pushbutton should be accessible. This means that they cannot be higher than three feet off the ground and should be located in close proximity to the curb cuts.

2.3.2.3 Funding and Budgeting

In order to create a safe and effective hub in each area of Newton, MA funding needs to be considered so the necessary measures required for improvement can be budgeted for. Funding for these kinds of projects typically comes from the U.S. Department of Transportation, typically through motor vehicle excise taxes. The Federal Highway Administration within the Department of Transportation is responsible for managing the dispersal of federal funds to these projects. The budgeting for improving pedestrian facilities was not even considered until 1991 when the Intermodal Surface Transportation Efficiency Act was passed. This broadened the Federal Highway Administration's focus to include improving modes of transit other than vehicular, including transit for pedestrians. Since 1991 many acts and programs were developed to improve these alternative modes of transit through various goals and funding (Cradock et. all, 2009).

Once the Federal Highway Administration disperses funding for these projects by state, it is then split up by region following by city or town. Due to this, funding becomes limited by the

time it reaches a local level. This budget then has to be split up by all the needs of the community. This makes funding for improvements of pedestrian hubs and facilities even more limited. Due to this, our group's recommendations for improvements need to be as cost effective as possible. This could include suggesting how repairs can be made rather than complete renovations. Many times repairs can be just as effective solutions as complete renovations and are often cheaper.

2.3.2.4 How Can Improvements Influence Walking

Good recommendations for improvement of pedestrian facilities are those that ensure that these improvements will be useful. In order for pedestrian facilities to be useful they must encourage people to walk and use them for transit. However, ensuring that people will be encouraged to walk with improved facilities is difficult because the benefits of driving as a means of transit are often perceived to outweigh the benefits of walking. Since 1977, walking for travel has decreased while vehicular transit has increased across the U.S. (Pucher et. all, 1999), this decrease in walking can be viewed as representative of how times have changed. According to the U.S. Census there was a decrease of 7% of people walking to work from 1960 to 2000. In addition, there was a drop of about 27% of children who walk to school from 1969 to 2001(Cradock et. all, 2009). Over time cars have become nearly available to anyone and driving often seems superior to walking in many aspects. Cars are faster, more comfortable, more convenient, and provide a sense of privacy and safety (Tolley, 2003).

There are many reasons for this decrease in people walking over time. Densely populated areas can result in dangerous conditions for walking on roads along fast moving and congested traffic. In the past decade vehicular trips beginning and ending in Newton have grown

approximately by 7% (MCPAC, 2007). Due to this, in some parts of Newton it has become increasingly unpleasant and unsafe to walk. Local shops are also fewer and farther between which can discourage walking. According to the Mayor's Comprehensive Plan Advisory Committee on Transportation and Mobility, "Many of Newton's village centers that once had neighborhood schools, hardware stores, grocers, and other useful amenities no longer have such services. Instead, Newton Residents must drive outside of their neighborhood to access these amenities" (MCPAC, 2007).

Walking should increase because improved pedestrian facilities will ensure safety and ease of access. With improved pedestrian facilities, pedestrians are at a lower risk of road traffic injury, since the majority vehicle crashes or accidents do not involve pedestrians. It can be argued that the years added to your life by the benefits of walking outweigh the risk of the years that could be lost in crashes (Tolley, 2003). If safety and ease of access are ensured then both the individual and community can use these facilities for their own benefit.

An individual can gain a number of health benefits from walking. Walking is a healthy, simple form of exercise available to nearly everybody. Walking is often linked to reductions in heart disease, diabetes, osteoporosis, colon cancer, obesity and depression (Tolley, 2003). Also many individuals use walking as their only means of transit. These might include residents without cars, bicyclists, elderly, children, and the disabled. This major portion of this population is often isolated in their homes without accessible pedestrian facilities (Wilkinson, 1997).

The community with good pedestrian facilities also gains many benefits when its residents walk. When walking is used as an alternative to driving, there is a reduction of pollution and congestion caused by street traffic (Elvik, 1999). Along with these benefits, walking can be considered part of community life. Increased walking within a community will

often reinforce relationships with neighbors, while busy streets flooded with traffic often divide neighborhoods and discourage many from walking to other parts of their community. A city or community in which many of its citizens walk provides a sense of security and safety for those who would otherwise be afraid of crime on the streets (Tolley, 2003).

Newton plans to improve its pedestrian hubs, promoting pedestrian mobility and in doing so enhancing villages, neighborhoods, and other areas. With improved pedestrian hubs, Newton expects improved mobility due to safer and more easily accessible pedestrian facilities. Improved pedestrian mobility benefits both Newton's individuals and community in many ways (MCPAC, 2009).

2.4 Summary

In this chapter, pedestrian mobility is clearly defined, and the obstacles have been separated into two major areas, the physical and implementation obstacles. Using this information, we will be able to develop methods for identifying and improving these types of obstacles in Newton. This will in turn help Newton reach its goal of increasing pedestrian mobility in its hubs.

3 Methodology

In this chapter, we will discuss our methods to develop recommendations for improving pedestrian mobility in four areas of Newton, MA. Our methods will help us identify the obstacles presented by sidewalks, crosswalks, and other pedestrian facilities that limit access to pedestrians, including the elderly and disabled. We will concentrate on three main objectives in order to collect the necessary data that will help us provide recommendations to our sponsors.

Our first objective will be to assess the conditions of pedestrian facilities in each study area of Newton. We will use an obstacle identification form and condition rating system to evaluate pedestrian facilities. These will be visually outlined on a Geographical Information Systems (GIS) map. This will help us determine all the physical obstacles in each study area of Newton. The second objective consists of observing pedestrians in each study area in Newton. Our recorded data from these observations will include the number of people walking in each area, a rating on vehicular traffic in each area, and other observations relevant to our study. This will help us identify patterns that affect which obstacles are most commonly encountered. The third objective is to conduct interviews with organizations in Newton that have a vested interest in pedestrian mobility and access. These interviews will provide independent assessments from users, including, but not limited to, the elderly, handicapped/disabled, concerned parents, business patrons, and cyclists. The information that we will obtain from these groups will include each group's current opinions of the state of pedestrian mobility in Newton, as well as provide insight on methods to promote walking within these groups. We will present our plan for meeting each of these objectives in the following sections.

3.1 Assess Pedestrian Facilities in Newton, MA

The first objective our group will provide is an overall characterization of the pedestrian mobility in Newton Centre, Newton Corner, West Newton, and Route 9. This objective will have multiple steps. These steps will include identifying and analyzing physical obstacles in these areas, assessing the conditions for each area, and putting our data into a GIS map for organizational purposes. This first objective will give our team a broad overview as to what recommendations can be made for improvements of pedestrian mobility in the City of Newton.

In order to accomplish our first objective, group members will survey the areas of study in Newton. During this step, our group will walk through all study areas and their pedestrian facilities. We will make note of any physical obstacles that we encounter on a map. Our group will spend one week collecting this data in groups of two. We will tackle one area at a time, spending two days on larger areas such as Newton Centre and West Newton. One day of field work will be needed for the two other study areas, Newton Corner and Route 9. One person in each group will be responsible for recording specific obstacles created by the poor conditions of pedestrian facilities. The other person is responsible for developing an overall condition for each block, or a section of pedestrian facilities in between two streets. The overall condition of each block is based on our Walkability Checklist, located in Appendix B. We will provide a list of all the obstacles but the overall condition of each block is needed to prioritize what specific obstacles need to be dealt with first. A block with many specific obstacles should have a higher priority for improvements than a block with a limited number of obstacles.

After this one week is over we will spend a few days entering this data into a Geographical Information Systems Map (GIS). Each specific area will be entered in with all the

data on our obstacle identification form, shown in Appendix C. This will give us a place to enter data when in the field, re-locate the obstacle, and give a brief description of the obstacle.

The physical obstacles that our group may encounter could include poor sidewalk conditions, lack of accessibility, lack of pedestrian facilities, and crosswalk/intersection conditions. This helps ensure that all physical obstacles are accounted for. The timing of this step is independent of traffic patterns and weather because we will be identifying physical obstacles. Our group feels as though this process is the most effective way of identifying all physical obstacles that may hinder a pedestrian's travel. The physical obstacles documented during our review will support our recommendations toward improved pedestrian mobility.

After identifying the physical obstacles in the study areas, our group will then be giving a grade to each one using a rubric similar to that shown in. Each Newton location will not be receiving one grade; rather, different parts within each study area will receive different grades reflecting the severity of the identified obstacles. Severity is based upon the number of identified obstacles and the impact on pedestrian mobility. This can range from faded crosswalks in need of new paint to poor sidewalk conditions with cracks or uneven surfaces that can impede wheelchairs and/or cause elderly to trip and fall. The purpose of grading based on number and severity of the obstacles is to prioritize the areas posing the greatest threat to pedestrian mobility and accessibility. This step will aid in making recommendations, especially in lean economic times when some areas may have to be delayed in favor of correcting the most egregious areas first.

Once we have reviewed all physical obstacles noted in a study area, a grade will be assigned from all four reviews. We will import maps into the program consisting of the study areas that the League of Women's Voters and the City of Newton has identified. Once the maps

of the study area are imported, we will enter all the data collected in steps one and two. This data includes the location, severity, description, and also the grade that our group assessed to the appropriate obstacles. The obstacles noted will be classified into grade of none, good, fair, poor, and new. Our plan is to recognize blocks on the GIS map by certain colors. To eliminate confusion, symbols will be given to obstacles to help identify them on the GIS map. Refer to *Figure 3* for a sample legend.

Obstacle	**Symbol**
Sidewalk Conditions	
Crosswalk/Intersection Conditions	
Lack of Pedestrian Facilities	
Accessibility	

Figure 3: Facility Coding System

The purpose of the color is to help recognize the blocks that possess the most obstacles that affect pedestrian mobility. Assigning colors to blocks will be based upon our groups overall rating of conditions within the area. The rubric in *Figure 4* helps explain how the grade will be determined.

Condition	Color	Description
None	Orange	No pedestrian facilities present.
Good	Green	Two or less obstacles present within the block.
Fair	Yellow	In between three to six obstacles are present.
Poor	Red	The block has over six obstacles present.
New	Blue	All facilities are new, no obstacles present.

Figure 4: Grading System for Obstacles in Newton

The purpose for entering all of our collected data into the GIS computer program is to help identify the areas that need the most improvements. Once completed, the GIS map will provide an easy starting point showing the necessary improvements in a prioritized manner. This information can further be exported into a Microsoft Excel file which will enable the city of Newton to estimate costs of repair to the areas with obstacles. This will be useful information in discussions of funding and planning budgets.

3.2: Observe and Identify Patterns of Pedestrian Behavior

The second objective is to observe the actions of pedestrians and identify patterns of behaviors in the study areas of Newton. These observations will be important to the completeness and effectiveness of our recommendations for the study areas. This will allow us to fully understand where, when, and how pedestrians travel through the pedestrian hubs. Patterns identified which include inaccessibility and walking patterns, may also be helpful to identify a general recommendation for improvement in Newton. By analyzing pedestrian traffic patterns we will identify areas of high concern. These areas could have a high level of pedestrian traffic, or have facilities that are being avoided or ignored.

We will collect and record data in groups of two. Recently, during a trip to Newton, we observed a disabled man traveling down a road rather than a sidewalk due to poor accessibility. By observing people's actions we will gain some perspective on which areas are in need of improvement. Data that will be entered will be the number of pedestrians in an area and other observations like these. Another datum point that we will collect are the vehicular traffic rhythms in each area described by San Diego's Regional Planning Agency, SANDAG, shown in *Figure 5*. This data will be recorded on the observation data form, located in Appendix D. This will allow us to properly measure the impact of traffic on pedestrians in a hub. We will observe the areas during the week and the weekend recording the time and date of when we made these observations. We will count pedestrians traveling through the blocks that will be specified in the first objective. The times and dates for observations will be chosen to allow for a comprehensive coverage of varying issues and critical conditions. The observations will be during morning and late afternoon hours to ensure that the peak commuting times are accounted for. These times should present the largest numbers of vehicles and pedestrians, allowing for more data to be collected.

Street Type	Challenges	Opportunities
Constant flow refers to a relatively even flow with peaks hardly noticeable due to either consistently low or heavy traffic volume.	• Low flow streets may have excess road capacity which can encourage higher speeds. • High flow street may become dividers in the community.	• For low flow, reclaim some of the street for the pedestrians, bicyclists or transit. • For high flow provide buffers, improve crossings and/or reconfigure the roadway and circulation network.
Peak flows describe periods of heavy traffic followed by relatively lighter traffic; composition of the traffic may also change during the day.	• A heavy peak period may restrict possibilities for improvements to those periods between peaks (e.g.; on-street parking only during non-commute times).	• Reduce peak load so that a more aggressive approach can be taken in terms of sidewalk, street design, and traffic calming.
Alternate peak flows occur when periods of lower traffic volumes are associated with heavy pedestrian activity.	• Usually indicates the street is playing a multi-functional role as being both an important traffic conduit and a community street.	• Future development along the street should continue to foster pedestrian activity.
Pulses occur when signalization is synchronized to allow "platoons" of cars to maintain a constant speed.	• During the traffic "pulse" crossing the street may be difficult.	• Provide opportunities for pedestrian activity in the "gaps" between pulses of traffic. • Reduce crossing distances and provide pedestrian refuge areas.

Figure 5: Vehicle Traffic Rhythm

We will analyze this information by comparing the behavioral patterns of pedestrians to the conditions that have already been identified on the GIS map from objective one. We will determine the relationship between these two sets of data. When determining high or low pedestrian traffic we need to consider that it is different for each study area, therefore, comparisons between each area cannot be made. For example, Newton Centre has much higher pedestrian traffic than Route 9 because it contains significantly more pedestrian facilities. We will define what high pedestrian traffic in each area is after we have collected data on the numbers of pedestrians traveling. We have identified four potential scenarios describing how conditions of pedestrian facilities affect the amount of people walking in each area. These scenarios are described below and shown in the *Figure 6*.

Facility Condition	# of Pedestrians	Cause	Result
Good	High	Good Mobility from Good Access	Not a high priorty for recommendations
Good	Low	No intrest of walking as a mode of transit	Determine the cause through interviews
Poor	High	People need to travel along route despite conditions	Address issues in recommendations
Poor	Low	No interest in walking or conditions are discouraging people form walking	Determine the cause through interviews

Figure 6: Scenarios of Facility Condition and the Number of Pedestrians

The first of these is our ideal scenario: A lot of people walking in areas with pedestrian facilities in good condition. This scenario supports our background research by showing that areas with well maintained pedestrian facilities have increased pedestrian mobility. The second scenario is a large number of people walking in areas with pedestrian facilities in poor condition. This suggests that people need to walk for travel despite these poor conditions. This is an area with high priority for improvement due to this relationship. Our third scenario describes areas with low numbers of people walking. This can suggest two things, either the conditions of these areas are so poor that people are discouraged from walking, or that there is no interest in walking regardless of the conditions. The specific cause for this relationship will be determined through interviews during our third objective. After evaluating these four scenarios, we define which areas apply to each scenario on the GIS map.

3.3 Conduct Interviews with Key Stakeholders

Along with investigating the areas of concern in Newton, we will also be interviewing various organizations who have a vested interest in pedestrian mobility. We will get their opinions and views on why citizens do not walk as a means of transportation, and how to improve pedestrian mobility. By conducting these interviews, we will be able to gather various opinions from a variety of people who want to see change in these areas. We will also get some insight from these organizations as to some things that need to be improved that we will not get to see first-hand while in Newton, such as snow removal from sidewalks.

We will first contact the representatives of the key stakeholders and schedule face-to-face interviews. Upon our arrival in Newton we plan on speaking with our sponsor, the League of Women Voters in order to make sure our objectives fit the goals they have for our project. We then plan on speaking with the Alderman Committee, Pedestrian and Bicycle Task Force, Mayor's Committee on People with Disabilities, and Council of Aging, and other groups. The interviews will be conducted throughout our time in Newton. We will first conduct interviews at the beginning of our research. These interviews will just pertain to information about the conditions of facilities that we cannot personally identify through our first two objectives, such as snow removal. Other interviews will need to be conducted after completion of our first two objectives so we can develop questions about the relationships in data that we have already discovered. At the start of the interviews, the participants will be given the IRB Consent form to fill out. We will ask a series of questions that will cover a set of general topics relevant to each group. Since these groups are all different, they could have different views on pedestrian mobility and access.

The interviews will be semi-structured, having a set of general questions we want answered, but that do not need to be answered in a particular order (see Appendix E). Some of the key topics we plan to discuss include sidewalk/crosswalk conditions, views on mobility and access, and opinions on traffic dangers. We will specifically ask questions about areas that have low numbers of pedestrians in order to find out if this is caused by a lack of interest in walking or poor pedestrian facility conditions. We will also ask specific questions about how other seasons affect pedestrian mobility since our research is limited to the spring. An example of this is snow removal, an important topic that we will not be able to observe firsthand. The interviews will be recorded with a handheld voice recorder, so we can go back and listen to parts as needed.

Once the interviewing process is complete, we will be able to analyze all of the data we collect. We will review the information gathered from each interview and compare some of it to our data collected from the other objectives. Our interview data will be interpreted in such a way that we can use it to help pinpoint key components of the GIS map that we will consider a high priority. High priorities will be identified through find similarities and relationships between the data from our three objectives. We will use the interviews specifically to clarify the reasons behind why certain areas have low numbers of pedestrians. Our previous two objectives have been able to identify these areas but the reasons for this cannot be determined by these objectives alone. The reason could be either a lack of interest in walking or poor conditions of pedestrian facilities are too discouraging to use. Therefore, determining the reason for this will help us figure out what additional improvements will be useful. In addition, these interviews shed light on the specific concerns, of various types of people, allowing use to determine what Newton's community wants to see implemented. Our research is conducted in the spring so weather conditions outside of this season that drastically affect the conditions pedestrian facilities need to

be considered when identifying what kinds of improvements will be the most important and beneficial to the city of Newton.

3.4 Summary

In this chapter, we identified our objectives for the project and how we will analyze the data collected from these objectives. We established our three main objectives: assess pedestrian facilities in Newton, observe people and identify patterns of pedestrian behavior, and conduct interviews with key stakeholders. We will use the data from these objectives to produce the deliverables for our project. This includes identifying all the obstacles facing pedestrian mobility and showing which of these obstacles are of high priority for improvement. This data will be represented on a GIS map in order to clearly display the areas that we recommend to the city of Newton are in need improvement.

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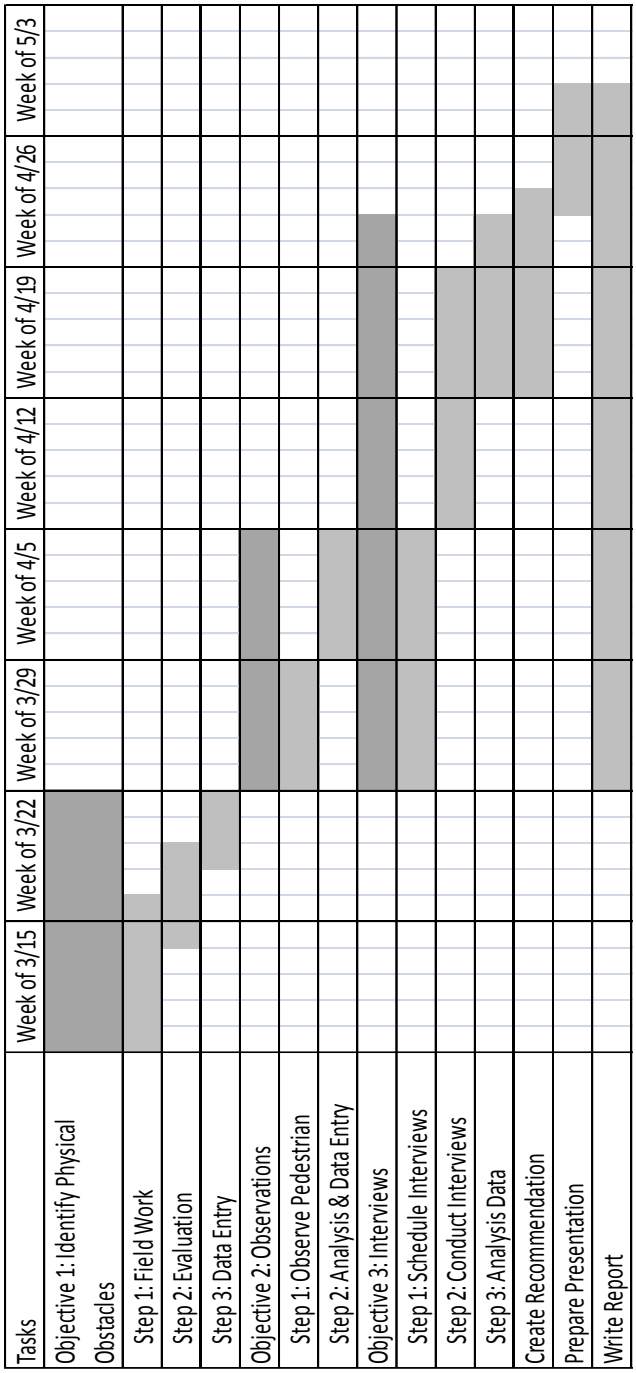
Appendix

Appendix A: Gantt Schedule

Table 2: Gantt Schedule

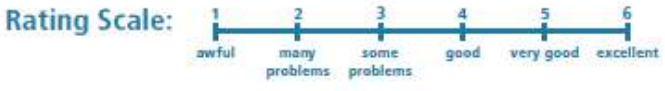


Appendix B: Walkability Checklist

Walkability Checklist **Name:_____ Date:_____**

Location of Walk:_____

Weather:_____



1. Did you have room to walk?

__ YES

__ SOME PROBLEMS:

__ Sidewalks started and stopped

__ Sidewalks were broken or cracked

__ No pedestrian facilities

__ Too much traffic (Vehicle or Pedestrian)

__Other:_____

Rating:

1 2 3 4 5 6

2. Was it easy to cross streets?

__ YES

__SOME PROBLEMS:

__ Poor road conditions

__ Faulty walking lights

__ Needs striped crosswalks

__ Needs traffic signals

__

Other:_____

Rating:

1 2 3 4 5 6

3. Was your walk safe?

__ YES

__ SOME PROBLEMS:

__ Crosswalks have poor visibility (For motorists or pedestrians)

__ Pedestrian facilities are not usable due to poor conditions

__ Traffic Danger

__Tripping Hazards

__

Other:_____

Rating:

1 2 3 4 5 6

4. Were pedestrian facilities easy to access during your walk?

__ YES

__ SOME PROBLEMS:

__ No curb cuts on sidewalks, medians, islands, etc.

__ Uneven transition of curb cuts and asphalt

__ Obstacles blocking the use of pedestrian facilities (poles, signs, shrubbery, dumpsters, etc.)

__ Other:_____

Rating:

1 2 3 4 5 6

HOW WALKABLE…WAS YOUR WALK?

(Add up your ratings for the conditions of each area)

Total Rating	**Condition**
26-30	New
21-25	Good
16-20	Fair
11-15	Poor
0-10	New

Appendix C: Obstacle Identification Form

Specific Location	**Date**	**Time**	**Nature of Obstacle**	**Person making Assessment**
The specific location is based upon street address in the City of Newton.	This is done for organizational purposes.	This is done for organizational purposes.	This describes what the physical obstacle actually is. Ex. Faded crosswalk, not visible by motorists due to faded lines.	This is to see what each group member has found in each study area, and also to help notice any similarities.

Appendix D: Observation Data Form

Study Area:		Group Members:		
Block	Date/Time	# of Pedestrians	Vehicle Rhythm	Other Observations

Appendix E: Sample Interview Questions

1) What areas within (insert location here) do you feel are in need of improvement?

2) How do you feel on current policies regarding sidewalk snow removal in Newton, MA?

3) In your opinion, how easy is it to move from place to place in (insert location name)?

4) Do you feel that these areas are accessible to everyone? If not, what do you feel should be changed to be more accommodating?