MODIFYING TRAFFIC CALMING ELEMENTS FOR THE CULTURAL AND SPATIAL CONSTRAINTS OF THE TURKISH URBAN STREETS: İZMİR-GÜZELYALI CASE STUDY

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ABSTRACT

MODIFYING TRAFFIC CALMING ELEMENTS FOR THE CULTURAL AND SPATIAL CONSTRAINTS OF THE TURKISH URBAN STREETS: İZMİR-GÜZELYALI CASE STUDY

The aim of this study is to identify preferred traffic calming elements, and to examine whether suitable traffic calming methods and elements for the cultural and spatial constraints of Turkish urban streets can be modified in order to discourage cut-through traffic and high volumes.

In Turkish urban streets, there is not widely applied traffic calming projects by local authorities. On the other hand, traffic calming elements can be used effectively in Turkish urban streets in order to solve traffic-related community problems. Since, the most important objectives of traffic calming are to provide equity in residential streets, and to make them more liveable places.

The case study focused on the application of the traffic calming elements in two residential streets which are used for cut-through traffic. By comparing the aplied traffic calming projects, by identifying advantages and disadvantages of traffic calming elements and problems of the case study streets in terms of cultural and spatial constraints, a look-up table was constituted. According to this table, the most suitable traffic calming elements were suggested in order to discourage cut-through traffic and to decrease traffic volume on the streets.

At the end of the study, survey showed that traffic calming is very foreign concept for the residents in the study site. However, it was concluded that for a street based traffic calming project a look-up table can be very useful in order to find the best solution for that street.

ÖZET

TÜRK KENT SOKAKLARININ KÜLTÜREL VE MEKANSAL YAPISINA UYGUN OLARAK TRAFİK DURULTMA TASARIM ELEMANLARININ GELİŞTİRİLMESİ: İZMİR-GÜZELYALI ÖRNEĞİ

Bu çalışmanın amacı; trafik durultma elemanlarını tanımlamak, ve diğer ülkelerde uygulnmakta olan trafik durultma projelerinin karşılaştımasını yaparak, Türk kentlerindeki sokakların kültürel ve mekansal yapılarına uygun olarak geliştirilip geliştirilemeyeceği konusunun araştırılmasını amaçlamaktadır.

Türk kentlerindeki sokaklarda trafik durultma projeleri uygulanmamakta olup yasalarda da bu tarz uygulamalara yönelik hükümler bulunmamaktadır. Ayrıca, her trafik durultma elemanı da Türk kentlerindeki sokaklarda kültürel ve mekansal anlamdaki kısıtlamalardan dolayı uygulanamamaktadır. Bununla beraber, trafik durultma elemanları, trafik problemleri yüzünden geleneksel özelliği olan "yaşam alanı" özelliğini kaybeden Türk kentlerindeki sokakların daha yaşanabilir hale gelmesi için çok etkili olabilecek uygulamalardır.

By çalışma ile, kestirme güzergah olarak kullanılan iki konut alanı sokağı için uygun trafik durultma elemanlarının seçilmesi ve uygulanması üzerinde durulmuştur. Sadece iki sokağı kapsamakta olan çalışma ile, öncelikle sokaklar üzerindeki problemler tespit edilmiş, hangi trafik durultma elemanlarının bu sokaklar için en uygun elemanlar olduğu araştırılmış ve en uygun trafik durultmam elemanlarını gösteren bir tablo oluşturulmuş, ve bu tabloya bakarak en uygun trafik durultma çözümleri önerilmiştir.

Çalışmanın sonucunda, çalışma alanındaki yaşayanlar için trafik durultma yönteminin çok yabancı bir kavram olduğu görülmüştür. Bununla beraber oluşturulan tablo ile en uygun trafik durultma çözümünün kolaylıkla bulunabileceği sonucuna varılmıştır.

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CHAPTER 1

INTRODUCTION

The number of motor vehicles is rapidly increasing in our country as all over the world. This exposed a traffic flow for roads which they were subjected to a pressure exceeding the capacity of them. However, streets are living places, especially in Turkish culture. People walk, shop, talk along the streets. But streets have become visually unattractive, noisy and unsafe.

The most common problems reported on residential streets regarding to motor vehicles are excessive speed, traffic volume and cut-through traffic. Also, traffic conflict between vehicles and pedestrians is another common problem on the streets that traffic engineers and urban designers have grappled with for years. All these problems make residents feel general decline in their quality of life, and they are beginning to understand that streets have too much traffic with a great speed and volume.

As a consequence, traffic calming is becoming the common term for addressing solving many traffic problems including slowing vehicle speeds, reducing cut-through traffic and traffic related noise, improving the aesthetics of the street, and increasing safety for pedestrians, bicyclists and vehicles. It is also gaining popularity, since it is based on the concept of sharing all modes of users in the same space. Besides, it has positive impact on safety and sustainability.

Recently, it has become increasingly clear that effective traffic calming must also incorporate enhancement of the streetscape. This includes design and landscaping and streetscaping features that not only improve the aesthetics and livability of a neighborhood but increase the effectiveness of many of the devices.

Also, the selection and design of various traffic calming elements are important. Because, each traffic calming element has appropriate applications, addressing one or more of the objectives. Each, however, also has disadvantages or negative impacts. Very few elements are so effective and have so few negative aspects that residents are willing to accept those that do not enhance the neighborhood environment.

In Turkey, there is not widely applied traffic calming projects; only a few traffic calming elements are applied as a consequence of seeing them only engineering

elements. On the other hand, traffic calming elements can be seen both urban design elements including landscape and streetscape design elements and traffic engineering elements. They enhance the neighborhood in addition to dealing with the traffic issues.

This thesis develops a scholarly concern about the wide usage of traffic calming elements gaining popularity all over the world. The aim of this study is to identify and select a preferred traffic calming elements that would take into account the safe and efficient of vehicular, pedestrian, and bicycle traffic while remaining accessibility needs of the adjacent residents, and to examine whether suitable traffic calming elements for the cultural and spatial constraints of Turkish cities can be modified in order to alleviate cut-through traffic and high volumes.

The primary objectives of the study include:

-improve the neighbourhood environment,

-encourage proper driving behavior,

-discourage cut-through traffic,

-minimize conflicts between road users,

-modify traffic calming measures according to cultural constraints of Turkish urban streets.

1.1. Problem Statement and Research Question Statement

Based on a review of various background documents, completed traffic analysis, site visits, and consultation with the public, the following study problem statement was developed:

“55 and 56 streets in Güzelyalı study area currently experience a high percentage of vehicles operating a considerable volume of cut-through traffic.”

The main question that is discussed in the study is: “How can traffic calming elements be modified in order to reduce cut-through traffic and create better environment in terms of spatial and cultural constraints of Turkish urban residential streets?”

The sub-questions in order to reach the solution of research question are:

-What is traffic calming and what are the traffic calming techniques and elements in urban streets?

-What defines the quality of neighborhood streets? What is the importance of neighborhood streets for neighborhood life in urban design?

-How neighborhood streets can be more livable and safer by using traffic calming elements as a street design element?

-Which traffic calming elements can be used in order to improve the quality of neighborhood streets in Turkish urban streets?

-What are the cultural and spatial constraints of İzmir-Güzelyalı urban streets?

-Can be a design guiding "look-up table" prepared in order to find the best traffic calming solutions by finding the similar examples in the world?

The examination of these questions is important for various reasons. First of all, traffic calming projects have not been applied in Turkish urban streets and also there is not any regulation about traffic calming in Turkish law. For this reason, it is important firstly to understand what is traffic calming and why it was appeared. Second of all, "streets" are living places, especially in Turkish culture. Hovewer, with the increasing number of vehicles they lose their "living place" feature. So, identifying the quality of streets is very important in urban desing in order to make streets again living places. Third of all, traffic calming elements are not only engineering elements but also street design elements. When traffic calming elements are used as street design elements, the streets can become safer and more livable places. Fourth of all, traffic calming is not applied in widely in Turkish urban streets which there are many cultural and spatial constraints. So, it must be carefully idendified which traffic calming elements are more suitable in Turkish urban streets.

1.2. The Study Site and Methodology

This thesis evolves around the case study of the two residential streets in Güzelyalı Neighbourhood in İzmir. It has been seen from the observations made in the limits of Güzelyalı Neighbourhood that cut-through transitions are made densely in some residential streets between İnönü and Mithatpaşa Streets within Güzelyalı Neighbourhood. 40 Street, 30 Street, 39 Street, 55 Street and 56 Street have been seen as the streets which have heavy traffic volume in Güzelyalı. From these streets, which have heavy traffic flow, traffic count was made, intensity of pedestrian and pedestrian use were observed in the 55 and 56 Sreeets and they were chosen as the study site.

Because the 55 and 56 Streets are the shortest route in order to cross from İnönü Street to Mithatpaşa Street, they are used as a cut-through route by drivers. Congestion has appeared on the streets because of the short-cuts made by drivers and they have become unsafe for pedestrians. Thereby, there are lots of commercial units along the streets, especially on the 56 Street. As a result of being both residential and commercial units, there are highly dense pedestrian activities. Also, there is one high school, one secondary school, one nursery school and one mosque on the streets. Generally, there are four and five storey apartments along the streets, and entrances to the buildings are made from the street.

The study methodology of this thesis has two parts: a literature review for defining traffic calming, its history and traffic calming elements, and a field study and on the project site in Güzelyalı.

The literature review includes the scholarly documents, the international charters, and also the graduate theses in urban planning departments of universities. As a part of literature review, also the graduate theses in the Turkish Universities that were electronically available at the archive of the National Thesis Center of Council of Higher Education *(*www.yok.gov.tr) were examined. Rather than with their content, meanwhile, a comparison of the graduate theses that are relevant for the research question of this thesis suggests that this thesis differs from those theses methodologically and with study findings. The total number of the graduate thesis that appeared in 8 scholarly disciplines was 61, including the overlapped keywords. Of this total, the numbers of the electronically accessible thesis were 32 and were completed between the year of 1999 and 2010 (see Table 1.1).

It was found that six theses related to traffic calming was performed in Turkey. In generel, theorotical background and varied implemented examples in abroad of pedestrianisation and traffic calming approaches, the applicabilty of those approaches in our city centres is theoretically researched, traffic calming elements as an effective new method in the revitalization of the urban streets were introduced, traffic calming techniques and policies as a new alternative in the restructuring of Turkish cities' streets were offered in other studies. All the studies offered area-wide traffic calming propositions.

This thesis differs from other studies in terms of the study case. This study offers based on one street traffic calming project. Also, proposed guideline design look-up

table for the case study streets is the most important difference from other studies of this thesis.

In addition to the literature review, this thesis also had fieldworks based on observations, questionnaires and face-to-face interviews. Field survey was completed in May-June-November-December 2011 and January 2012. First of all, general observations were made in Güzelyalı Neighbourhood. From these observations it was seen that most of the streets are too narrow, there is one-way application on some of them and there is a crucial parking problem on all of the streets. 40 Street, 30 Street, 39 Street, 55 Street and 56 Street have been seen as the streets which have heavy traffic volume in the district. From these streets 55 and 56 streets were chosen as study site. Because they are the shortest route in order to cross from İnönü Road to Mithatpaşa Road, they are used as a cut-through route by drivers. Second of all, in order to understand the density of cut-through traffic on those streets, vehicles entering and exiting the streets were counted manually at peak hours at weekdays and weekend and the rate of vehicles making cut-through were found approximately.

Table 1.1.The graduate theses in the Turkish universities searched according to the keywords in the electronic archive of the National Thesis Center of Council of Higher Education.

KEYWORD	NUMBER OF THE FINDINGS	NUMBER OF THE ELECTRONICALLY ACCESSIBLE THESIS	THE TIME INTERVAL OF THE ACCESSIBLE THESIS	ACCESSIBLE THESIS ACROSS THE DISCIPLINES							
				D1	D2	D3	D4	D5	D6	D7	D8
TRAFFIC CALMING	6	0									
PEDESTRIANIZATION	9	5	2006-2009	4	1						
WOONERF	0	0									
DEMOCRATIC STREETS	0	0									
SUSTAINABLE TRANSPORT	4	4	2003-2008	2			2	1			
SUSTAINABLE URBAN TRANSPORT	1	1	2006								
URBAN DESIGN	41	18	1999-2010	7	1	1			1	1	7

The name of the disciplines:

D1: City and Regional Planning
D2: Urban Design
D3: Traffic Planning
D4: Civil Engineering
D5: Engineering and Natural Sciences
D6: Interior Architecture and Environmental Design
D7: Social Sciences-Ceramic
D8: Landscape Architecture

This thesis develops in five chapters. The first chapter introduces why traffic calming has appeared as a solution of traffic peoblems, and describes the research question, aim method and findings of the study. The second chapter gives a conceptual framework for the process of appearing traffic calming. The third chapter gives a conceptual framework for traffic calming, and street design and traffic calming interdependencies in the literature. Also, this chapter gives some examples of traffic calming projects. The fourth chapter describes the cultural and spatial constraints of Turkish urban streets in terms of İzmir context and sets the most suitable traffic calming elements and design evaluating the previous chapters. The fifth chapter, conclusion chapter, has a general evaluation of the research.

CHAPTER 2

LITERATURE REVIEW

This chapter examines in general how traffic calming is defined, what traffic calming elements are, and why traffic calming has an important role for decreasing the negative impacts of traffic in literature.With the increasing of car using, many traffic problems have appeared and there are many negative impacts of these problems. In order to decrease many traffic problems, various solutions were invented. Firstly, the separation of vehicle and pedestrian/cyclist was one of these solutions. Pedestrianization and traffic calming are two of those solutions.

In this chapter, the process of appearing traffic calming was examined. Besides, what kind of traffic calming elements there are and the impacts of them were described. Firstly, what are the negative impacts of traffic was exmined generally. Secondly, the sustainable transport was defined. Thirdly, pedestrianization and woonerf/shared space concepts were examined in order to reach how traffic calming has appeared. Also, some traffic calming projects were given as example. These examples are mostly from Europe because of having similar streets with the case study site. Finally, the relationship between traffic calming and street design was examined.

2.1. General Overview on Traffic Negative Impacts

The number of cars on the roads and motor vehicle ownership levels are rapidly increasing with the increase of populations. Therefore, many urban streets were invaded by motor vehicles. As a result, traffic is reported to be a key problem in urban streets and open spaces. It is said that its negative impacts are reduced safety for other car users, pedestrians and cyclists, vibrations, noise, air pollution, fear (especially for children), the prevention of movement in places, intrusive parking, and environmental damage and degradation (Williams and Green 2001). However, urban streets should be a part of urban life and they are in danger because of the negative effects of traffic which impact equally on all residential districts. On the other hand, near the end of the 20th century, people have realised that the car has not only brought freedom of

movement but also declining city centres, urban sprawl, air pollution, traffic noise and accidents, and present trends in transport are not sustainable (Greene and Wegener 1997).

First of all, the negative impacts of traffic damage the environment and deter people from cycling and walking. For instance, parents discourage their children from walking and cycling because of perceived traffic danger. Then the children are driven by car especially to school which increases the traffic. This also causes fewer pedestrians, increased traffic nuisance such as air pollution, a less vibrant neighbourhood, decreased levels of fitness in children, increasing levels of obesity, and undermine open space use for children's play. Williams and Green (2001) claims that recent empirical research for the Children's Play Council indicated that over a quarter of children interviewed prefer to play in the street. But for many parents the streets are dangerous for their children and they discourage children from playing in the street because of heavy traffic.

Second of all, it is claimed that there is evidence that high traffic volumes have negative effects on the social function of public space. This is especailly a crucial problem for Turkish urban streets. Since, the streets have an important role for social interaction in Turkish culture and heavy traffic can prevent streets being used for that role. Appleyard's study (1981) can be shown as an evidence for this issue. He studied three similar residential streets in San Francisco characterised by heavy, medium and light traffic flow. He accepted 'light streets' as having 2000 vehicles a day and 'heavy streets' as having 16000 vehicles a day. He found in mapping exercies that people on the 'light street' considered the whole street to be their home territory. On the other hand, residents of the 'heavy street' regarded it to be a smaller area around their own building. He concluded his study that heavy traffic has a negative effect on public interactions (Appleyard 1981).

Third of all, heavy traffic can lead to crime by isolating local residents in their homes. However, it was claimed that where a city's transport priorities are public transport, walking and cycling, a greater amount of human interaction and community exists which also provide safety on the streets. Also, the trend for increasing car use for local services is evidently undermining the government's policies for sustainable environments (Williams and Green 2001). Furthermore, Metzger (2008) explains that when congestion on major roads increases, drivers move to alternate routes cutting through residential neighborhoods to decrease travel time and delay that would

otherwise be experienced on the larger arterial roadway. When cut-through traffic increases on residential streets, safety related concerns also increase, too. Especially, residential neighborhoods, lined with pedestrian activity (many including children), become very unsafe when higher volumes of traffic use the roadway.

Finally, increases in pollution, noise and accidents are also problems caused by traffic growth (Gargett and Gafney 2004).

2.2. The Sustainable Transport

The term sustainable development was first used by World Conservation Strategy (WCS) in 1980 to emphasize the significance of resource conservation for future of humanity. According to the World Commission on Environment and Development (1987) "sustainable development is one that meets the needs of the present without compromising the ability of future generations to meet their own needs". Also, the Charter of European Cities and Towns Towards Sustainability (1994) (the 'Aalborg Charter') states as the objective of sustainable development "to achieve social justice, sustainable economies, and environmental sustainability." Qureshi and Huapu (2007) claims that the rapid urbanization and motorization in mega cities around the world have a direct impact on sustainable development and, according to them, the transport sector's energy consumption and greenhouse gas emissions will likely be doubled by the year 2025 (Qureshi and Huapu 2007).

Sustainable transport is an expression of sustainable development in the transport sector. According to Castillo and Pitfield (2010), sustainable transport has become the fundamental goal of transport planning and policy in the past two decades and there is still no single universally accepted definition of 'sustainable transport' like the concept of 'sustainable development'. Since, transportation is a complex social, technical and economic system which is difficult to address comprehensively (Goldman and Gorham 2006). On the other hand, Lee (2004) explains that the European Union Council of Ministers of Transport (2001) put three views for the definition of sustainable transport. First one is that it allows the basic access and development needs of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations. Second one is that it is affordable, operates fairly and efficiently, offers

choice of transport mode, and supports a competitive economy, as well as balanced regional development. Third one is that it limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and, uses non-renewable resources at or below the rates of development of renewable substitutes while minimizing the impact on the use of land and the generation of noise.

Sustainable transport, firstly, seeks to reduce the consumption of energy caused by vehicles by exploring alternatives to the automobile. It is claimed that researchers and practitioners try to create alternative land use development patterns that are less automobile dependent and have more opportunities for walking in order to promote more sustainable modes of transportation (Randall et al. 2005). As the result of this, it can be said that the most overarching objectives for sustainable transport are supposed to be liveable streets and neighbourhoods, protection of the environment, equity and social inclusion, health and safety, and support of a vibrant and efficient economy (Castillo and Pitfield 2010).

2.3. Pedestrianization

Pedestrians are the largest single group of road users and walking is one of the most used transport modes. Pedestrians include people of both sexes, people of various degrees of physical fitness encompassing the disabled, and of all ages and socio-economic groupings. However, they are at highest risky groups in the traffic. Since, they are very undefendable to serious injuries in the traffic (O'Flaherty 1997).

There are various meanings of pedestrianzation. Hass-Klau (1990) defines it as the removal of vehicular traffic from city streets through road closures and other restrictions.

There are many diferent reasons for having pedestrianization. Firstly, it improves pedestrian safety and mobility. Secondly, it reduces both noise and air pollution by discouraging or restricting access of non-essential vehicles. Thirdly, it helps to promote walking as a transport mode by making the walking experience more enjoyable. Fourthly, it provides a more pleasant environment whereby people can engage in different social, cultural and tourist activities. And finally, it promotes economic growth (Lee 2004).

2.3.1. History and Basic Principles of Pedestrianization

Traffic congestion in many large cities had become a serious problem from the mids of the nineteenth century. There are two important reasons of increasing traffic congestion. First one is the bicycle developed during the second decade of the nineteenth century, which was in common use from 1895 onwards. And second one is the car developed in 1885 by Carl Benz and Gottlieb Daimler.

Pedestrianization has been practiced in many countries for years. Leonardo da Vinci was the first known planner to suggest the separation of pedestrians from heavy traffic arteries to solve the traffic problems of Milan during the fifteenth century. His idea was to put the traffic underground. Venice which developed from the fifth century onwards is accepted the most beautiful example of early separation between traffic and pedestrians. Furthermore pavements and arcades were the first planned attempts in congested urban areas to separate pedestrians from wheeled traffic (Hass-Klau 1990).

In 1933, the Charter of Athens recommended strict separation of traffic from civic spaces. The principle of segregation was most clearly supported by the committee chaired by Colin Buchanan, whose seminal report *Traffic in Towns* was published in 1963. Buchanan argued that the two principal purposes associated with streets and public spaces, those of movement and of social interaction, would need to be strictly segregated as traffic volumes increased (Hamilton-Baillie 2008).

In Buchanan report, it was claimed that traffic movement was need to be segregated from pedestrians and social activities (Buchanan 1963). Lee (2004) explains that many European cities first began closing some of their narrow streets to wheeled traffic in the early 20th Century, since these streets were not wide enough to meet the needs of both motor vehicles and pedestrians. Germany is one of those earliest countries to accept the idea of pedestrianization. The earliest generation of pedestrian streets first appeared during the late 1940s and during the 1950s, and the second generation of pedestrianization schemes was completeted between the early 1960s and 1980s. Downtown shopping streets were pedestrianized throughout the 1960s across Germany. Pedestrian streets were provided as part of a general redesign of city centers. All cities and almost all towns with a population of over 50000 have central pedestrian areas (Clarke and Dornfeld 1994).

In Britain, the pedestrianization of shopping centers began 1920s (Lee 2004). Between 1930s and the 1960s "play streets", which could be used as playground for children, were closed for vehicles for specific period during a day or on certain days (Hass-Klau 1990). On the other hand, British Law did not allow the closing off of streets for the use of pedestrians before the end of the 1950s until the Road Traffic Regulation Act (Lee 2004). Besides, the uses of pedestrianization schemes were not widespread as other European countries like Denmark and Germany in general (Hass-Klau 1990). In Italy, downtown areas are closed to traffic with the exception of permit holders and motor vehicle access to historic city center was restricted by improving public bus services. In Denmark, by 1977, 39 cities had pedestrianized streets in their city centers as the result of growing traffic congestions. In the United States of America, two main types of strategies are used to separate pedestrians from motor vehicles. They are skywalks systems and outdoor pedestrian malls. The first downtown pedestrian mall was built in 1959 in the city of Kalamazoo in Michigan State. By the end of the 1970's over 200 cities had got similar malls. At the beginning during the 1960's and 1970's most of these downtown malls were closed totally to vehicle traffic. Many Americans that were used to suburban malls felt that downtown malls were inferior with them being uncomfortable, less safe and convenient. Some cities had even decided to reopen their malls to motor vehicles. As for skywalks, the first such system was built in 1962 in Minneapolis. They were networks of elevated pedestrian walkways that were interconnected and linked with different buildings in city centres. There were usually shops inside buildings connected to these walkways. By 1993 over 30 cities in the United States and Canada had skywalks systems. Unlike pedestrian malls, the number and scale of skywalks in American cities continued to increase (Lee 2004).

Clarke and Dornfeld (1994) state that 120 German towns were surveyed by Monheim in 1975 to determine why they had implemented pedestrianization. Monheim found that the most important reason was to have an up-to-date town layout and attractive image. Other popular answers were:

-improvements for traffic and safety;

-leisure use of the center, especially for evening use;

-attracting shoppers from surrounding countryside;

-less noise and pollution;

-preservation of historic townscape;

-prevent loss of trade to competing towns (Clarke and Dornfeld 1994).

Clarke and Dornfeld (1994) claim that there are some basic principles of pedestrianization. Firstly, streets should already have significant pedestrian activity before motor vehicle traffic is removed. And secondly, pedestrian areas should not usually introduced as isolated measures, but as part of a package designed improve the whole downtown area.

2.4. Woonerf/Shared Street

Woonerf is the Dutch name for a "living street" in which the needs of car drivers are secondary to the needs of users of the street as a whole. It is a "shared space" designed to be used by pedestrians, playing children, bicyclists, and low-speed motor vehicles, becoming a public place for people instead of single-purpose conduits for automobiles. It integrates pedestrian activity and vehicular movement on one shared surface (Ben-Joseph 1995).

In 1963, Niek De Boer designed cul-de-sac streets which were designed in such a form that motorists felt as if they were driving in their own garden and he gave these streets a different name which is “woonerf”. His idea was taken up by the Municipality of Delft. The Planning Department of Delft showed that the speed of vehicle traffic could be reduced with specific design measures such as speed humps and trees at the side of pavements. And they invited residents who were living in those streets to express their own ideas. The idea was to avoid the typical street separation between pavements and carriageway. Instead of this, integration into one road surface was provided giving the visual impression. According to planners, this impression would be enhanced by trees, benches and small front gardens. And finally, these new streets were called “woonerven”. The woonerf idea was implemented in an historic housing area in Delft. After the success of woonerf implementations, woonerven obtained legal status in Dutch law in 1976. With the woonerf design the feeling that priority rests not with the motor vehicle but with residents on foot, children playing and nonmotorized users is given. Moreover, the whole street is on the same level by not providing any sidewalk. Vehicles had to drive at horse-walking pace, and car parking was allowed in clearly parked marking spaces (Hass-Klau 1990).

Figure 2.1. Early woonerf in Rijswijk, The Netherlands
(Source: Hamilton-Baillie 2008)

Clarke and Dornfeld (1994) identify that the 1976 Law includes very specific design requirements. Firstly, the impression that the highway is divided into a separate roadway for motor vehicles and a footpath must be avoided. There should, therefore, be no continuous difference in cross-sectional elements along the lenght of the road.

Secondly, features must be introduced which will restrict the speed of all types of vehicles at the parts of the highway intended for motor vehicle use. These features should not be more than 50 meters apart. Thirdly, adequate street lighting must be provided to ensure that all features are fully visible at night.

Furthermore, Clarke and Dornfeld (1994) explain that five basic principles also were outlined. First one is that pedestrians may use the full width of the roads within a woonerf which is designated as such playing is also permitted on the roadway. The second is that drivers within a woonerf may not drive faster than at walking pace. They must make allowance for the possible presence of pedestrians, including children at play, unmarked objects, and irregularities in the road surface, and the alignment of the roadway. The third one is that traffic from the right has priority over the left in a woonerf. Normally, fast traffic has priority over slow traffic. The fourth one is that drivers may not hinder pedestrians within a woonerf. Pedestrians shall not unnecessarily hamper the progress of drivers in a woonerf. And the last one is that drivers of motor vehicles with more than two wheels are not permitted to park in a woonerf except at

places which are identified by the appropriate traffic sign or the letter P marked on the pavement (Clarke and Dornfeld 1994).

Ben-Joseph (1995) identifies that the woonerf/shared street can be characterized as follows:

-It is a residential, public space;

-Through traffic is discouraged;

-Paved space is shared by pedestrians and cars, with pedestrians having priority over the entire street;

-Walking and playing are allowed everywhere;

-It can be a single street, a square (or other form), or combination of connected spaces;

-Its entrances are clearly marked;

-There are no conventional, straight stretches of pavement with raised curbs, and pavement (carriage way) and sidewalk (footway) are not rigidly demarcated;

-Car speed and movement are restricted by physical barriers, and by deviations, bends, and undulations;

-Residents have auto access to dwelling fronts;

-The area has extensive landscaping;

-The area has street furnishings (Ben-Joseph 1995).

Figure 2.2. All traffic signs, signals and markings removed in Makkinga, Friesland (Source: Hamilton-Baillie 2008)

Figure 2.3. Skvallertorget, Norrköping, Sweden before and after remodelling of the intersection (Source: Hamilton-Baillie 2008).

However, it is identified that there are some problems with woonerven. First of all, modernising existing neighborhoods to become woonerven can be expensive. Second of all, woonerven has very strict design requirements which often could not be met. Finally, the principles of woonerven could not legally be extended to shopping streets or village centers (Clarke and Dornfeld 1994). But Hamilton-Baillie (2008) claims that more recent schemes have begun to indicate that woonerf/shared space principles might be suitable for busier town centre intersections and high streets. Since, they provide the integration of traffic into the social and cultural fabric of the built environment. For instance, in 2002 the main shopping street in the suburban town of Haren, near Groningen, was redesigned along shared space principles. Another example is the 800 metre-long Rijksstraatweg which carries between 8,500 and 12,000 vehicles per day through the main shopping and civic area. The former centre-line road markings, traffic signals, separate bicycle lanes and high kerbs were all removed (Hamilton-Baillie 2008).

Figure 2.4. Gran Via, Bilbao
(Source: Hamilton-Baillie 2008)

CHAPTER 3

TRAFFIC CALMING

Traffic calming was originally developed in the Netherlands under the term woonerven during the late 1960s and early 1970s. Since then it has been developed much further and successfully applied in many other countries. It is against to both pedestrianization and motorization on the streets.

Traffic calming is both a planning and a transport policy and may become a new way of life in built-up areas in the future. If we are serious about the cultural inheritance of our towns and villages it may well be the only way forward to cope with the increasing number of motor vehicles which have been forecast (Hass-Klau 1990).

The streets' purpose is for people to walk, stroll, look, gaze, meet, play, shop and even work alongside cars but not dominated by them. Traffic calming is founded on the idea that streets should help create and preserve a sense of place. It has some elements to make this. The elements of traffic calming take a different approach from treating the street. They include techniques designed to lessen the impact of motor vehicle traffic by slowing it down, or literally "calming" it. This helps build human-scale places and an environment friendly to people on foot.

However, traffic calming projects can be done locally or area wide basis. If it is done locally then there is chance that drivers may change their direction and alternate routes will be congested. So traffic calming projects should be done area wide basis instead of localized treatment. This also provide users a regular announcement avoiding them becoming amazed with new designs. An extensive approach should be undertaken to solve neighborhood traffic problems. This should involve a more detailed traffic study including evaluation of the capacity and design features of the neighboring collector and/or arterial roadway network (Rahman et al. 2005).

3.1 Definition of Traffic Calming

In the literature traffic calming definitions vary. First of all, the Institute of Transportation Engineers (ITE) defines traffic calming as the combination of mainly

physical measures that reducce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for nonmotorized street users.

Second of all, the American Planning Association describes it as a form of traffic planning that seeks to equalize the use of streets among automobiles, pedestrians, bicyclists, and playing children.

Another definition is: "Traffic Calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users" (Lockwood 1997, 22).

Lockwood (1997) also explains the meanings of the phrases in this definition. The definition's phrase "mainly physical measures" means physical measures and a supportive environment, which includes such things as policy and legistlative support for traffic calming and flexibility of standards, guidelines and practices. According to Lockwood (1997) a supportive environment is as important as the traffic calming measures themselves because it is allows traffic calming to happen.

The phrase "reduce the negative effects of motor vehicle use" means "changing the design and the role of the street to reduce the negative social and environmental effects of motor vehicles on individuals (e.g., speeding, intrusion, etc) and on society in general (e.g., energy consumption, pollution, urban sprawl, etc)" (Lockwood 1997, 23).

The phrase "alter driver behavior" points "the self enforcement aspect of traffic calming; the lowering of speeds, the reduction of aggressive driving and the increase in respect for non-motorized users of the streets" (Lockwood 1997, 23).

The phrase "improve conditions for non-motorized street users" means "to promote walking and cycling, increase safety, create a feeling of safety, improve the aesthetics, etc." (Lockwood 1997, 23).

Lockwood (1997) also defines the related words and phrases. These are;

-"Traffic calming measures are design elements in and/or along the street or intersection that conform to the definition of traffic calming" (Lockwood 1997, 24).

-"Route modification (or traffic management) is the combination of measures that alters the available routes for traffic or traffic flow" (Lockwood 1997, 24).

-"Route modification is an attempt to change traffic routing or traffic flow on the street network, while traffic calming is an attempt to alter driver behavior." Both traffic calming and route modification often share the common goal of improving quality of life by preventing cut-through traffic (Lockwood 1997, 24).

-“Traffic control devices: are signs, signals and markings designed to regulate, warn, guide and provide information” (Lockwood 1997, 24). Examples include stop signs, speed limit signs and traffic signals. Traffic control devices are frequently confused with traffic calming measures. Although a traffic control device and a trafic calming measure could share the common goal of slowing down car drivers, the traffic control device is an attemt in communication, while the traffic calming measure is a part of the design of the street or intersection (Lockwood 1997).

-“Streetscaping includes planning and placing distinctive lighting, furniture, art, trees, other landscaping, etc. along streets and at intersections” (Lockwood 1997, 24). According to Lockwood (1997) streetscaping can ocur quite successfully without traffic calming, but traffic calming is most successful when it is done in conjuction with streetscaping which is why “related streetscaping” was included in the definition of traffic calming (Lockwood 1997).

-“Traffic calming plans affect one or more streets and/or intersections and involve traffic calming measures” (Lockwood 1997, 24).

-“Neighborhood traffic calming plans: are traffic calming plans for whole neighborhoods” (Lockwood 1997, 24).

-“Area-wide traffic calming plans: are traffic calming plans for large areas” (Lockwood 1997, 24).

-“Street modification plans affect one or more streets and inersections and involve traffic calming, route modification/traffic management, streetscaping, traffic control, provisions for non-automobile modes (sidewalks, conta-flow cycle lanes, etc.) and on-street parking” (Lockwood 1997, 24).

3.2. The Goals and Objectives of Traffic Calming

According to Lockwood (1997) the lists of goals and objectives are very useful supplements to the definition. They allow traffic calming to be related to other policies, official plans, master plans, etc. It is recognized that the goals are rather intangible, which is what goals should be. However, the objectives are more tangible. Therefore, by using the objectives, people can evaluate traffic calming at whatever level they need to, and develop measures of success and failure for their own traffic calming projects and policies (Lockwood 1997).

The basic traffic calming goals include:

-increasing the quality of life;

-incorporating the preferences and requirements of the people using the area (e.g., working, playing, residing) along the streets, or at intersections,

-creating safe and attractive streets helping to reduce the negative effects of motor vehicles on the environment (e.g., pollution, sprawl) and

-promoting pedestrian, cycle and transit use (Lockwood 1997).

Traffic calming objectives include:

-achieving slow speeds for motor vehicle;

-reducing collision frequency and severity;

-increasing the safety and the perception of safety for non-motorized users of the streets;

-reducing the need for police enforcement;

-enhancing the ste Street environment (e.g., streetscaping)

-encouraging water infiltration into the ground;

-increasing access for all modes of transportation;

-reducing cut-through motor vehicle traffic (Lockwood 1997).

Lockwood (1997) states that the goals and objectives demonstrate that traffic calming involve much more than just motor vehicle issues. It is important that municipalities and comunities have a choice of why they should traffic calm. For example, in one city, reducing speeding may be the key objective, while in another it may be a combination of improving aesthetics and increasing water infiltration into the ground. Another city may be concerned about urban reneval and crime (Lockwood 1997). Moreover, it is recognized that different combinations of goals and objectives will apply to different situations.

3.3. History and Development of Traffic Calming

Traffic calming can be traced to the development of three types of methods: environmental areas, pedestrianization, and the Dutch “woonerven”. The origin of traffic calming can be traced to Germany where downtown shopping areas were converted into pedestrian areas (Clarke and Dornfeld 1994).

However, many transportation and planning professionals believe that Buchanan's controversial Traffic in Towns, which was an influential report on urban and transport planning policy produced in 1963, shaped the revival of and reinforced belief in traffic calming in Europe. The report signified some fundamental shifts in attitudes to roads by recognising that there were environmental disbenefits from traffic.

In 1959 the Ministry of Transportation had commissioned Buchanan to investigate "improving urban transport." Buchanan brought to the team an innovative analysis that identified the conflict between providing for easy traffic flow and maintaining the residential and architectural fabric of the street. After that they suggested the creation of specific street zones called "environmental areas" or "urban rooms". According to them, these specific street zones would have a character different from typical streets and would vary according to their functions. They claimed that streets would be evaluated not only for their capacity to carry traffic, but also for their environmental quality as measured by noise, pollution, social activity, pedestrianization, and visual aesthetics. Thus, certain environmental areas would segregate traffic and pedestrians completely, but others would have a mixture of pedestrians and vehicles. Their main idea was to allow pedestrians and vehicles to mix safely in the street. Redesigning the physical aspects of the street would reclaim the social and physical public domain for pedestrians (Ben-Joseph 1995).

On the other hand, the report's concepts of "traffic integration" and "traffic calming" in the environmental capacity zones failed to find acceptance and were misunderstood by British policy makers. The ideas ran counter to the economic and development policies of the time, which sought economic growth by building motor ways, reforming the railway system, and improving roads. Interestingly, the Traffic in Towns report had much more impact in mainland Europe (Ben-Joseph 1995).

Ben-Joseph (1995) idendifies that Niek De Boer, Professor of Urban Planning at Delft University of Technology and the University of Emmen in the Netherlands, was inspired by Buchanan's theoretical ideas in his work on the physical design of streets. Trying to overcome the contradiction between children playing and car use, De Boer turned to Buchanan's concept of coexistence; he designed cul-de-sac streets in such a form that motorists would feel as though they were driving in a "garden" setting, and so would be forced to take into consideration the other street users. De Boer renamed this type of street "Woonerf," or "residential yard." At the same time (1969), the Municipality of Delft was about to redesign and upgrade the road surfaces in iner city

locations. The planners decided to implement De Boer's ideas in some lower-income neighborhoods where more child play areas were urgently needed but available sites were almost nonexistent. With resident participation, a physical design was formed that integrated sidewalks and roadways into one shared surface, creating the impression of a "yard." This was further enhanced by trees, benches, and small front gardens (Ben-Joseph 1995).

As the result, it is accepted that traffic calming had its genesis in The Netherlands, in the form of ''woonerfs,'' or residential precincts, designed to limit the mobility of motor vehicles in neighborhoods. Moreover, is the result of community action against speeding traffic on community streets on the Netherlands in the 1960s (Metzger 2008). The first traffic calming element was installed at the end of an alley in Delft in 1970 and it was a road hump with an elevation of 8 cm. By 1976, regulations that incorporated traffic calming features into design standards had been established. Other European nations followed suit, with Austria, Denmark, Germany, and Switzerland all adding traffic calming codes by 1984 (Cottrell et al. 2006). Pharaoh and Russell (1991) observed that speed humps were rejected in Germany, but were employed extensively in Denmark and The Netherlands.

It was stated that in Denmark, speed humps were considered to be necessary for effective speed reduction. However, in The Netherlands, speed humps were being used to seperate the boundaries of 30 km/h calmed streets; 50 km/h humps were being used on roads that provide access to residential streets (Cottrell et al. 2006).

Metzger (2008) states that some early traffic calming measures, street closures and traffic diverters, were used in the United States as early as the late 1940's. The first citywide adoption of traffic calming took place in Seattle, WA in the early 1970's. It was not until 1980 that the first comprehensive study of traffic calming in the United States was performed (Metzger 2008).

According to Clarke and Dornfeld (1994), in the United States traffic calming attempts usually incline to focus on spot locations and they mostly tend to reduce motor vehicle speed and result in fewer motor vehicle accidents. Furthermore, not only traffic calming but also pedestrianization, extensive bicycle facility networks, improved public transport has been less severe, and the solutions less widespread and well developed than in Europe (Clarke and Dornfeld 1994).

The Japanese have also experimented with woonerven and traffic calming in recent years. The first "community street" was installed in Nagaike-cho, a suburb of

Osaka, based on the woonerf design in 1980. It was reported that Pedestrian traffic in the street increased 5 percent, bicycle traffic rose by 54 percent and car traffic entering the street fell by 40 percent (Clarke and Dornfeld 1994).

Although traffic calming techniques has been known throughout the world for 30 years, it is almost an untouched topic for Turkey. Thus, it is too hard to find the comprehensive study and application projects related to traffic taming efforts in Turkey. On the other hand, the promotion of traffic calming measures throughout the country can only be provided with the construction of the model projects and the preparation of the traffic calming design guidelines by the significant municipalities. No doubt that, the application of the area-wide traffic calming schemes will have the major role in the creating of walkable streets in our cities and towns.

3.4. Traffic Calming Elements

Traffic calming elements are defined as “they are physical road design elements intended to reduce vehicle speeds and improve driver attentiveness” (Docstoc 2012). They can be generally confused with the traffic management measures which are the application of turn restrictions and other measures to redirect or restrict traffic flows (Docstoc 2012). Traffic calming elements have been used primarily for residential streets but are sometimes used on collectors and arterials (Steiner and Butler 2007).

Traffic calming elements can be categorized under four groups generally.

1. Volume Control Elements
2. Speed Control Elements
3. Narrowings (Both Volume and Speed Control Elements)
4. Other Elements (Environmental and Aesthetic Elements)

Additionally, these categorized elements can be combined, and new type of elements can be constituted or modified. These different combinations of traffic calming measures are appropriate depending on the existing motor vehicle speeds and volumes, the overall traffic calming plan and goals and objectives for the streets. However, the location type (entrance, internal intersection, mid-block location), street type (local, collector, arterial or highway), street geometry, adjacent land uses, public transit needs, budget, aesthetic considerations and community preferences are the crucial factors of applying what kaind of elements should be chosen or modified (Lockwood 1997).

Traffic calming elements have many advantages for both pedestrian and vehicle accommodation. Firstly, they reduce motor vehicle speeds, their stopping distances, and the severity of pedestrian/motor vehicle conflicts. Secondly, they increase the attentiveness of motor vehicle drivers to the presence of pedestrians. Also, they reduce crosswalk distances, and the extent of pedestrian/motor vehicle conflict and increase sidewalk space Furthermore, they reduce motor vehicle speed, and as a result they reduce the probability and severity of crashes. Finally, they also provide motor vehicle drivers with multiple reminders of safe and appropriate operating speed (Docstoc 2012).

On the other hand, there are also some disadvantages of traffic calming elements. First disadvantage is that traffic calming elements can slow emergency response since they often require slower operating speeds or diversions. So, it is important to coordinate traffic calming plans with local emergency response departments so that these impacts are minimized. Second one is that inappropriately designed or placed traffic calming elements can impede large truck traffic. Also, some traffic calming elements can cause increased noise and headlight impacts to adjacent properties (Docstoc 2012).

The choice of proper traffic calming elements and its implementation result in gaining the best benefits. So, traffic calming elemenst should be chosen or modified based on the type of the problem of the street (Rahman et al. 2005).

Table 3.1. Traffic Calming Elements

TRAFFIC CALMING ELEMENTS			
Volume Control Elements	Speed Control Elements	Narrowings (Both Volume and Speed Control Elements)	Other Elements (Environmental and Aesthetic Elements)
-Full Street Closure -Half Street Closure -Directional Closure -Forced-turn Island -Diverter -Median Barrier	-Speed Hump -Speed Table -Speed Cushion -Raised Intersection -Raised Crosswalk -Traffic Circle -Roundabout -Curb Extension -Curb Radius Reduction -Lateral Shift -Chicane -Realigned Intersection	-Neckdown -Choker -On-street Parking -Centre Island Narrowing	-Textured and Coloured Pavements -Occasional Strip -Entrances and Gateways -Planting/Greenery -Street Furniture and Lighting

3.4.1. Volume Control Elements

Cut-through traffic is one the most important problems on residential streets. Motorists prefer to use the residential cut-through as their normal route of travel if they want to avoid traffic, save time, or shorten their travel distance. The primary purpose of volume control elements is to reduce the quantity of vehicles that use a specific roadway and to discourage or eliminate cut-through traffic (DOWL Engineers 2001).

Volume control elements consist of closures (full street, half street and directional), diverters and maiden barriers.

1. Full Street Closure

Description and Purpose:

A full street closure is a barrier extending the entire width of a roadway, which obstructs all motor vehicle traffic along the roadway. A closure can change a four-way intersection to a three-way intersection, or a three-way intersection into a non-intersection.

The purpose of a full closure is to eliminate short-cutting or through traffic (Murphy 2003).

Examples of full street closures include hammer heads, cul-de-sacs, and dead-end. Closure barriers may consist of landscaped islands, walls, gates, side-by-side bollards, or any other obstructions that leave an opening smaller than the width of a passenger car (DOWL Engineers 2001).

Benefits:

-A full street closure eliminate all short-cutting or through traffic.

-It is able to maintain pedestrian and bicycle access.

-It is very effective in reducing speeds.

Disbenefits:

-Legal procedures is required for street closures.

-It restricts resident access to the neighbourhood and business;

-It may be expensive;

-It may divert significant volume of traffic to parallel streets without traffic calming measures (Murphy 2003).

Placement:

It is good for locations with extreme traffic volume problems in which several other elements have been unsuccessful.

Estimated cost:

Although the cost may cgange depending on the design, the estimated cost is $120.000.

Figure 3.1. Full street closure with greenery
(Source: Murphy 2003)

2. Half Street Closure

Half street closures are barriers that block travel in one direction for a short distance on otherwise two way streets. They are also sometimes called partial closures or one-way closures. When two half closures are placed across from one another at an intersection, the result is a semi-diverter that blocks through movement on a cross street (DOWL Engineers 2001). It is good for locations with extreme traffic volume problems in which several other elements have been unsuccessful.

Benefits:

- It is able to maintain two-way bicycle accesss

-It is effective reducing volumes.

Disbenefits:

- It restricts resident access to the neighbourhood and business

-It causes circuitous routes for local residents and emergency services

Placement:

It is good for locations with extreme traffic volume problems in which several other elements have been unsuccessful.

Estimated cost:

Although the cost may cgange depending on the design, the estimated cost is $40.000.

Figure 3.2. Half street closures
(Source: DOWL Engineers 2001)

3. Directional Closure

Description and Purpose:

A directional closure is a curb extension or vertical barrier extending to approximately the centreline of a roadway, effectively obstructing one direction of traffic.

The purpose of a directional closure is to obstruct short-cutting or through traffic.

Benefits:

Directional closures typical result in about a 40% reduction in traffic volumes. Some streets may also experience a reduction in travel speeds.

Disbenefits:

- It restricts resident access to the neighbourhood; and

-It may divert significant volume of traffic to parallel streets without traffic calming measures (Murphy 2003).

Figure 3.3. Directional closure obstructs one direction of traffic.
(Source: Murphy 2003)

4. Forced Turn Island

Forced turn islands are raised islands on approaches to an intersection that block certain movements. They are sometimes called forced turn channelizations, pork chops, or right turn islands (DOWL Engineers 2001).

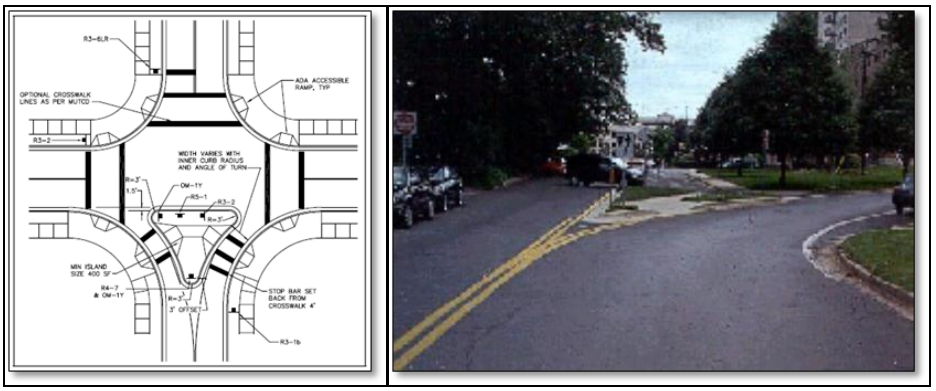

Figure 3.4. Forced turn island
(Source: DOWL Engineers 2001)

5. Diverter

Description and Purpose:

A diverter is a raised barrier placed diagonally across an intersection that forces traffic to turn and prevents traffic from proceeding straight through the intersection. Diverters can incorporate gaps for pedestrians, wheelchairs and bicycles and can be

mountable by emergency vehicles. They are also called full diverters and diagonal road closures (DOWL Engineers 2001).

The purpose of a diverter is to obstruct short-cutting or through traffic (Murphy 2003).

Benefits:

Diverters can result in a 20% to 70% reduction in area-wide traffic volumes, depending on extent of diverters used.

Disbenefits:

-It restricts resident access to the neighbourhood; and

-It may divert significant volume of traffic to parallel streets without traffic calming measures (Murphy 2003).

Placement:

Like half street closure, diverter is often staggered to create circuitous rroutes through the neighbourhood as a whole, discouraging non-local traffic while maintaining access for local residents. It is good for inner-neighbourhood locations with non-local traffic volume problems.

Estimated cost:

Although the cost may cgange depending on the design, the estimated cost is $85.000.

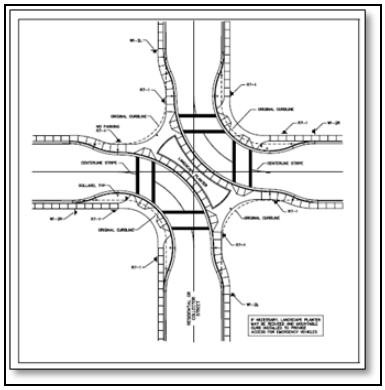

Figure 3.5. Diverter
(Source: DOWL Engineers 2001)

Figure 3.6. Diverter
(Source:Murphy 2003)

6. Median Barriers

Description and Purpose:

A median barrier is an intersection in an elevated median located on the centreline of a two-way roadway through an intersection (Murphy 2003) .They are also referred to as median diverters or occasionally as island diverters (DOWL Engineers 2001).

The purpose of a raised median through an intersection is to:

-Obstruct short-cutting or through traffic;

-Reduce crossing distance for pedestrians (Murphy 2003).

Benefits:

-It can reduce traffic volumes on a cut-through route that crosses a major street.

-It can improve safety at an intersection of a local street and a major street by prohibiting dangerous turning movements.

Disbenefits:

-It restricts resident access to the neighbourhood;

-It may divert significant volume of traffic to parallel streets without traffic calming measures (Murphy 2003).

Placement:

It should accommodate normal turning radii near intersections where applicable; placed in the middle of the roadway with proper warning signing and delineation.

Estimated cost:

$5,000-$15,000 per island (Traffic Engineering Division 2002).

3.4.2. Speed Control Elements

Speed control elements can be grouped under two categorized. First one is vertical speed control measures and the second one is horizontal speed control measures. They control the speed of vehicles on streets and impact pedestrian access. Also, they discourage non-local traffic from travelling through a neighbourhood.

Speed control elements consist of vertical and horizontal elements. Vertical elements consist of Speed Hump, Speed Table, Speed Cushion, Raised Intersection and Raised Crosswalk. And horizontal elements consist of Traffic Circle, Roundabout, Curb Extension, Curb Radius Reduction, Lateral Shift, Chicane and Realigned Intersection.

3.4.2.1. Vertical Speed Control Elements

Vertical speed control elements are elevated segments of roadway that require vehicles to slow down. Typical measures include speed humps/bumps, speed tables, raised crosswalks, and raised intersections (DOWL Engineers 2001).

1. Speed Hump and Speed Cushion

Description and Purpose:

A speed hump and a speed cushion are a raised area of a roadway, which deflects both the wheels and frame of a traversing vehicle. The purpose of a speed hump is to reduce vehicle speeds by producing an uncomfortable sensation for vehicle occupants travelling at speeds higher than the design speed (Murphy 2003).

Benefits:

-They are inexpensive.

-Speeds humps effectively slow traffic and benefit all pedestrians including people with disabilities. It is stated that vehicle speeds can reduce in relation to the spacing of the speed humps:

-50 km/h with speed humps at 125 metre spacing;

-40 km/h with speed humps at 80 metre spacing;

-30 km/h with speed humps installed in pairs at 60 metre spacing (Traffic Engineering Division 2002).

Disbenefits:

-They may increase noise and air pollution.

-Some traffic may be diverted to parallel streets that do not have traffic calming measures;

-Fire vehicles experience an 8 to 15 seconds delay per speed hump (Murphy 2003).

Placement:

Speed hump is good for locations where very low speeds are desired, and noise and fumes are not a major concern. Spacing should be about 152.4 meters, clearly visible for 60.96 meters, and placed at least 60.96 meters from intersections; should include warning signs (Traffic Engineering Division 2002).

Estimated cost:

$2,000-$3,000 per speed hump (Traffic Engineering Division 2002).

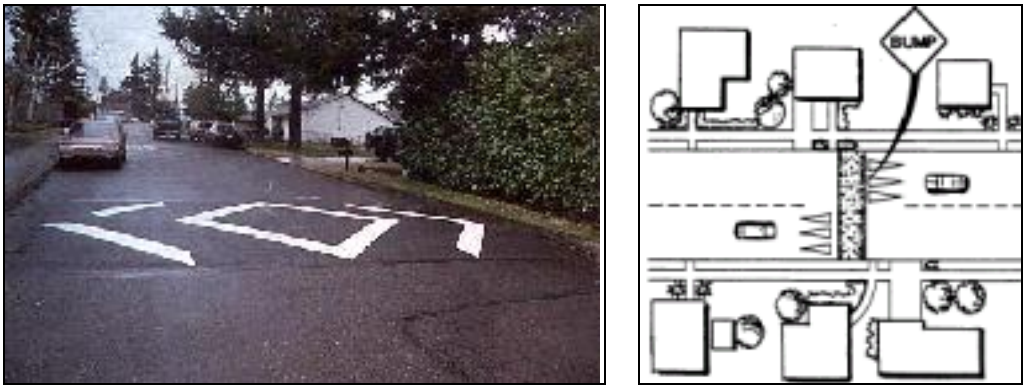

Figure 3.7 Speed Hump.
(Source: DOWL Engineers 2001)

Figure 3.8. Speed Cushion.
(Source: Murphy 2003)

2. Speed Table and Raised Crosswalk

Description and Purpose:

Speed tables are flat-topped speed humps often constructed with a brick or other textured materials on the flat section. They are also called trapezoidal humps and plateaus. If they are marked for pedestrian crossing, they are called raised crossings or raised crosswalks. (DOWL Engineers 2001).

The purpose of a speed table and a raised crosswalk are to:

-Reduce vehicle speeds;

-Improve pedestrian visibility; and

-Reduce pedestrian-vehicle conflicts (Traffic Engineering Division 2002).

Benefits:

-Speed table is smoother on large vehicles such as fire trucks than speed hump.

-Reduce vehicle speeds;

-Speed tables can be used as raised crosswalks to increase pedestrian visibility.

Disbenefits:

-They are textured, so materials can be expensive.

-They may increase noise and air pollution.

-Traffic may be diverted to parallel residential streets that do not have traffic calming measures. (Murphy 2003)

Placement:

-Speed table is good for locations where low speeds are desired but a somewhat smooth ride is needed for larger vehicles.

-Adveance warning signs should include where significant number of pedestrians cross the roadway.

Estimated cost:

$2,500-$8,000 per speed table and raised crosswalk. The higher estimate includes the construction of two curb ramps (Traffic Engineering Division 2002).

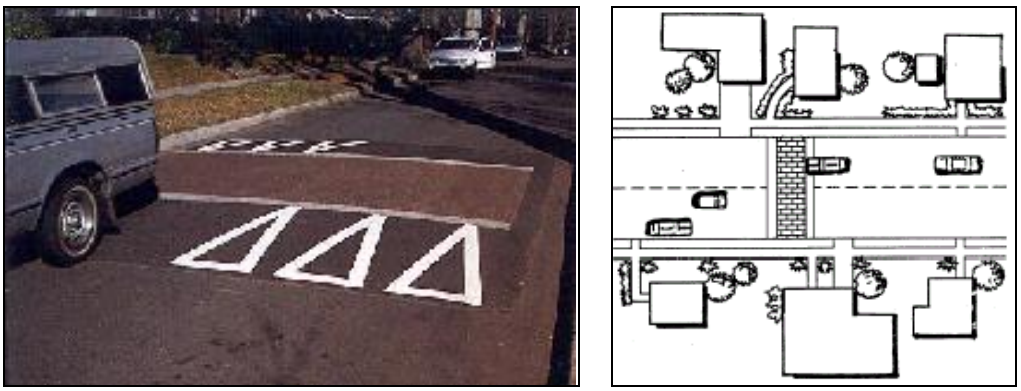

Figure 3.9. Speed Table.
(Source: DOWL Engineers 2001)

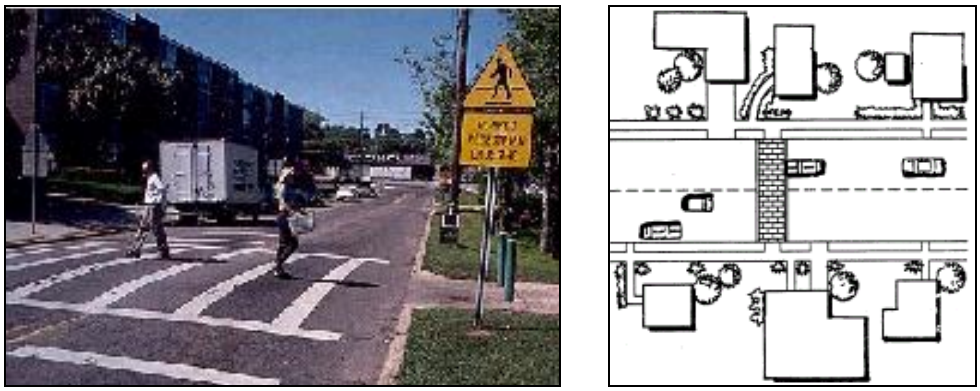

Figure 3.10. Raised Crosswalk.
(Source: DOWL Engineers 2001)

3. Raised Intersection

Description and Purpose:

A raised intersection is an intersection constructed at a higher elevation than the adjacent roadways. It also includes crosswalks (Murphy 2003). Moreover, it is also called raised junctions or intersection humps. It usually rises to sidewalk level in order to increase visibility (DOWL Engineers 2001).

The purpose of a raised intersection is to:

-Reduce vehicle speeds;

-Better define crosswalk areas; and

-Reduce pedestrian-vehicle conflicts

Benefits.

-It improves safety for pedestrians and vehicles.

-Vehicles forced to slow through intersection area. For instance, 85th percentile speeds at mid-block location in Toronto reduced from 47 km/h to 36 km/h.

-Pedestrian area is better defined.

-It can calm two streets at once.

-It can have positive aesthetic value if designed well.

Disbenefits:

-It has high cost. If it is textured materials can be expensive.

-It may divert traffic to parallel residential streets that do not have traffic calming;

-It slows emergency vehicles to approximately 25 km/h (Murphy 2003).

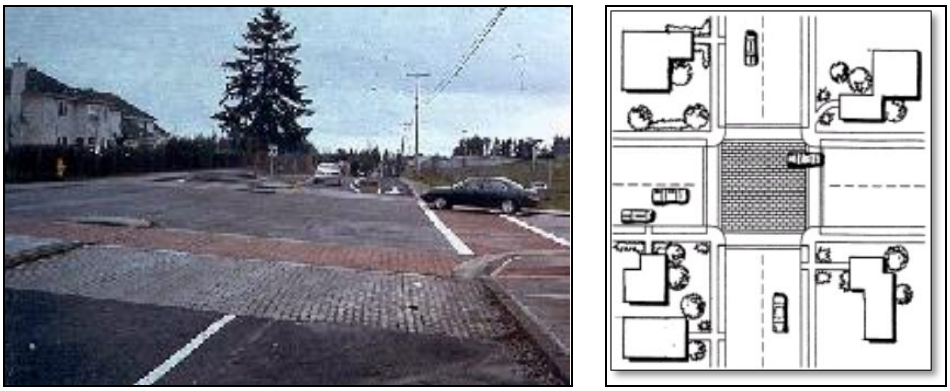

Figure 3.11. Raised Intersection.
(Source: DOWL Engineers 2001)

3.4.2.2. Horizontal Speed Control Elements

Horizontal speed control elements change the typical straight line traveled way of a specific roadway to reduce speed. Typical elements include mini traffic circles, roundabouts, lateral shifts, and chicanes (DOWL Engineers 2001).

1. Traffic Circle

Description and Purpose:

A traffic circle is a raised circular island located in the centre of an intersection. It requires vehicles to travel through the intersection in a counter-clockwise direction around the island (Murphy 2003). They are sometimes called intersection islands.

The purpose of a traffic circle is to:

-Reduce vehicle speeds; and

-Reduce vehicle-vehicle conflicts at intersections (DOWL Engineers 2001).

Benefits:

It is stated that traffic circle installation may occur 10% to 20% reduction in traffic volumes. Also, it was experienced that a significant reduction in the number of traffic crashes occurred (Traffic Engineering Division 2002).

Disbenefits:

-Some pedestrians feel that traffic circles force vehicles into the unmarked crosswalk area, increasing the potential for pedestrian-vehicle conflicts.

-Traffic circles may require removal of some on-street parking;

-Also traffic circles may divert a significant volume of traffic to parallel streets without traffic calming measures;

-Fire emergency response vehicles can be delayed 5 to 10 seconds per traffic circle encountered while on route to an emergency (Murphy 2003).

Placement:

It is statetd that street grades approaching the intersection should not exceed 10 percent and entrances should be a minimum of 30.48 meters away on all approaches (Traffic Engineering Division 2002).

Estimated cost:

Usually the cost is $3,500-$15,000 each (Traffic Calming Guide for Local Residential Streets, 2002). Also, the cost is approximately $6,000 for a landscaped traffic mini-circle on an asphalt street and about $8,000 to $12,000 for a landscaped mini-circle on a concrete street.

Figure 3.12. Traffic circles can be combined with landscape elements
(Source: Murphy 2003)

2. Roundabout

Roundabout is similar to mini traffic circle, but it is larger than traffic circles. It is designed for higher speeds, and has raised splitter islands to channel approaching traffic to the right. It is found primarily on arterial and collector streets (DOWL Engineers 2001).

Benefits:

Unlike many other forms of traffic calming, roundabout benefits are aimed primarily at motorists. The installation of roundabouts prioritizes improving traffic

flow, maximizing vehicular capacity, and eliminating the need for stop signs and traffic signals.

Disbenefits:

- Busy roundabouts provide very few gaps long enough to cross. This can be especially problematic and unsafe for pedestrians such as children, elderly with mobility and cognitive impairments, and people with vision impairments.

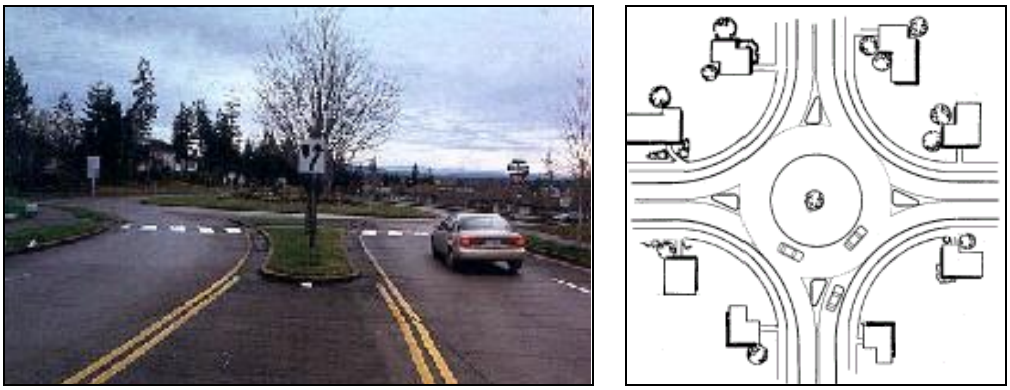

Figure 3.13. Roundabout.
(Source: DOWL Engineers 2001)

3. Curb Radius Reduction

Description and Purpose:

A curb radius reduction is the reconstruction of an intersection corner with a smaller radius, usually a radius of 3.0 to 5.0 metres. The purpose of a reduced curb radius is to:

-Slow right-turning vehicles;

-Reduce crossing distance for pedestrians; and

-Improve pedestrian visibility.

Benefits:

Speeds of right-turning vehicles reduced and improved pedestrian safety.

Disbenefits:

Long trucks, buses and other large vehicles may need to cross into adjacent travel lanes in order to negotiate turns at the intersection (Murphy 2003).

4. Lateral Shift and Chicane

Lateral shift is a curb extension that cause travel lanes to bend one way and then back the other way. It is one of the few measures that can be used on collectors where high traffic volumes (DOWL Engineers 2001).

Chicane is a curb extension that alternate from one side of the street to other forming s-shaped curves. It is also referred to as deviation, serpentine, and reversing curve (DOWL Engineers 2001).

The purpose of chicane and lateral shift are to discourage shortcutting or through-traffic, and reduce vehicle speeds (Murphy 2003).

Benefits:

-They reduce vehicle speeds and volume.

Disbenefits:

-The chicane may divert significant volume of traffic to parallel streets without traffic calming (Murphy 2003).

Placement:

-On-street parking must be removed inside, and within 5 metres of the chicane;

-They should accommodate normal turning radii;

-Sets should be placed 122-183 meters apart;

-They should include advance warning signing and delineation (Traffic Engineering Division 2002).

Estimated cost:

Per set costs $5,000-$15,000 (Traffic Engineering Division 2002).

Costs for landscaped chicanes are approximately $10,000 (for a set of three chicanes) on an asphalt street and $15,000 to $30,000 on a concrete street. Drainage and utility relocation often represents the most significant cost consideration.

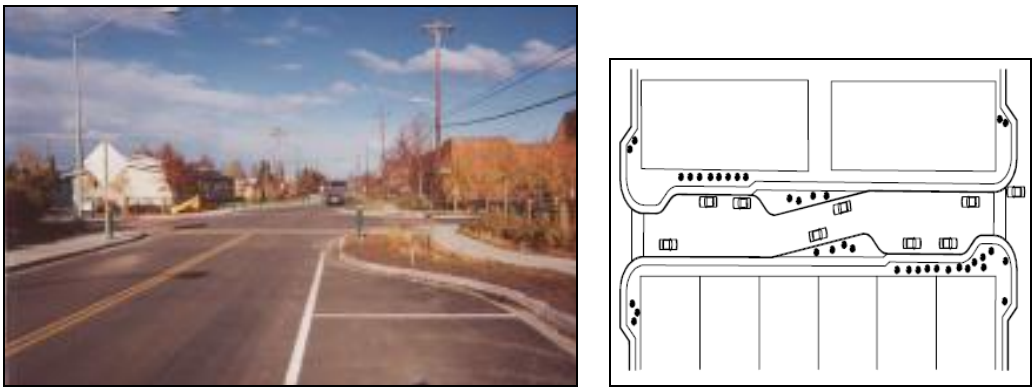

Figure 3.14. Chicane
(Source: DOWL Engineers 2001)

Figure 3.15. Chicane and lateral shift provides also parking spaces.
(Source: Murphy 2003)

5. Realigned Intersection

Realigned intersections are changes in alignment that convert "T" intersections with straight approaches into curving streets meeting at right angles. A straight shot along the top of the "T" becomes a turning movement. Realigned intersections are sometimes called modified intersections

Benefits:

-It can be effective reducing speeds and improving safety at a T-intersection that is commonly ignored by motorists.

Disbenefits:

-It may require some additional right-of-way to cut the corner

-Curb alignment can be costly

Estimated cost:

The cost varies.

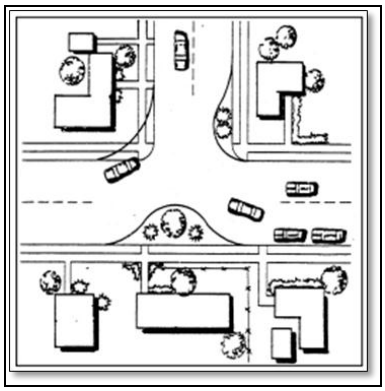

Figure 3.16. Realigned intersection
(Source: Ite 2011)

3.4.3. Narrowings (Both Volume and Speed Control Elements)

Narrowings, as the name implies, are short roadway segments that are narrower than the typical roadway section. Typical narrowings include curb extensions, neckdowns, chokers, and island narrowings (DOWL Engineers 2001). Narrowing consist of Neckdown, Choker, On-street Parking and Centre Island Narrowing.

1. Curb Extension

A curb extension is a horizontal intrusion of the curb onto the roadway resulting in a narrower section of roadway. The curb is extended on one or both sides of the roadway to reduce its width to as little as 6.0 metres for two-way traffic.

The purpose of a curb extension is to:

-reduce vehicle speeds;

-reduce crossing distance for pedestrians;

-increase pedestrian visibility; and

-prevent parking close to an intersection.

Benefits:

-Vehicle speeds are typically reduced by 1 to 5 km/h.

-Reduced pedestrian crossing distance and improved visibility may reduce vehicle-pedestrian conflicts.

Disbenefits:

-Some cyclists on shared roadways may feel forced into path of motor vehicles.

-It requires the removal of on-street parking in location of curb extension (Murphy 2003).

Estimated Cost:

Curb extensions cost from $2,000 to $20,000 per corner, depending on design and site conditions. Drainage is usually the most significant determinant of cost. If the curb extension area is large and special pavement and street furnishings and planting are included, costs would also be higher.

Figure 3.17 Curb extension
(Source: Murphy 2003)

2. Neckdown / Bulbout

Neckdown is a curb extension at intersections that reduce roadway width curb-to-curb. It is sometimes called nubs, bulbouts, knuckles, or intersection narrowings. If coupled with crosswalks, they are referred to as safe crosses. Placed at the entrance to a neighborhood, often with textured paving between them, they are called gateways.Their primary purpose is to “pedestrianize” intersections (DOWL Engineers 2001).

Benefits:

-It iproves pedestrian circulation and space;

-Through and left-turn movements are easily negotiable by large vehicles;

-It creates protected on-street parking bays;

-It reduces speeds, especially for right-turning vehicles.

Disbenefits:

-Effectiveness is limited by the absence of vertical or horizontal deflection;

-It may require the elimination of some on-street parking near the intersection.

Placement:

It is good for intersections with substantial pedestrian activity and areas where vertical traffic calming elements would be unacceptable because of noise considerations.

Estimated Cost:

The cost is $40.000-$80.000.

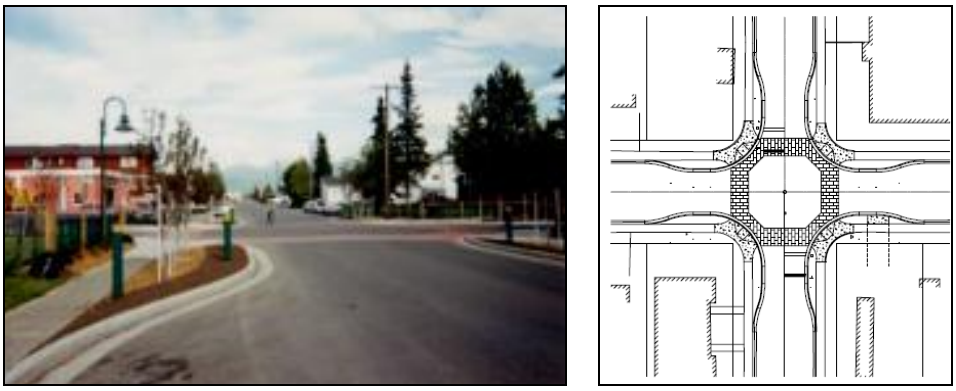

Figure 3.18. Neckdown
(Source: DOWL Engineers 2001)

3. Choker

Chokers are curb extensions or edge islands at midblock that narrow a street at that location. In different configurations, they are called midblock narrowings, midblock yieldpoints, and pinch points. If marked as crosswalks, they are also called *safe crosses*. Chokers can leave the street cross section with two lanes, albeit narrower lanes than before, or take it down to one lane (DOWL Engineers 2001).

Benefits:

-Easily negotiable by large vehicles such as fire trucks

-can have positive aesthetic value if designed well

-reduce both speeds and volumes

Disbenefits:

-may require the elimination of some on-street parking

Placement:

It is good for arreas with substantial speed problems and no on-street parking shortage.

Estimated Cost:

$7,000-$10,000 per pair (Traffic Engineering Division 2002).

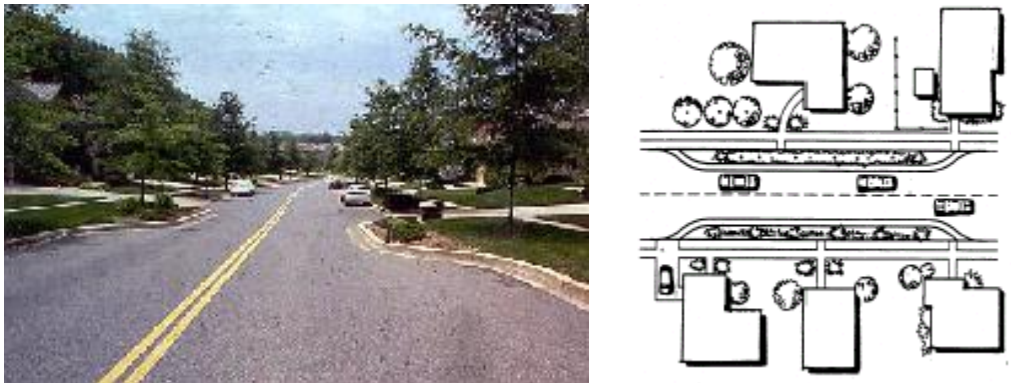

Figure 3.19. Choker
(Source: DOWL Engineers 2001)

4. Center Island Narrowing

Description and Purpose:

Center island narrowing is a raised island located along the centerline of a street that narrow the street at that location. It is also called midblock mediates, median slow points, raıse medıan ısland and median chokers. Placed at the entrance to a neighborhood, often with textured paving on either side, it is called gateways (DOWL Engineers 2001).

The purpose of a raised island is to:

-reduce vehicle speeds; and

-reduce pedestrian-vehicle conflicts.

Benefits:

-It increases pedestrian safety;

-It can have positive aesthetic value if designed well;

-It reduces traffic volumes.

Disbenefits:

-It may require elimination of some on-street parking;

-Speed reduction effect is limited by the absence of any vertical or horizontal deflection.

Placement:

It is good for entrances to residential areas and wide streets where pedestrians need to cross.

Estimated Cost:

The cos may be between $8.000 and $15.000.

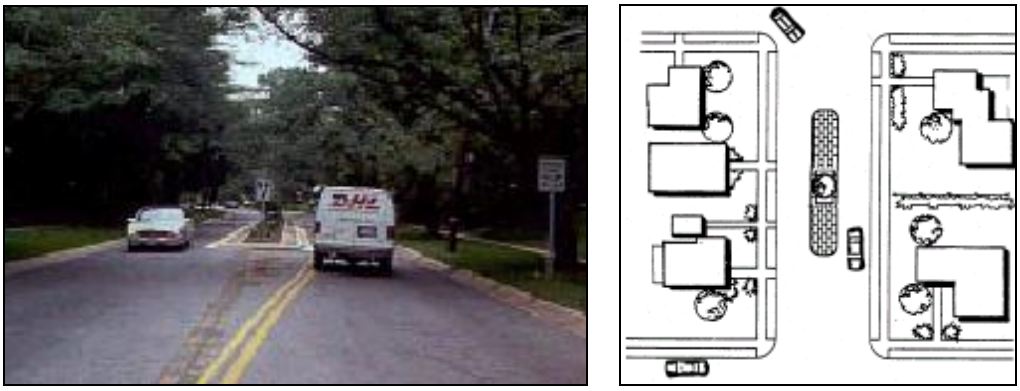

Figure 3.20. Center Island Narrowing.
(Source: DOWL Engineers 2001)

5. On–Street Parking

Description and Purpose:

On-street parking is the reduction of the roadway width available for vehicle movement by allowing motor vehicles to park adjacent and parallel to the curb.

The purpose of on-street parking is to:

-reduce vehicle speeds;

-reduce short-cutting or through traffic.

Benefits:

Parked vehicles provide a buffer between traffic and pedestrians on sidewalks. Traffic noise may be reduced due to a reduction in traffic volumes or speeds.

Disbenefits:

On-street parking can reduce visibility of pedestrians crossing the roadway (Murphy 2003).

3.4.4. Other Traffic Calming Elements (Environmental and Aesthetic Elements)

These elements can make the other traffic calming elements more effective and aesthetic. They can be applied together with most of the other traffic calming elements.

1. Textured and Coloured Pavements

Description and Purpose:

Textured and coloured pavement includes the use of stamped pavement or alternate paving materials to create an uneven surface for vehicles to traverse. They may be used to emphasize the entire intersection or a pedestrian crossing, and are sometimes used along entire street blocks.

The purpoae is to:

- distinguish between different surface functions,
- improve street appearance,
- reinforce speed reduction measures,
- simplify construction of traffic calming measures in the carriageway,
- improve visual impact, particularly in poor light and under street lighting.

Benefits:

-They reduce vehicle speeds over and extended length.

-They can positive aesthetic value if designed well.

-A clear contrast can be provided for different intended uses of the available space

Disbenefits:

-Materials may be expensive.

-If they are used on a crosswalk, they can make crossing more difficult for wheelchair users and the visually impaired.

Placement:

They are good for main street areas where there is substantial pedestrian activity and noise is not a major concern.

Estimated Cost:

The cost varies depending on the materials.

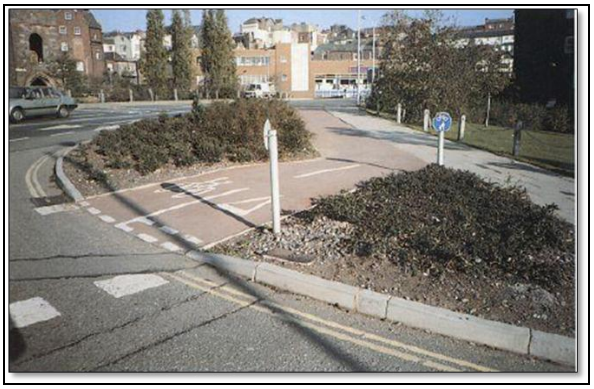

Figure 3.21. The use of red slurry seal clearly defines this section of the Exe Cycle Route (Source: Devon County Council Engineering and Planning Department of 1991)

(a) (b)

Figure 3.22. (a) Traditional high-quality paving can still be found in many historic areas. Here, iron railings throw a pattern of light across real Stone paving, and a cobbled gutter banded with granite. Lichfield

(b) Attention to detail can produce attractive results. The bollards here, for example, are specifically positioned in the granite banding to avoid the need to cut paving tiles. Cologne, Germany
(Source: Devon County Council Engineering and Planning Department of 1991).

2. Occasional Strip

Description and Purpose:

Occasional strips are set out adjacent to and at the same level as the maincarriageway. They occur either side of the carriageway, and may also be used to divide the carriageway. They are distinguished from the main carriageway by the use of surfaces with a different texture or colour.

The purpose is to:

-allow reduction of carriageway width while retaining access for buses and lorries,

-improve the optical effect for slow driving,

-provide greater safety for pedestrians crossing the street, for cyclists, and for on-street parking/loading activity.

Benefits:

-They can reinforce speed reduction and other traffic calming objectives while retaining access for moderate volumes of larger vehicles.

-They provides greater functional and design flexibility especially where street width is limited.

Disbenefits:

-They are probably unsuitable where larger vehicles form a high proportion of traffic.

-Textured surfaces may discourage their use by cyclists.

Figure 3.23. Informal side strips can enhance the appearance of village streets. Here the strips are in sympathy with the informal arrangement of buildings and side accessways. Borgentreich, Germany (Source: Devon County Council Engineering and Planning Department of 1991)

3. Entrance and Gateway

Description and Purpose:

The purpose of an entrance and gateway is to mark the beginning and end of areas where different rules or expectations for drivers apply, or where special functions ocur.

Benefits:

-They effect drivers' perception of change of street priorities.

-They can add visual interest to the streetscape.

Disbenefits:

Structures may be too large for the scale of the street if all classes of vehicle are allowed through.

Placement:

They may be applied in entrances to slow speed or 20 mph zones, villages and special areas such as street markets, historic centres.

(a) (b)

Figure 3.24. (a) A village entrance is here given emphasis with "gateposts", nameboard and a change in surfacing. Zuidlaren, Netherlands.

(b) An archway makes a grand entrance to this quiet Kensington mews, London.

(Source: Devon County Council Engineering and Planning Department of 1991)

4. Planting / Greenery

Description and Purpose:

The purpose is to:

-limit forward views,

-reduce physical and optical width,

-define street spaces and activities,

-improve street appearance and the environment, including micro climate, noise and dust absorption.

Benefits:

-Planting makes a major contribution to the required change of street character in traffic calming schemes, whilst at the same time improving the street scene and micro climate.

-Trees provide vertical features at relatively low cost.

-Frontagers may be encouraged to contribute to the creation and/or the maintenance of planted areas.

-Planting can engender pride in the traffic calming scheme and in the street generally.

Disbenefits:

-They may increase maintenance costs unless sponsored or adopted by frontagers or other bodies.

Figure 3.25. Planters, mature trees and hanging baskets greatly improve the environment in Exeter High Street (Source: Devon County Council Engineering and Planning Department of 1991).

5. Street Furniture and Lighting

Description and Purpose:

Street furniture elements include signs, signals, street lights, walls, fencing, and pedestrian furnishings such as benches, shelters and trash receptacles. In traffic calmed

settings, it is desirable for street furniture to border the street and provide a separation between the pedestrian pathway and traffic. Poles and planters are normally located 2-3 feet from the back of curb, leaving room for the opening of car doors or for movement of pedestrians to/from parked automobiles, as shown in Exhibit 16-5. Benches, kiosks and shelters should allow sufficient space (6-8 feet from curb) for the comfort of their users (Docstoc 2012). Bollards are used as an alternative or reinforcement to kerbs as a means of separating vehicle and pedestrian areas. To keep motor vehicles out, bollards have to be spaced about 1.5m apart. Functional elements including seats, litter bins, telephone kiosks, cycle racks, bus shelters, and information points can be designed and grouped to create attractive focal points within the street.

The purpose of them is to:

-improve the functional and aesthetic qualities of the street,

-encourage the use of public space,

-enhance the safety and security of pedestrians,

-provide vertical elements adjacent to the carriageway.

Benefits:

-They help to enhance the functional and aesthetic qualities of the street, and thus to reinforce its "living" character.

Disbenefits:

-There are not any disbenefits if properly designed and sited.

Placement

Lighting and street furniture should be designed and located consciously to enhance the "living" character of streets in built-up areas, and thus to reinforce the effectiveness of traffic calming elements.

Figure 3.26. Bollards can be removable to provide access, and can serve as meter posts. Cologne, Germany (Source: Devon County Council Engineering and Planning Department of 1991)

3.5. Design Considerations of Residential Traffic Calming Elements

While selecting a traffic calming implementation element more cost and availability of resources must be considered beyond need. Often there are direct and indirect consequences of traffic calming implementation which must be predicted to the best extent possible beforehand. If an element has been chosen incorrectly or improperly implemented, it can have direct consequences on the safety, sustainability and/or efficiency of the network. Some negative side effects of traffic calming implementation may include increase noise or air pollution, an increase in cut through or diverted traffic, drainage issues and maintenance responsibility issues. It is important to investigate all potential side effects of traffic calming elements and its costs with its benefits (Metzger 2008).

First of all, traffic calming elements should be clearly visible day and night. Reflectors, buttons, highly reflective paint, or illumination should be used as appropriate to ensure visibility. Additionally, traffic calming elements should not be placed where drivers do not have adequate stopping sight distance for the operating speed of the road. Second of all, advance signs should warn motorists of upcoming traffic calming elements and, to the extent possible, guide the motorists' response to such measures. Third of all, traffic calming elements should blend naturally with the streetscape and enhance the appearance and feel of the street. They should alert drivers that they are in or entering a residential place. Fourth of all, traffic calming elements

should be designed to accommodate emergency service and other large vehicles at an acceptable speed (Traffic Engineering Division 2002). Emergency vehicles can have difficulty maneuvering through or over certain traffic calming measures. It is important that the location of the roadway segment or intersection be carefully studied in this respect. A cost-benefit analysis may need to be performed to determine if the safety benefits of a traffic calming measure are more beneficial than a slower emergency vehicle response time where applicable (Metzger 2008). Additionally, long-term maintenance needs should be anticipated in the design process and minimized to the extent possible. Some jurisdictions contract with the neighborhood to maintain plantings or simply eliminate landscaping in the absence of a willingness on the part of residents to participate. Finally, on-street parking in residential areas creates a sense of activity; some jurisdictions encourage on-street parking for this reason. However, in some instances, on-street parking also creates sight line restrictions, which may be unsafe for drivers who are speeding (Traffic Engineering Division 2002).

TRAFFIC CALMING TOOL BOX	Volume Reduction	Speed Reduction	Safety Improvement	Pollution Reduction	Access Restriction	Emergency Access	Maintenance Problems	Level of Violation	Community Acceptance	Cost
Full Closures	◒	●	◒	●	●	●	●	n/a	○	●
Half Closures	◒	◒	◒	< >	●	●	○	○	○	●
Diverters	◒	◒	◒	< >	●	●	●	n/a	○	●
Speed Bumps/Humps/Raised Crosswalks/Raised Intersections	◒	●	○	○	○	●	◒	n/a	○	◒
Traffic Circles/Roundabouts	○	◒	◒	○	○	●	◒	n/a	○	●
Neckdowns/Chockers	◒	○	◒	○	○	○	○	n/a	●	●
Chicanes/Lateral Shifts	◒	◒	◒	○	○	○	○	n/a	○	●
NON ENGINEERING MEASURES										
Increased Enforcement	○	●	◒	○	○	○	○	n/a	●	◒
Variable Speed Display	○	●	◒	○	○	○	○	n/a	●	○
Watch for Children	○	○	○	○	○	○	○	n/a	●	○
Pavement Markings	○	○	○	○	○	○	○	n/a	●	○
Street Narrowing	○	◒	◒	○	○	○	○	n/a	○	◒
Turn Restrictions	●	◒	◒	< >	●	○	○	○	○	○
Basket Weave Stop Signs	○	◒	●	○	○	○	○	○	●	○
Yield Signs	○	◒	○	○	○	○	○	◒	●	○
Do Not Enter	◒	○	◒	< >	●	○	○	◒	○	○
Speed Limit Changes	○	○	○	○	○	○	○	●	●	○
Parking Restrictions	○	○	●	○	○	○	○	○	○	○
All Way Stop	○	◒	◒	○	○	○	○	◒	●	○
One Way Streets	◒	○	◒	○	●	○	○	○	○	○

KEY
○ Low, Unlikely, No
◒ Mid, Moderate, Possible
● High, Likely, Yes
< > Traffic Shift
n/a Not applicable

Figure 3.27.Summary of the Effectiveness of Some Traffic Calming and Non-Engineering Elements (Source: DOWL Engineers 2001).

3.6. The Impacts of Traffic Calming

There are many important impacts of traffic calming on residential streets. First of all, it has become an important design tool and transportation policy by providing the equity to all of the users of the streets. As Pucher and Dijkstra (2003) explains that traffic calming gives pedestrians, bicyclists, and playing children as much right to use residential streets as motor vehicles. Second of all, it results in making the streets safer placaes by reducing traffic speed and traffic volume on residential streets. Finally, it

causes many positive environmental impacts suh as decreasing noise and air pollution on the residential streets.

Rahman et al. (2005) state that in order to understand the impacts of traffic calming a before and after study of traffic speed, volume, accident level, residents satisfaction and environmental features are measured.

The first important impact of traffic calming elements is "safety impacts". Firstly, safety impact of traffic calming is the reduced speeds of motor vehicles. Traffic calming elements reduce the traffic volume and speed and thereby reduce the accident frequency and severity (Rahman et al. 2005). This is crucial because not only to the motorist's ability to avoid hitting pedestrians and bicyclists but also to the survival of nonmotorists in a crash (Pucher and Dijkstra 2003). It was reported that the British Department of Transport, for example, found that the risk of pedestrian death in crashes rises from 5% at 32 kpm/h to 45% at 48 km/h and 85% at 64 km/h (Pucher and Dijkstra 2003).

Pucher and Dijkstra (2003) explain that area-wide traffic calming in Dutch neighborhoods has reduced traffic accidents by 20% to 70%. Moreover, traffic calming in German neighborhoods has reduced traffic injuries overall by 20% to 70% and serious traffic injuries by 35% to 56%. Also, a comprehensive review of traffic calming impacts in Denmark, Great Britain, Germany, and The Netherlands found that traffic injuries fell by an average of 53% in traffic-calmed neighborhoods (Pucher and Dijkstra 2003). In short, all these rates show that traffic calming greatly reduces the danger of traffic deaths and injuries in residential neighborhoods and it improves not only pedestrian safety but also the safety of bicycling and motorizing.

Second important impact of traffic calming elements is vehicle speed and volume impacts. Reducing vehicle speed in residential streets is the primary goal of traffic calming. For determining a speeding problem on a specific roadway, the 85^{th} percentile speed is often used (Rahman et al. 2005). The 85^{th} percentile speed is defined as the speed at or below which 85 percent of the motorists drive on a given road unaffected by slower traffic or poor weather. This speed indicates the speed that most motorists on the road consider safe and reasonable under ideal conditions. From the Table 3.2 speed reduction effect of different traffic calming elements can be seen as an example.

Table 3.2. Before and After Speed Counts
(Source: Rahman et al. 2005)

Method	Roadway	Segment from	Segment to	Posted speed limit, km/h	Pre-km/h	Post-km/h
Speed humps	Shade Avenue	Browning Street	Hatton Street	40.23	54.85	39.48
Speed tables	Orange Avenue	Bahia Vista Street	Loma Linda Street	48.28	71.25	54.52
Diverter	Irving Street	Osprey Avenue	Yale Street	40.23	60.64	37.01
Neck-out Bulb-out	Hyde Park Street	Lime Avenue	Shade Avenue	40.23	66.66	46.82
Median	Ringled Boulevard	Lime Avenue	Shade Avenue	40.23	61.77	52.53

Measure	Average Percent Reduction in Traffic Volume
Speed Humps	20%
Speed Tables	12%
Traffic Circles	5%
Narrowings	10%
Full Closures	44%
Half Closures	42%
Diagonal Diverters	35%
Source: R. Ewing, *Traffic Calming State-of-the-Practice*, Institute of Transportation Engineers, Washington, D.C., 1999.	

Figure 3.28. Volume Impacts of Common Traffic Calming Elements
(Source: Traffic Calming Protocol Manual 2001)

Reducing through traffic volume in residential streets is another primary objective of traffic calming. According to Rahman et al. (2005) traffic volume reduction on traffic calmed streets depends on the availability of alternative routes and on the devices installed.

Table 3.3. Volume impacts of speed humps for local streets
(Source: Rahman et al. 2005)

TrafficVolume(vehicles/day) Before	After	Number of Speed Humps	Spacing (m)	Location
5615	3840	2pairs+1	137-160	Scarborough, ON
2500	2125	4	120-170	Sherbrooke, OC
1200	1000	9	60-78	Toronto, ON
800	1600	9	68-95	
2200	1600	7	65-77	
800	540	2	104	Bellevue, WA

Third crucial impact of traffic calming elements is environmental impacts. Environmental impacts of traffic calming measures are described for the indicators of noise and air pollution. Due to fewer and slower vehicles traffic calming can reduce noise in residential streets. In Buxtehude, Germany, monitoring of vehicle emissions before and after the implementation of traffic calming indicated a reduction in Carbon Dioxide levels of 20%, a reduction in Hydrocarbons of 10% and a reduction in Nitrogen Oxide of 33% (Rahman et al. 2005).

Finally, the impact on residents' satisfaction is also important. Acceptance of traffic calming by the local community is the most important issue for success of the scheme. Surveys before and after the implementation of a scheme in the German town of Buxtehude found 46% of car drivers and 49% of residents opposed to the project prior to its construction, and yet three years later 67% of car drivers and 76% of residents were in favor (Rahman et al. 2005).

3.7. Examples of Traffic Calming Projects

In this part, some traffic calming projects have been given as example. The projects given are only one-street traffic calming project. The examples of area-wide projects were not shown, because the case study of the thesis does not comprise a wide area. Moreover, all the examples are given from European cities, since the urban neighbourhood streets are more similar to Turkish urban neighbourhood streets in terms of the use of them.

3.7.1. Cologne-Wittekind Street, Germany

Cologne-Wittekind Street is similar to the case study streets in terms of the problems on it. The most important problem of the case study streets is cut-through traffic. So, the proposed solutions for Cologne-Wittekind Street can be an example for the case study streets.

Description:

It is a residential street in inner south-west Cologne which was used as a cut-through route at evening peak hours by drivers seeking to avoid congestion on surrounding main roads. Also, there were commonly 4 or 5 accidents per year.

Problems:

-high cut-through traffic at evening peak hours.

-high through traffic

-high vehicle speed

Solutions:

-Remaining traffic was slowed by narrowing the carriageway to 4.5m and by creating lateral shifts at intervals of 50m or less.

-A speed table was provided at each junction.

-At two intermediate crossroads both lateral shifts and plateaux were built.

-The lateral shifts, equal to the width of the traffic lane, were created by alternate 30 degree angled parking, defined by planted areas.

-Outside the kindergarten, the carriageway was aligned to provide maximum visibility of children on the footway.

Cost:

Not known

Assessment:

-West-bound through traffic was eliminated (from 200 vehicles per hour) while east-bound traffic remained about the same (less than 100 vehicles per hour).

-No serious injuries occurred after the scheme (Source: Devon County Council Engineering and Planning Department of 1991).

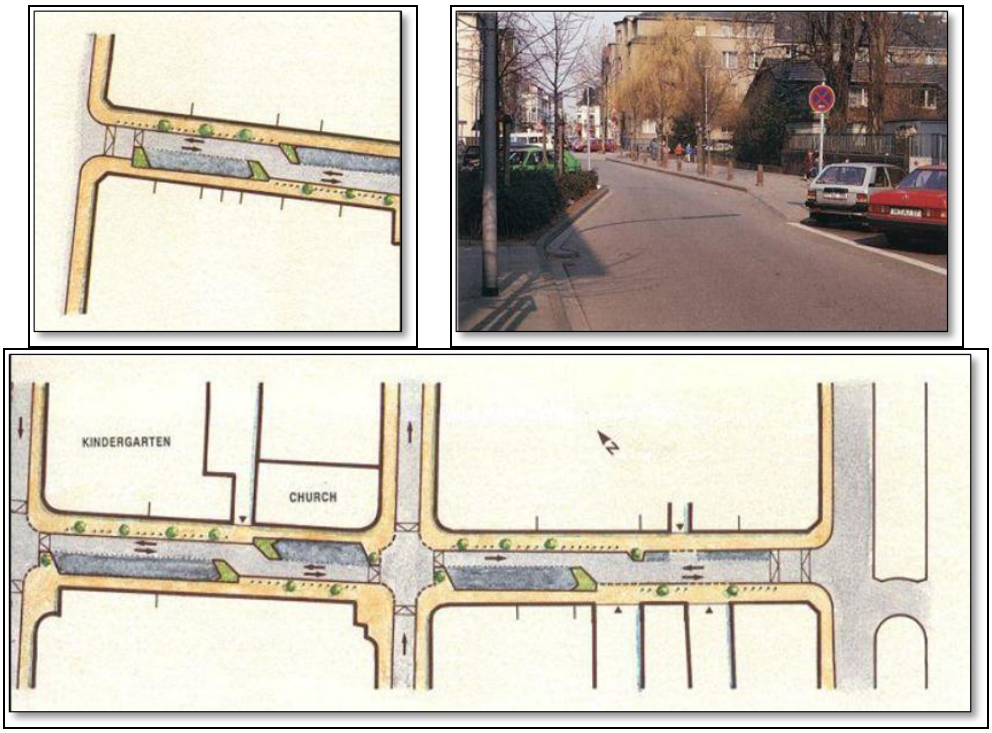

Figure 3.29. One-side parking has the advantage of providing drivers with an unobstructed view of one footway, here used to good effect outside a kindergarten, creating much safer conditions for children (Source: Devon County Council Engineering and Planning Department of 1991).

Figure 3.30. For a good speed reduction effect, lateral shifts need to be at least the width of a traffic lane, as shown here. The shift is created by the provision of alternate angled parking bays, defined by permanent planted areas. Bollards prevent parking on the footway (Source: Devon County Council Engineering and Planning Department of 1991).

3.7.2. Exeter–Burnhouse Lane, England

Description:

It is a distributor road and connects a major radial road to a large district of Exeter known as Heavitree. It is a long straight road with uninterrupted visibility of 0.6 km and 12.5 m width. Two schools are sited on this road which also acts as a main access route to a Secondary School and a Nursery School. There are shops, churches, a surgery, a village hall, and a public house along its length.

Problems:

-high traffic speed

-high accident rate

-poor environment

Solutions:

-The main carriageway width was reduced from 12.5m to 5.5m wide, with an additional 1 m wide cycle track on both sides and sheltered parking was provided.

-Flat top humps were installed along the route and at the junctions.

-Lateral shifts were introduced at the approaches to the junctions.

-The road and sheltered parking was surfaced in bitumen macadam, the cycle track was surfaced with red slurry seal and small (300mm x 450mm) grey concrete slabs were used for the footway.

-The road humps were formed by fixing brindle coloured concrete blocks to the carriageway on an epoxy mortar bed with bitumen macadam approach ramps.

-Accesses across the footway to private drives were formed in grey concrete blocks.

-Raised planters were constructed in red. brick and this, combined with the planting of trees and the change in alignment, succeeded in removing the impression of a wide straight fast road.

-Lighting columns with long outreach arms were provided at the back of the footway.

-A lighting column with a spherical lantern was provided on the footway at each side of the road humps, which has the double benefit of enhancing the lighting at these sites where pedestrians are most likely to cross and also acting as a means of drawing

the motorist's attention to the road humps themselves (Source: Devon County Council Engineering and Planning Department of 1991)

Cost:

-The cost was £220,000 for the total length of scheme of 0.6 km.

Assessment:

-The 85 percentile speed was 34 mph, with maximum speeds being recorded between 50 and 55 mph. Following the completion of the scheme, the 85 percentile speed had fallen to 24 mph with maximum speeds of between 29 and 33 mph being recorded.

-At the road humps themselves the speeds are approximately 14 mph.

-A 12% reduction in traffic flows during peak hours has been achieved.

-The use of quality materials and planting has contributed to the environmental improvements (Source: Devon County Council Engineering and Planning Department of 1991).

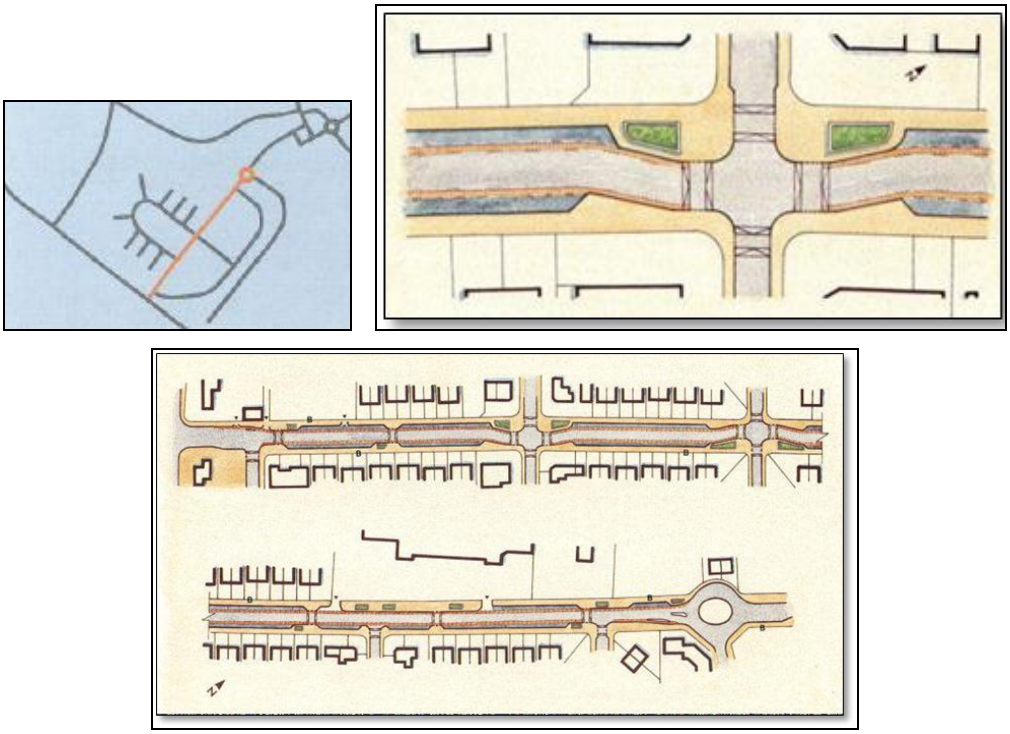

Figure 3.31. The street was a long straight road with uninterrupted visibility 0.6 km and 12.5 m width (Source: Devon County Council Engineering and Planning Department of 1991).

Figure 3.32. Flat top humps, lateral shifts and footway extensions at approach to junction. Planting, including raised red brick flower beds, adds to the street scene (Source: Devon County Council Engineering and Planning Department of 1991).

3.7.3. Haringey–Mount Pleasant Road, England

Description:

It is a 1 km lenght residential road in the east of the London Borough of Haringey, used as a cut-through route by drivers seeking to avoid congestion on main roads.

Problems:

-high cut-through traffic

-high traffic flows, vehicle speeds and accidents

Solutions:

-A series of 16 road humps (installed according to the Road Hump Regulations 1986) and 10 carriageway narrowings at road hump locations along the length of the road.

-Seven of the narrowings reduced carriageway width to 3.5 m and were signed on both approaches "Road Narrows on Both Sides".

-Footway extensions were constructed in most side entrances to control vehicle parking and improve pedestrian visibility.

Cost:

-The cost was approximately

Assessment:

-Vehicle speeds have been reduced from a mean speed of 34 mph (85 percentile = 39 mph) to 26 mph (85 percentile = 28 mph).

-No accidents had been recorded in the first seven months after the scheme came into operation (Source: Devon County Council Engineering and Planning Department of 1991).

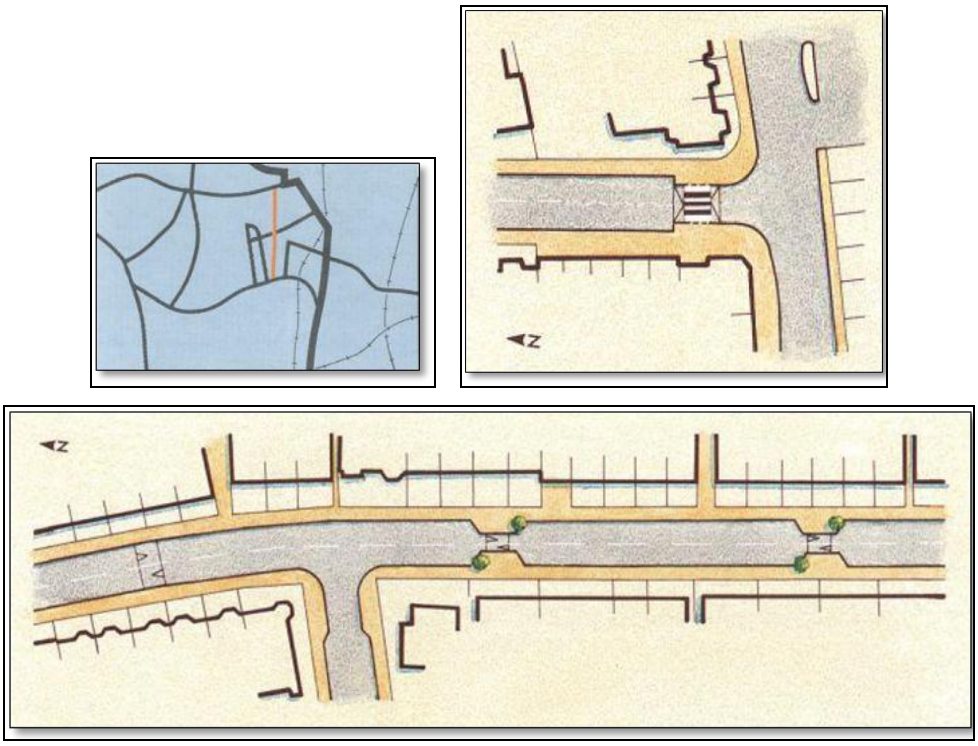

Figure 3.33.Cut-through traffic was eliminated with traffic calming elements. (Source: Devon County Council Engineering and Planning Department of 1991)

3.7.4. Leicester Worthington Street, England

Description:

Worthington Street, which is open to through traffic with a peak flow of about 130 vehicles per hour, is lined with 80 terraced houses fronting directly onto the street.

Problems:

-high through traffic

-high vehicle volume and speed

Objectives:

-To transform Worthington Street into an area principally for the relaxation and enjoyment of its residents through the creation of an open space environment, but, without closing it to traffic.

-To deter unnecessary through traffic

-To encourage vehicles using the street to travel slowly and carefully

-To improve the environment for the benefit of residents and pedestrians.

Solutions:

-The traditional carriageway and kerb-defined footways were replaced with a new surface, and a range of different colours were used to define, in particular, areas to which vehicles are restricted.

-Speed restraint was achieved with a narrow carriageway incorporating lateral shifts and a flat top hump.

-Alternate angled parking is provided together with some lateral parking.

-Victorian style street lighting was installed, and trees and shrubs planted to soften the overall design.

Cost:

The total cost including Professional fees was about £180,000, met partly from Urban Programme grants.

Assessment:

-The introduction of more attractive paving and street furniture has produced a pleasant residential environment.

-Traffic speeds and volumes have been reduced, though some cars still travel too fast (Source: Devon County Council Engineering and Planning Department of 1991).

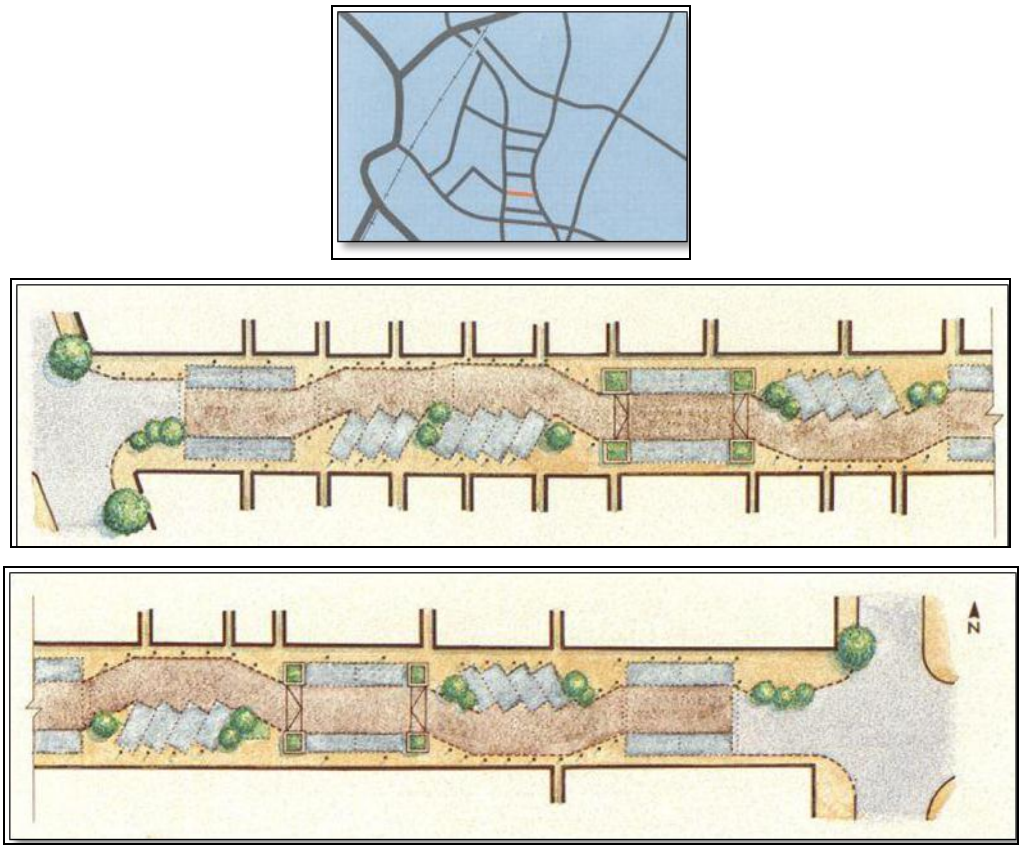

Figure 3.34. Worthington Street with traffic calming design.
(Source: Devon County Council Engineering and Planning Department of 1991)

(a) (b)

Figure 3.35.(a) Shared surface showing street furniture and coloured pavers.

(b) Parking bays defined with dark brown pavers and cast iron bollards. Railings also add interest to the street scene outside a local shop.
(Source: Devon County Council Engineering and Planning Department of 1991)

(a) (b)

Figure 3.36.(a) Lateral shift in the carriageway formed by angled parking bays defined with planting and cast iron bollards .

(b) Speed reduction ramp between brick planters.

(Source: Devon County Council Engineering and Planning Department of 1991)

3.7.5. Plymouth-Vivtoria Road, St.Budeaux, England

Description:

Victoria Road is a residential street in which suburban shopping and commercial activities ocur along the middle section of it. The width of it varies between 7m and 10m.

Problems:

-Drivers use it as a cut-through route

-Traffic flow had increased from under 8,000 to over 11,000 vehicles per 12 hour day

-Poor environment

Objectives:

-To change the image of Victoria Road from that of a major traffic route and to deter extraneous traffic.

Solutions:

-To slow motor traffic and to provide additional crossing points for pedestrians are proposed. These measures include the introduction of mini roundabouts, narrowing of the wide carriageway, provision of cycle tracks, removal of some yellow lines to allow parking, and highway enhancement such as repaving of footways and landscaping.

Cost:

The estimated cost is £250,000 to £300,000 (Source: Devon County Council Engineering and Planning Department of 1991).

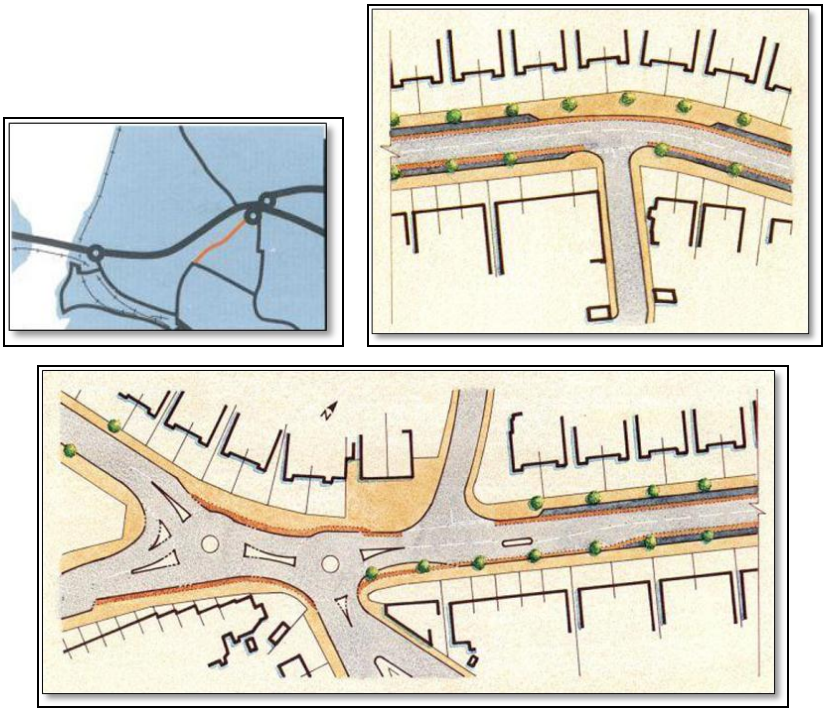

Figure 3.37. Traffic calming design in Victoria Road.
(Source: Devon County Council Engineering and Planning Department of 1991)

3.7.6. Exeter–High Street/Queen Street, England

Description:

High Street and Queen Street are the historic parts of the city.

Problems:

-The area suffered from overwhelming domination by motor vehicles which resulted in a hostile and unsafe environment for pedestrians.

Objectives:

-To relieve the problems typical of a city centre, namely intrusion from high volumes of traffic through the main shopping streets and the resulting conflicts in order to stimulate the upgrading of the physical and commercial environment

-To give priority to pedestrians and public transport

Solutions:

-Carriageway narrowing and the creation of better facilities for pedestrians have been provided in Queen Street

-A flat top hump has been installed at a very busy pedestrian crossing point to make crossing the road an easier and safer movement

-The scheme also involved measures to improve both the functional and aesthetic elements of the streets involved. These included the provision of high quality paving, new and improved street lighting, seats and other street furniture and colour co-ordinated pedestrian finger posts.

Cost:

The cost was about £250,000.

Assessment:

-An improvement of the "city centre" atmosphere has been achieved with a much enhanced shopping environment.

-The appearance and furnishing of the area encourage pedestrians to stay or rest in the streets rather than just hurry through as before (Source: Devon County Council Engineering and Planning Department of 1991).

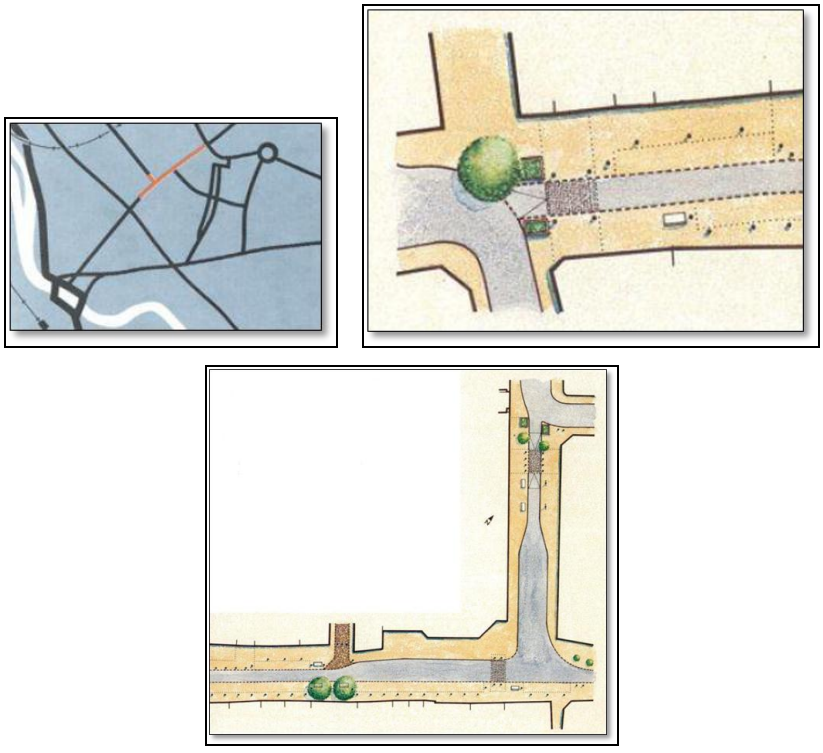

Figure 3.38. Traffic calming design in High Street and Queen Street.
(Source: Devon County Council Engineering and Planning Department of 1991)

(a) (b)

Figure 3.39. (a) The carriageway in High Street narrowed to a single lane primarily for buses. Planted areas in the widened footway add to the appearance and seats allow people to rest and enjoy the surroundings.

(b)Widened footway in Queen Street has improved the area for pedestrians. The flat top hump at footway level assists pedestrians when crossing and the street furniture and planting help define the route traffic has to take. (Source: Devon County Council Engineering and Planning Department of 1991)

3.7.7. Exeter–Bedford Street, England

Description:

Bedford Street is a main commercial and business street. It had wide carriageway with on-street parking and carried traffic flows inappropriate for pedestrians.

Problems:

-There are safety problems for pedestrians.

Objectives:

-To extend the successful pedestrian priority in the High Street, to promote a safe and pleasant environment for pedestrians

Solutions:

-Better facilities for pedestrians have been provided as well as a combined flat top hump and pedestrian crossing at the open end for service vehicles entering the street.

-Redesigned on-street parking for disabled drivers is provided directly outside the Post Office.

Cost:

The cost was £70,000.

Assessment:

-The domination of the motor vehicle and associated hazards to pedestrians have been successfully overcome, thus encouraging pedestrians to take full advantage of the benefits of the considerably enhanced environment (Source: Devon County Council Engineering and Planning Department of 1991).

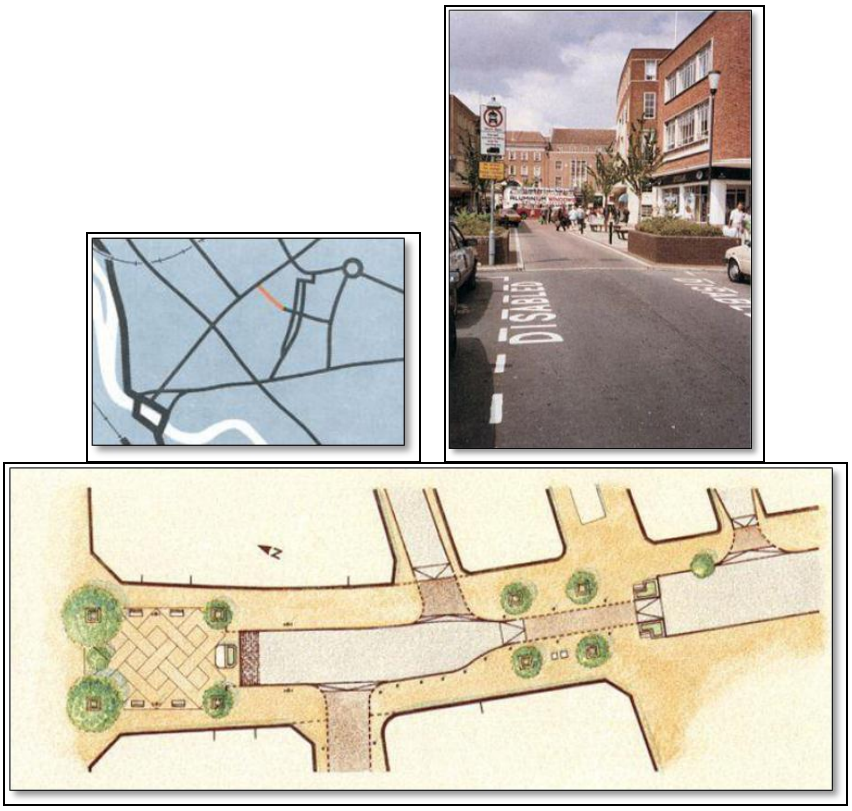

Figure 3.40. Traffic calming design in Bedford Street.
(Source: Devon County Council Engineering and Planning Department of 1991)

3.7.8. EindhoveN–Leenderverg, Netherlands

Description:

Leenderweg is a main radial route between the inner and middle ring roads. Because cut-through traffic on adjacent roads has been stopped and there is no alternative route for through traffic, there is a high rate of cut-through traffic on this street. Suburban shopping and commercial

activities occur along most of the street, together with housing. Buildings are medium density and height. It is also a bus route with 6 to 10 buses per hour each way.

Problems:

-"Rat running" traffic on adjacent roads has been stopped and is now accommodated on this route.

-Suburban shopping and commercial activities occur along most of the road, together with housing.

- It is a bus route with 6 to 10 buses per hour each way.

Objectives:

-To reconcile the through traffic function of the street (to be increased with closure of adjacent "rat runs") with its role as a sub centre

-To provide a better environment as well as provision for parking, loading, pedestrians and cyclists.

Solutions:

The design measures for the section with the most intensive shopping include:

-A parallel service and parking road with a "Woonerf' atmosphere

-Wider (2.5m) footways, and separate (2.1 m) cycleways

-Light controlled pedestrian crossings and central islands of 1.8m width

-Functional surfacing including asphalt for the main carriageway, bricks for the service road, and small concrete tiles for the footways, loading areas and cycleways, the latter in a different colour

-Tree planting on the strip dividing the service road and main carriageway

Cost:

The cost was £320,000 for the 0.5 km length

Assessment:

- The supply of on-street parking has been slightly increased and loading is better organised (less double-parking).

- The reduced carriageway width has moderated driving speeds, and made crossing easier for pedestrians (Source: Devon County Council Engineering and Planning Department of 1991).

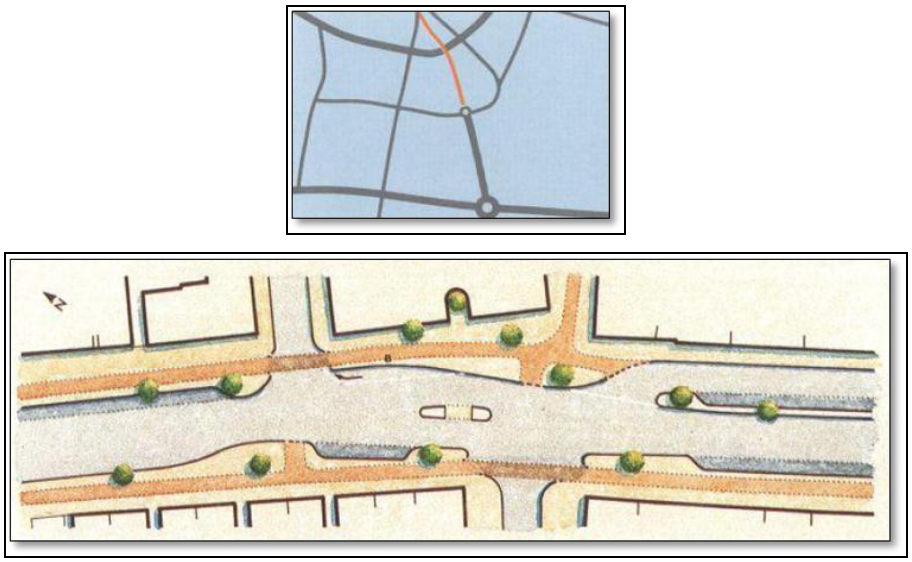

Figure 3.41. Traffic calming design in Leenderweg Street.
(Source: Devon County Council Engineering and Planning Department of 1991)

Figure 3.42. The kerb line of the original 16m wide carriageway is just visible. Within this space can now be seen a narrow carriageway, separate service road, linear parking, extended footways at corners and trees planted to soften the scene (Source: Devon County Council Engineering and Planning Department of 1991).

3.7.9. Barnstable-High Street, England

Description:

It is a busy main shopping street, narrow in places, there is pedestrian activity on it.

Problems:

-Conflict between vehicular traffic and pedestrians was severe and environmental conditions were of unacceptable standards

Objectives:

-To exclude traffic from the High Street, except for access for goods vehicles, during most of the working day

-To introduce measures to reduce traffic speeds at other times

-To implement environmental improvements

Solutions:

- Traffic in the middle section of the High Street is excluded from 9.15 a.m. to 5 p.m. with access for goods vehicles only at other times.

- The footways have been widened and the carriageway surfaced with clay pavers and removable bollards have been installed at each end.

- Access to the northern section of the High Street is also restricted to vehicles loading and unloading only, Monday to Friday 8 a.m. to 6 p.m. and is open to pedestrians only on Saturdays.

Cost:

- The cost of the paving was £40,000 and that for narrowing the carriageway £1,000 which was paid by developers.

Assessment:

- There has been a positive improvement in the shopping environment of the High Street with considerable benefits to the comfort and safety of pedestrians (Source: Devon County Council Engineering and Planning Department of 1991).

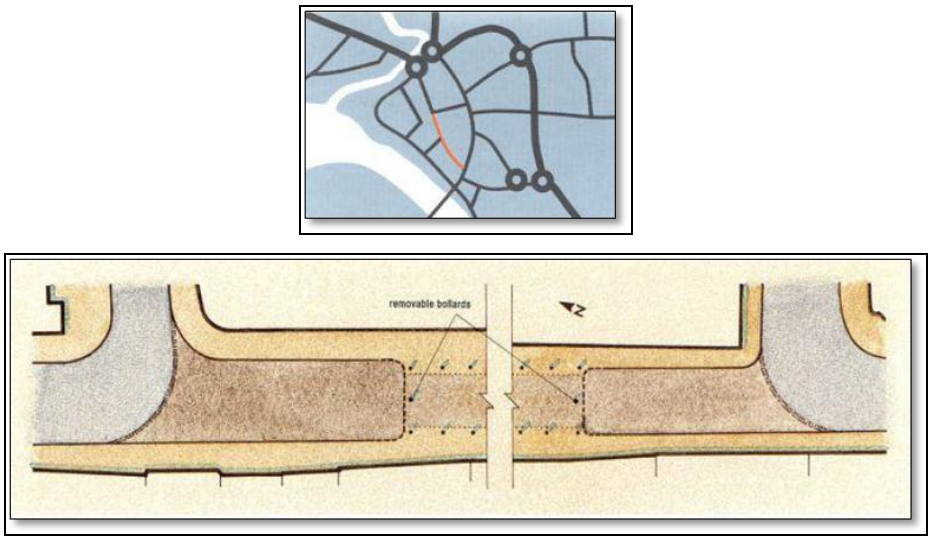

Figure 3.43. Traffic calming design in Barnstable-High Street.
(Source: Devon County Council Engineering and Planning Department of 1991)

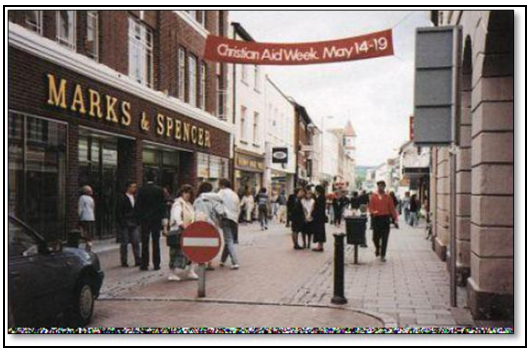

Figure 3.44. Full width paving enhances the street scene. Vehicle speeds have been reduced during the times when access is allowed (Source: Devon County Council Engineering and Planning Department of 1991).

3.7.10. Dartmouth–Town Centre, England

Description:

Dartmouth is an attractive historic town overlooking the River Dart in South Devon. The town centre is recognised as having an outstanding conservation area worthy of special attention to safeguard its future character.

Objectives:

-To safeguard Dartmouth historic town's future character

-To treat existing and proposed roads and footways

-To control on-street parking

Solutions:

-The scheme involved repaving the carriageway and footways at one level using traditional yellow and blue brick pavers.

-Removable bollards placed at the ends of the streets enforce the pedestrian priority.

Cost:

-The total cost for Foss Street and Union Street was £25,000.

Assessment:

-Combination of hard and soft landscaping has produced an environment where vehicles are viewed as an intrusion into pedestrian activity (Source: Devon County Council Engineering and Planning Department of 1991).

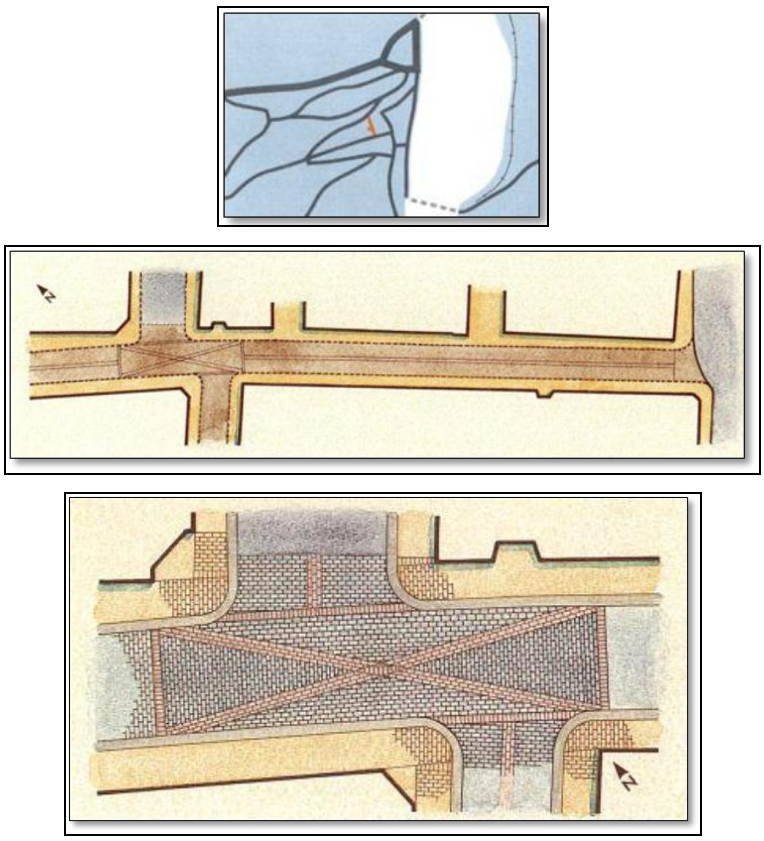

Figure 3.45. Traffic calming design in Dartmouth.
(Source: Devon County Council Engineering and Planning Department of 1991)

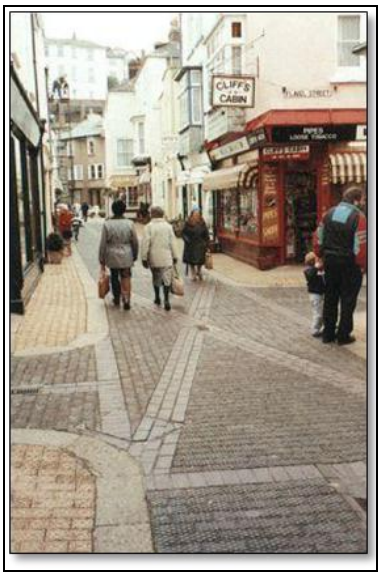

Figure 3.46. The carriageway and footway paved at one level. Traffic is calmed by the overall impression given by the layout of this street (Source: Devon County Council Engineering and Planning Department of 1991).

3.7.11. Totnes–The Plains, England

Description:

The Plains is a historic town. The eastern side of it consists of a number of warehouses and

other listed buildings which had fallen into disrepair, while the western side contains several listed buildings mainly in commercial use.

Problems:

-The whole area was dominated by an excessive amount of carriageway space, largely devoted to parking and bus services

-Pedestrians were afforded little space in this important part of the town.

Objectives:

-To improve the quality of the environment in The Plains it was recognised that a substantial change of emphasis was required to reduce the domination of vehicles.

Solutions:

-Measures included removing all the on-street parking and providing a pleasantly landscaped area where people can sit and relax or enjoy a drink from the recently refurbished

-The majority of the on-street parking was removed

-To give considerably more space for safe pedestrian activity, seating and signs footways were widened.

Cost:

The cost of the refurbishment Works was approximately £250,000

Assessment:

-The scheme has achieved the objectives of helping to reduce vehicle speeds and providing larger safe areas for pedestrians

-By removing much of the on-street parking and reducing the widths of the carriageway, pedestrian movements have been made considerably easier and safer.

-The environment has been greatly enhanced (Source: Devon County Council Engineering and Planning Department of 1991).

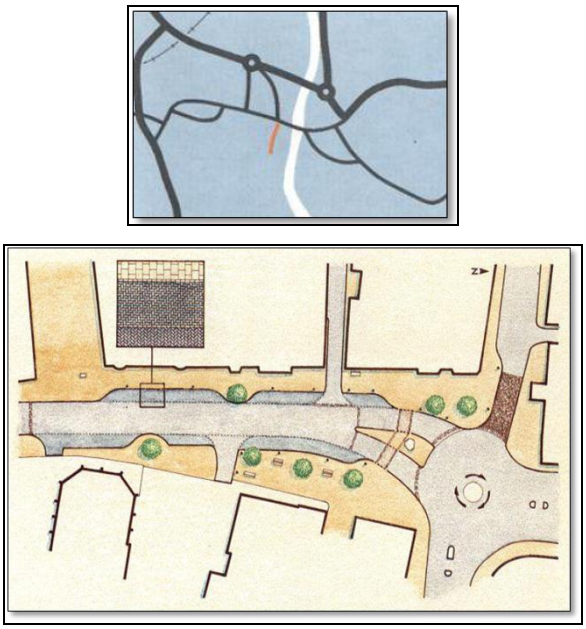

Figure 3.47. Traffic calming design in the Plains
(Source: Devon County Council Engineering and Planning Department of 1991)

Figure 3.48. The Wills Memorial Island. The paving and footway widening has helped to reduce vehicle speeds and provided a safer and pleasanter area for pedestrians (Source: Devon County Council Engineering and Planning Department of 1991).

3.8. Street Design within Urban Design Context

Urban design is defined as the art of making places for people. It includes the way places work and matters such as community safety, as well as how they look. It concerns the connections between people and places, movement and urban form, nature and the built fabric, and the processes for ensuring successful villages, towns and cities. It is also stated that urban design is a key to helping create lively places with distinctive character; streets and public spaces that are safe, accessible, pleasant to use and human in scale (DETR 2000).

CABE (2002) defines streets as a multi-functional space, providing enclosure and activity as well as movement. Its main functions are circulation for vehicles and pedestrians, access to buildings and the provision of light and ventilation for buildings, a route for utilities, storage space especially for vehicles, and public space for human interaction and sociability (CABE 2002). As well as providing access to buildings and the services to them, streets are our most important public spaces. Streets serve many functions, not only the circulation of traffic, but walking, cycling, play and meeting people. The spaces defined by buildings frame the street. Streets are multi-functional spaces and there is always the risk of conflict between uses. The key is to design for all the uses and users. (Yeang 2000)

The design of a street affects how successful it is in performing these functions, and it can also vitally affect the urban character of a neighbourhood and influence how people use the street and interact with each other on it. In any development the design of

streets should start by asking "what will happen on this street?" The street should be designed to suit the activities that we would like to see carried out on it. For example, if the street is lined with shops it should be designed to enable people to get to the shops, cross the road, have a chat and linger in front of shop windows, or have a beer in the sun (Yeang 2000).

The term 'streetscape' refers to the design quality of the street and its visual effect, particularly how the paved area (carriageway and footway) is laid out and treated (CABE 2002). Well-designed streets are a fundamental right of everyone and that the potential benefits of better urban design are very much. It is claimed that 80% of public realm is being public highway, so creating better streets and movement spaces is a high priority (Slinn et al. 2005). According to Nozzi (2005) it is time starting to design communities for people instead of cars. For him, one of the exciting ways to do that is through use of traffic calming (Walkablestreets 2011). Since, traffic calming appears to be one of the most cost-effective ways to promote pedestrian and bicycle use in urban and suburban areas in which walking and bicycling are often hazardous and uncomfortable by improving the quality of urban neighborhoods. Moreover, it is claimed that because the best road safety education cannot adapt a child to modern traffic, traffic must be adapted to the child. And traffic calming adapts the traffic to the children (Walkablestreets 2011).

Street design involves the design of some of the most important and most used public spaces. This is especially true in the case of residential areas, neighborhood centers, and downtown commercial areas where the design approach must include the various needs of pedestrians, bicyclists, transit, motor vehicles; the street's relationships to adjacent and future land uses; and where many factors must be compared, considered and decided in order to develop the final design solutions. Children and other nondrivers are too often needlessly impacted by street design that is exclusively motorist-oriented. When a person cannot safely or conveniently travel to without a vehicle, even simple matters such as children's recreation outside of the home become more rigidly scheduled due to travel coordination needs. By rethinking the design of streets it is possible to accommodate nonmotorist travel and replace some vehicular trips with nonvehicular trips, especially by walking (Bicycle Federation of America Campaign to Make America Walkable 1998).

The need to improve the quality of streets in their ability to cope with movement presents a challenge to engineers and urban designers. Congestion and unreliable

journey times in towns and cities remain sources of concern to almost all governments and highway authorities, and the introduction of traffic controls and other highway measures do not appear to have succeeded in improving journey times or reducing congestion. Average speeds for cars across London remain between 11 and 13 mph, roughly the same as at the beginning of the twentieth century (Hamilton-Baillie 2008).

Concern about declining streetscapes tends to revolve around a number of interconnected themes. These range from issues relating to the environment (emissions, pollution etc), those affecting economic activity (pedestrian flows, traffic congestion, rental values), to those related to health (such as obesity, mental health, public safety etc) and those concerned with the quality of civic life and community cohesion (inclusiveness, antisocial behaviour, civility etc.). It is worth touching on some of these in more detail (Hamilton-Baillie 2008).

Design can have a major impact on the success or failure of the public realm. Much literature concentrates on simple design problems at the local scale: such as bus stops which hinder pedestrian flows; pedestrians denied proper waiting room at crossings or traffic lights; use of poor quality or inappropriate materials; poor transport integration; and inappropriate street furniture, landscaping, art and lighting. Another design problem is the number of town and city centres which are still dominated by the engineer-driven enhancement schemes of the 1970s. Engineers concentrated on vehicular flow and segregated pedestrians from transport routes.

Moreover, children's use of other spaces in the public realm can cause conflict. Millward and Wheway (1997) examined twelve housing estates in England to ascertain children's use of public space. Children used all available areas for play, not just designated playgrounds. They required public space for many activities such as physical play, quiet games, for social contact and to play on bikes. Individual spaces were used for a short time, and moved between spaces where possible. Most children played where they could 'see and be seen'. They concluded that policies to 'corral' children into 'safe places' would limit play opportunities and probably fail. Also, for children to fully exploit the public space of their estates traffic speeds need to be reduced to 10 mph and visibility of pavements and roads needs to be clear. Children were observed to be playing mostly in the following areas: roads/pavements (46%); public open space/grassed areas (18%); gardens (14%); and play areas (12%). Here, clearly there are conflicts between the priorities of car users and of children and their families (Williams and Green 2001).

For streets to work as social places the traffic must be slowed. The best way to do this is to design streets that encourage drivers to drive with caution. The arrangement of buildings, spaces and activities can act as a natural traffic calmer and has the double advantage of being visually less intrusive and far more pleasant for pedestrians and cyclists (Yeang 2000). Traffic calming involves the use of various roadway design treatments to reduce motor vehicle speeds and traffic volume. It is most often used on residential and downtown streets, although there is increased use of traffic calming techniques to help manage motor vehicle speeds on collector and arterial streets. When traffic calming techniques are applied on a neighborhood-wide basis, rather than in isolated locations, the behavior of motorists tends to be more significantly influenced and the traffic problems of the area are more generally improved, as opposed to simply shifting them from one location to another. While traffic calming is not initiated expressly for pedestrians, the effects-slower motor vehicle speeds and reduced motor vehicle volumescan significantly improve the pedestrian environment. High-speed traffic is intimidating to pedestrians and it shortens reactions times for drivers. The higher their speed, the less likely drivers are to yield or stop for pedestrians. And, when crashes occur, the higher the speed of motor vehicles the more severe the injuries are to pedestrians (Bicycle Federation of America Campaign to Make America Walkable 1998).

Simply lowering the posted speed limit may seem like the most logical strategy for slowing traffic. However, it is generally accepted that is it the design of the street and not the posted speed limit, that determines how fast people drive. People drive faster on roads that are wide, that lack sharp turns, and that allow the driver to see a longer distance ahead. Wide, visually uninterrupted roadways send the message that "this road is for cars." It encourages motorists to increase their travel speed and lulls drivers into paying less attention to pedestrians.

It is important to note that the best approach to traffic-calming is to change the basic design of streets so that motor vehicle operating speeds are appropriate and compatible with the area and its related activities. For instance, streets in residential areas, in downtown shopping areas, near schools and parks, and other places where pedestrians, especially children, are likely to be should be designed to limit motor vehicle speeds to 15 to 25 mph. Narrower streets and rights-of-way, together with the use of street trees and medians, can have a significant effect on keeping motor vehicles

speeds down. This helps to create both safer and more attractive conditions for walking (Bicycle Federation of America Campaign to Make America Walkable 1998).

On the other hand, Yeang (2000) claims that there are many cases where a development inherits an existing street layout that cannot be traffic-calmed except through add-on measures. In this situation, firstly, the measures should be designed with pedestrians, cyclists, public transport, service and emergency vehicles in mind e.g. raised junctions make it easier for pedestrians to cross and chicanes can be used to create informal spaces in the street. Secondly, traffic calming measures should be designed to suit the local context, avoiding the use of standard solutions. This is the job of the urban designer and landscape architect, not just the traffic engineer (Yeang 2000).

Also, traffic calming eleemnts should be designed by considering the goals and objectives of urban design. For instance some traffic calming design polices can be contributed as shown below:

-Reasonable automobile access should be maintained. Pedestrian, bicycle, and transit access should be encouraged and enhanced wherever possible.

-Parking removal should be considered on a project-by-project basis. Parking needs of residents should be balanced with the equally important functions of traffic, emergency vehicle access, transit, bicycle, and pedestrian movement.

-Traffic-calming projects on collector streets should not divert traffic off the street (e.g., through the use of traffic diversion devices).

-Traffic may be rerouted from one local street to another as a result of a traffic-calming project. The acceptable traffic increase should be defined on a project-by-project basis (Bicycle Federation of America Campaign to Make America Walkable 1998).

Furthermore, Hayward and McGlynn (1993) emphasize that urban designers need to understand the benefits of traffic calming elements to aid them in achieving better places. Good urban design creates spaces in urban areas that encourage people to stay and enjoy.

Streets perform certain basic functions in the built environment such as providing routes for vehicles and public transport, and accommodating utility services and drainage systems. The design of a street affects how successful it is in performing these functions, and it can also vitally affect the urban character of a neighbourhood and influence how people use the street and interact with each other on it.

CHAPTER 4

THE CASE STUDY CONTEXT: 55 AND 56 STREETS IN GÜZELYALI, İZMİR

In this chapter, traffic calming concept was investigated whether the western design concept of traffic calming can be applied or, if not, how it can be modified to our cultural norms and urban design standards with the case study of two residential streets in Güzelyalı in İzmir. Firstly, cultural and spatial constraints of the Turkish urban streets were investigated. And then the spatial and cultural structures of Güzelyalı Neighbourhood and the neighbourhoods around it were explained generally. Secondly, the case study of two residential streets were dscribed in terms of the reason of chosing those streets. The location of the streets, the land use, the height distribution and other streets around them were explained. Thirdly, traffic volume and cut-through traffic of the study site were explained in terms of the number of vehicles passing and the number of vehicles using the case study area as a cut-through route during peak hours. Fourthly, the problems observed and collected from traffic volume data were explained, and finally, how traffic calming concept can be applied in order to solve the problems on the streets.

The case study comprises two streets in Güzelyalı Neighbouhood. It has been seen from the observations made in the limits of Güzelyalı District that cut-through transitions are made densely in some residential streets between the İnönü and Mithatpaşa Streets. 40 Street, 30 Street, 39 Street, 55 Street and 56 Street were seen as the streets which have heavy traffic volume in Güzelyalı District.

From these streets, which have heavy traffic flow, traffic count was made, intensity of pedestrian and pedestrian use were observed in 55 and 56 Sreeets and these streets were chosen as the case study site.

For this case study, information was gathered at five main steps. The first step contains literature review from articles, thesis, and web based researches about Güzelyalı Neighbourhood. Also, visual information, such as maps, from both literature survey and Konak Municipality had beem got.

In the second step, a set of field surveys were conducted. Firstly, general observations were made within the Neighbourhood in general. From these observations, it was seen that there are crucial spatial constraints such as parking space and sidewalks for children. The streets are too narrow; however the number of vehicles on the streets is too high. Becasu of that reason, some of the streets have one-way route. On the study streets (55 and 56 streets), there is also one-way application. After general observations, traffic count surveys were made on the case streets (55 snd 56 streets). Vehicle counts were made in order to find the rate of cut-through traffic for three weeks at peak hours. Pedestrian count was made only on Fridays (for three days). Pedestrian density was found from the observations where and at what times increase. Moreover, because the parking is the most crucial problem on the streets, parking counts were made by using the "The number of vehicles=1,62+0,2xstreet length (m)" formulation and parking count. But parking vehicle counts could only be made one day at one hour. So, mostly the formulation about parking was used. It was found that because there is not any alternative parking space, the streets, usually sidewalks are used as parking space. On-street parking is a method of parking, but it must not threaten the pedestrian areas.

In the third step, problem points within the study streets were idendified. By looking at the "look-up table" the most suitable traffic calming elements were proposed and the streets were redesigned according to proposed traffic calming elements.

In the fourth step, questionnaires were completed in the site for getting opinions of the residents about proposed solutions for the problems on streets. The questionnaires were done with 75 residents. Developed questions were focused on the problems on the streets and having an idea about traffic calming and traffic calming elements. The questionnaires were developed according to quality of life of the streets and the problems for residents on the streets. Also, the questions were used as a guide for the interviews. The interview format was one of a structured conversation rather than questionnaire administration. Since, I aimed for a holistic understanding of the residents' ideas about traffic calming elements. As a result, the interviews did not always cover every single question in equal detail, but did identify the main issues as each respondent saw them.

There are eight different data collection techniques which may be employes for the surveys:

-Documentary searches,

-Observational searches,

-Household self-completion surveys,

-Telephone surveys,

-Intercept surveys,

-Household personal intervies surveys,

-Group surveys,

-In-dept surveys (Richardson et al. 1995).

In this study, observational and household personal interviev surveys were made.

The fifth step includes the evaluation of proposed traffic calming solutions according to the results of questionnaries.

4.1. The Meaning and Social Dimensions of the Street

There is a distinction between street and road. Rykwert (1991) explains that road suggests movement to a destination and the transportation of people and goods on foot, by pack-animal or vehicle. However, street's meaning is that"it is a road in a town or village, comparatively wide as opposed to a lane or alley" (Moughtin 1992, 129). The road mostly differs from the streets as the movement of fast-moving or heavy traffic with all its engineeringrequirements.

The purpose of the street can be grouped under three categories: movement channels for traffic, the exchange of goods, and social exchange and communication (Velibeyoğlu 1998).

The urban process is importanf for shaping process of the street. Social, political, technical and artistic forces generate the city's form and consequently effect the shaping process of the street. Today the role of street and the nature of social interaction vary with class, ethnic group, age structures and type of specializationof neighborhood (Velibeyoğlu 1998).

The daily life in public urban spaces declines in our age as the result of increasing rate of private car use, new information and mass media Technologies, car-oriented shopping centers, increased crime and violence on the street. On the other hand, one of the great characteristics of cities is the strong notion of people in communication, because of the street function as a nodal point for both regional and internal communication. Our economic, social and even environmental structure

depends on the street, roads and highways as a means of movement, orientation and communication. The street through its process has always becamea heavily built its artifact not only its surface but also in its subsurface for subway andinfrastructure facilities and along its edges (Velibeyoğlu 1998).

There are three factors greatly effecting the street as a place for communication. First one is the replacement of the street as an information source by new communication Technologies. The second one is the reliance of automobiles to travel on streets. Ant the third one is the development of new streets that do not facilitate pedestrian movement (Velibeyoğlu 1998).

4.2. The Cultural and Spatial Constraints of the Turkish Urban Streets

The increasing number of motor vehicles in our country as all over the world caused congestions in our roads which they can not carry. On the basis of the problem, the reluctance of the obeying to the rules of living together and urban culture that apply all over the world, especially traffic rules lie. Also, the lack of awarenes of understanding why rules have emerged is the main reason of traffic problems like other social problems (Pampal et al.1999).

Traffic problems were collected under four maing headings at the Trafic Search Conference (Trafik Arama Konferansı) organized by Sabancı University in 1998.

1. Social awareness and common sensitivity
2. Education, human factor
3. Infrastructure (physical, technical)
4. Control and legistlation.

Ties between human and space is an important theme of the high quality of urban life. The spaces people want to make fun help to develop belonging of space. Belonging to the space consists of the fields that appear meaningful to people. The spaces which people equated with themselves, felt as a part of these spaces, mostly quality spaces for people (Mazumdar 2007).

Culture plays a major role in elements that people enjoy and sense of belonging. Cultural values determine the objects and activities that is felt close. Cultures have developed unique and different ways of building a relationship and being in interaction with the environment. Culture really make a difference. Characteristics of cities around

the world keep their distinct cultural traditions despite the joint technology, similar struvtures, growing trade and rising prosperity. For instance, Asia-Pacific region is different from South Asian and Middle Eastern cities and other jurisdictions in the West shapes (Mazumdar 2007). Also, cities in the Mediterranean countries show different features from cities in the northern countries.

Streets have major role in feeling sense of place. It is very obvious that the streets in Ho Chi Minh City in Vietnaw are very different from the streets in ABD, China and India. The streets are not straight, angled or wide in the Muslim regions in the Middle East. Not only the shapes of the streets are different but also they have different uses and concepts. Many Western writers have described the streets of the East and the Middle East as narrow, dark or crowded. Also, they felt that some of those streets are noisy, interesting and alive until late at night (Mazumdar 2007).

Cultural spaces are specific and sometimes unique areas that cultures created to do their own activities. Tea houses in Vietnam and "kahve"s in Turkey. These are places where people come together to meet, talk, make friends, establish business connections. These places such teahouses take the place of squares in Europe. Another example is cemeteries in Iran. The cemeteries here are places that are not only for the dead, but also for families who make picnics and family chats. In some places, bazaars turned into fields of culture. The squares in Europe are places for social interaction. To be in a square which is open to the public means to meet with a friend, acquaintance or stranger. For example, there are lots of shops around the square in front of the town hall and church in Delft in the Netherlands. People go to those places to meet, talk or eat (Mazumdar 2007).

On the streets there is different street people communication each other. The street people may be arranged under six distinct genera or kinds:

-Street sellers

-Street buyers

-Street-finders

-Street-performers

-Street artisans, or working pedlars

-Street labourers (Jukes 1991).

The daily street life is very important for Turkish culture as in the Mediterranien countries. The Turkish urban streets are also affected by having the Meditrranean culture. King et al. (2001) claim that there is no commonly-agreed boundry which

defines the Mediterranean region. The Mediterranean has been used as a flexible concept whose spatial extent varies according to the perspective being used environmental, cultural, economic and geopolitical.

In historical and cultural terms, the Mediterranean is often portrayed as a series of distinct if overlapping units of influence: southern Europe, the Maghreb, the Mashreq, the Middle East, the Arab States, the ottoman Empire etc. (King et al. 2001). Also, King et al. 8201) explain that the region's 19 states were divided into four groups: countries belonginig to the European core (France, Italy), countries of the European periphery (Greece, Turkey), socialist states (Albania, former Yugoslovia) and the Arab states. Throughout its history, the Mediterranean was a route of communication between hegemonic city states and colonies or independent cities. During their glory days, Mediterranean cities formed a sort of urban network by the sea The celebrated industrial revolution pushed the Mediterranean down from core to peripheral status in the global economy in a slow process of decline from the 17th to the 20th century. Mediterranean cities did not go through any industrial revolution. They were marginalised and surpassed by Northern ports in Belgium and Holland (Bruges, Antwerp, Amsterdam), and then London (Jones 1990; Mumford 1961-1966). The factory and the railroad, the capitalist economy, did not take root in the South and were not the main forces transforming its cities. Capitalist development in Mediterranean history has been different from that of Western Europe in many respects and the process of urbanisation was not triggered by industrialisation. With the partial exception of Italy, which industrialised earlier, in the rest of Southern Europe and Middle East, cities grew because of poverty and insecurity in the countryside, informal work opportunities in the cities, as well as the Mediterranean culture of urbanism, as discussed below. Fast urbanisation without industrialisation turned Mediterranean cities into large agglomerations in the world (Isigmagazine 2012).

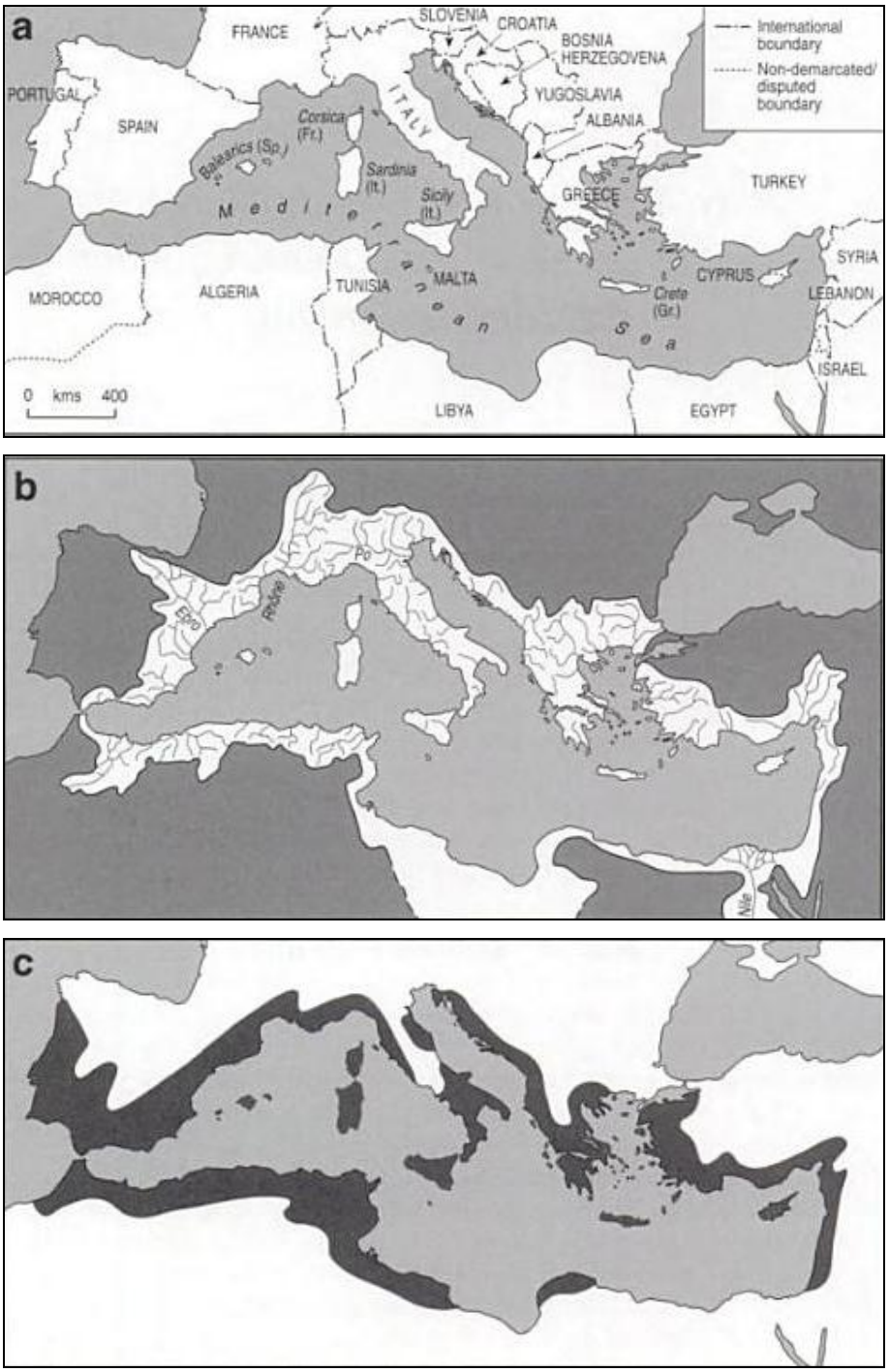

Figure 4.1.Delimiting the Mediterranean: (a) Mediterranean countries, (b) the Mediterranean watershed, (c) limit of cultivation of the olive (King et al. 2001).

	Population (m.)	GNP ($US bn.)	GNP per capita ($US)
EU Mediterranean			
France	58.8	1,466.0	24,940
Spain	39.3	533.7	14,080
Portugal	10.0	106.4	10,690
Italy	57.6	1,166.2	20,250
Greece	10.5	122.9	11,650
Other Northern Mediterranean			
Malta	0.4	3.6	9,440
Cyprus	0.8	–	–
Slovenia	2.0	19.4	9,760
Croatia	4.6	20.7	4,520
Bosnia-Herzegovina	2.5	–	–
Yugoslavia-Serbia	10.6	–	–
Macedonia-FYROM	2.0	2.6	1,290
Albania	3.4	2.7	810
Turkey	63.5	200.5	3,160
Maghreb			
Morocco	27.8	34.8	1,250
Algeria	30.0	46.5	1,550
Tunisia	9.4	19.2	2,050
Other Southern Mediterranean			
Libya	5.3	–	–
Egypt	61.4	79.2	1,290
Lebanon	4.2	15.0	3,560
Syria	15.3	15.6	1,020
Israel	6.0	95.2	15,940

Source: World Bank (1999).

Figure 4.2.Mediterranean countries: population and wealth
(Source: King et al. 2001)

Southern cities influence Northern cities in a process of "Mediterraneanisation". This was first named in Liverpool, but was also enacted in many other inner cities around the globe such as central Baltimore, Glasgow, the Melbourne and London waterfronts, the Graz island, 'reconquered' cities such as Lyon, Strasbourg, Copenhagen, Melbourne, and also more recently in Eastern European cities of Hungary, Romania, Bosnia and other Balkan cities which belong to states with Mediterranean coasts. London has adopted both "Mediterraneanisation" in the docks, and American highrises (Isigmagazine 2012).

North and South converge in three important ways. First type of 'Mediterraneanisation'relates with the urban renovation with the revival of inner-city living and outdoor cafes and the valorisation of historic heritage. Second type is the global architects, many of whom originate in Southern Europe such as S. Calatrava, R. Piano, A. Tombazis, mingle with other cultures but also disturb renaissance harmony, as

in Venice, or construct whole innovative complexes, as in Athens, Genova, Lisbon. Last type is the second homes and residential tourism. Since the 1980s another form of seasonal sprawl affected the Mediterranean city: residential tourism by North-South migrants lining the Mediterranean shores (Isigmagazine 2012). It is also claimed that this is an important version of suburbia by affluent populations since the 18th and mainly the 19th century beyond city and indeed national boundaries, and can be as removed from cities as the French Riviera is removed from French or British cities, and Algeria is removed from Paris (Isigmagazine 2012).

If in the Anglo-American city public space is physical space, in the Mediterranean it is the place where democracy and citizenship were concretized from antiquity until our days. Urban life revolves around the city and the home, and there is another North/South divide here since Roman times. The Mediterranean tradition sees the whole city as the context for civil life and the housing units as small private enclaves. Anglo-American cultural stereotypes see houses as the essential setting for everyday life. The English public life has not particularly needed the city: the elements of civilisation already existed in everyone's home: "my home is my castle". By contrast, Mediterranean castles enclosed a whole city, and were consecrated as boundaries or limits of the city (Leontidou 2003).

Leontidou (2003) claims that this is extended today towards a contrast between street life in the South (which spreads to continental cities such as Paris), and 'hurried leisure' in America, where at least in the period of modernism the private car has superseded the pedestrian. The antithesis extends to leisure patterns such as eating out, where 'hurried leisure' is evident in restaurant queues in Northern Europe, in the practice of waiters of keeping glasses full, and in their pressure to clear the table for the next round of customers as soon as a meal appears to be finished. This is not experienced in Mediterranean cities, nor is anybody expected to leave the table or the cinema as soon as the meal or the film ends. People are allowed to enjoy their meals and performances in unhurried leisure (Leontidou 2003).

Leisurely enjoyment of public spaces and the tendency towards street life can not be attributed to the mild Southern climate alone. They reflect urban-oriented cultures in compact and enclosed cities. Certain aspects can also be found in French urban 'café societies', in Vienna, and in tourist squares elsewhere. The popularity of the city centre and the inner city more generally is evident in the tendency of the more affluent social groups to live in the centre. This contrasts with inner-city poverty in

British and several Northern European cities, where the more affluent classes have suburbanised from a very early period. It is not spacious living (as in the Burgess and Alonso models), but accessibility to the city centre which is highly valued and preferred in Mediterranean cities (Leontidou 2003).

Streets are important spaces for communities in term of social/economic function, and cultural idendity and interaction. However, culture of communities affects the urban streets as well. One the most important impact of culture for the urban streets is traffic problems. With the rapid urbanization in cities, urban populatin has increased and most people could not adopt urban life. And this compliance problem showed itself within the urban streets with the increasing number of motor vehicles. The most important cultural constraints for urban streets are lack of social awareness and common sensitivity, lack of education and legistlation difficulties (Pampal et al. 1999). First of all, the behaviours of drivers, passengers and pedestrians affect the security of traffic and urban streets. It is claimed that the rate of humn factor that cause traffic problems is very high according to the road and environmental aspects. For instance, in Turkey this rate is araound 95%. This high rate shows that improving the quality of streets or rules do not solve the traffic problems unless improving the human factor. Secondly, long-term plans aimed at solving the urban transportation could not be produced, and also implementation of existing plans is not placed. Furthermore, local governments remain under the influence of market mechanism and as a result, they prefer to produce temporary solutions with encourageing individual vehicle Access instead of permanent and efficient solutions. Thirdly, infrastructure of the streets is constantly intervened by using the structural and functioning problems related to urban transport system. But, the sources of the problems are; in fact, appear according to the relationships between market mechanism and public service. Finally, solutions that promote access to the private car cause more congestion on urban streets.

Traffic congestion in urban centers, lack of parking, parking on the siedwalks and too narrow streets are the most important spatial constraint in Turkish urban streets. As the result of rapid urbanization and increasing use of private cars in 1950s and 1960s, it was understood that the needs of street and road must be met. However, at this period, the reqirements of public transport was overlooked and the streets were tried to be improved in order to provide the necessities of private cars. Since, private car increase was interpreted as the increasing level of life. As a consequence, urban planning became an advantage for private cars and disadvantage for public transport.

Çamur (2003) idendifies that unlimited freedom given to the use of private car in urban space threatens the sustainability of public space and urban streets. Private vehicles priority, parking every place on the streets including sidewalks and parks maket he streets unlivable places. However living streets are one of the most important feautures of traditional Turkish streets.

Spatial constraints, also, appear because of inadequate legal regulations and lack of comprehensive transportation planning. First of all, planning system, and laws and regulations for urban space and streets are dependent on each other. Laws are made only by thinking engineering solutions for urban spaces and streets. For instance, Road Traffic Regulation (Karayolları Trafik Yönetmeliği) brought the speed limit on city and suburban. According to the Regulation, the sped limit in the city center for cars is 50 km/h. This limt must be detailed according to according to the characteristics of the streets.

Secondly, Zoning Law (3194 sayılı İmar Kanunu) contains lots of regulations in detail, but problems are experienced in practice. Since, every urban street must have its own characteristic features; however zoning regulations bring the same regulations for every urban palce and street. The widths of the streets are idendified and some obligations are wanted, such as sidewalk obligation.

4.3. Spatial and Cultural Structure of Güzelyalı Neighbourhood

Güzelyalı is a neighbourhood of Konak District which is one of the most importanr districts in the İzmir Metropolitan Boundaries. It is located between Göztepe and Mehmet Ali Akman Neighbourhoods. Also, it is between Mithatpaşa and İnönü Roads.

The south side of the Gulf of İzmir, the shoreline up to from Karataş to Güzelyalı and the neighborhoods located here were called “Yalılar” until the early years of the Republic from the mid-century of 19 (Ürük 2011). These neighborhoods which were developed around Mithatpaşa Street extending east-west directions starts in front of Bahribaba, continue throughout Karataş, Salhane, Karantina, Güzelyalı and end in Üçkuyular.

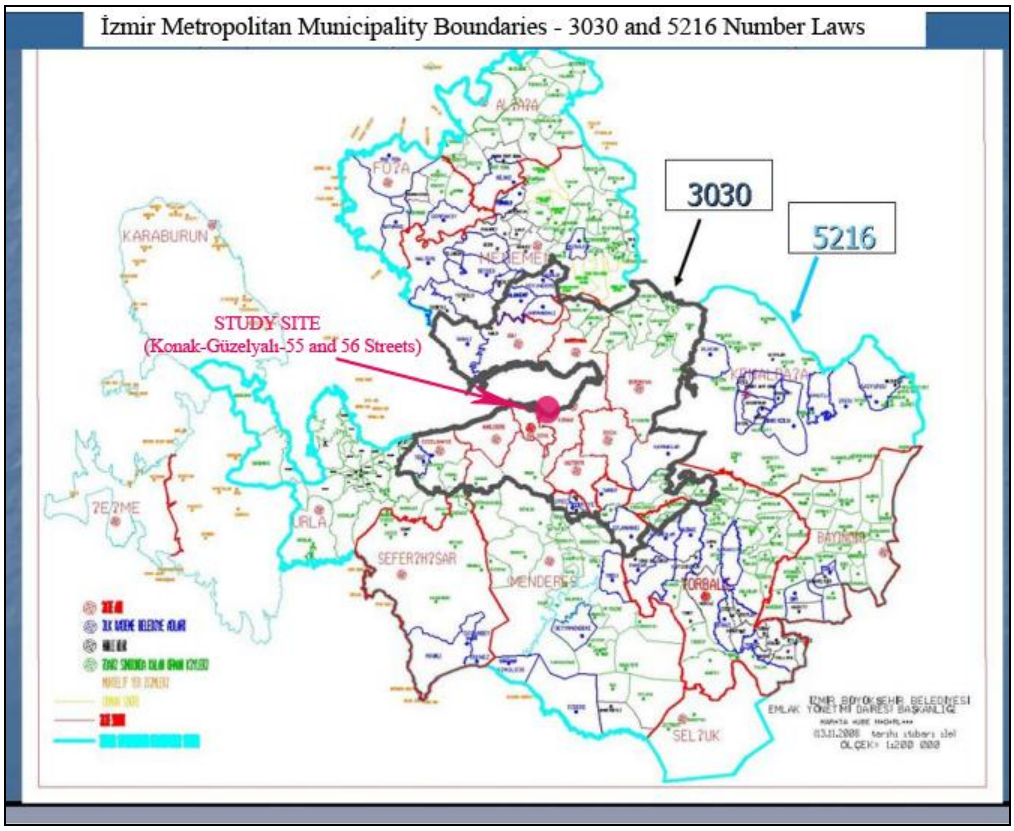

Figure 4.3. Authority and Responsibility Areas of Izmir Metropolitan Municipality and the Location of the Study Site (Source: Final Report Summary of İzmir Transportation Master Plan 2010).

Figure 4.4. Location of the Güzelyalı Neighbourhood.
(Source: Citysurf Globe of İzmir Metropolitan Municipality)

Before apartment-type of construction destroyed the architectural features of İzmir, the neighborhoods in this area called “Yalılar” had the important unique buildings. At this period the names of neighborhoods in “Yalılar” were Melantia (Karataş), Kallithea (Karantina), Port (Köprü), Spartali (Sadık Bey), Enopi (Göztepe) and Mikrati (Güzelyalı) (Ürük 2011).

There are two important arterial roads in this area. First of them is the Mithatpaşa Street. Mithatpaşa Street forms the backbone of the region extending from Karataş to Güzelyalı. It starts form Konak, after pass from Karataş, Karantina, Köprü, Göztepe and Güzelyalı, it exits from the boundaries of Konak District in Üçkuyular. A part of the road between Sarı Kışla and Göztepe was opened in 1880 when Mithet Paşa was the Governor of İzmir. The streets’s name was changed as Mithatpaşa in 1951 while the name of it was İnönü after the Republic. It is the longest road of all of the roads in İzmir that it is 25140 meters length. 5900 meters of this length is within Konak, 4170 meters is within Balçova, 7230 meters is within Narlıdere and 7840 meters is within Güzelbahçe boundaries.

The second important road of “Yalılar” is the İnönü Road. It starts from Konak and ends at the Fahrettin Altay Square in Üçkuyular. It is 5896 meters length. There is a metro work on this road.

In the Final Report Summary of İzmir Transportation Master Plan, İnönü Road was defined as an arterial road and Mithatpaşa Street was defined as a collector road.

Figure 4.5. Network Road of the Body of İzmir Metropolitan (2001)
(Source: Final Report Summary of İzmir Transportation Master Plan 2010)

Güzelyalı Neighbourhood is generally a residential neighbourhood although most of the first floors of buildings are commercial. The height of buildings that face the İnönü and Mithatpaşa Roads are change between 7 and 10 floors. However, in the area there are between 1 and 7 storey buildings. Most of the streets in the area are narrow. As a result of that some of the streets are one-way. One-way streets in Güzelyalı District are 24, 25, 34, 38, 39, 40, 43, 44, 54, 55, 76 streets and one part of 56 street. On the other hand, there is a very serious parking problem in the area. Because there are not enough parking lots, all of the streets have on-street parking.

Todays's total population of Güzelyalı is 23000 (Headman of Güzelyalı). When looking at the population of Güzelyalı according to the age groups, it is seen that the majority of the population consists of elderly people. The total number of buildings is 1078 whereas the total number of housing is 8194 and the number of establishments is 1106 (www.konak .bel.tr).

Land use distribution and the number of storeys of the buildings in the area show that the density of the neighbourhood is very high. Also, the area is a compact

neighbourhod. The compactness of the neighbourhods is mostly more favorable in term of accessibility and livability. On the other hand, it was seen from the observations that Güzelyalı and other neighbourhoods around it are not livable because of the traffic problems such as congestion, cut-through traffic and parking prolems.

Table 4.1. Number of Population, Housing, Establishments and Buildings in Güzelyalı. (Source: Konak Municipality)

NUMBER OF POPULATION	23000
NUMBER OF TOTAL HOUSING	8194
NUMBER OF ESTABLISHMENTS	1106
NUMBER OF BUILDINGS	1078

Table 4.2. Population Information by Age Groups in Güzelyalı. (Source: Konak Municipality)

AGE	POPULATION
0-4	555
5-9	687
10-14	763
15-19	929
20-24	1132
25-29	1387
30-34	1444
35-39	1363
40-44	1248
45-49	1305
50-54	1438
55-59	1447
60-64	1210
65+	3009

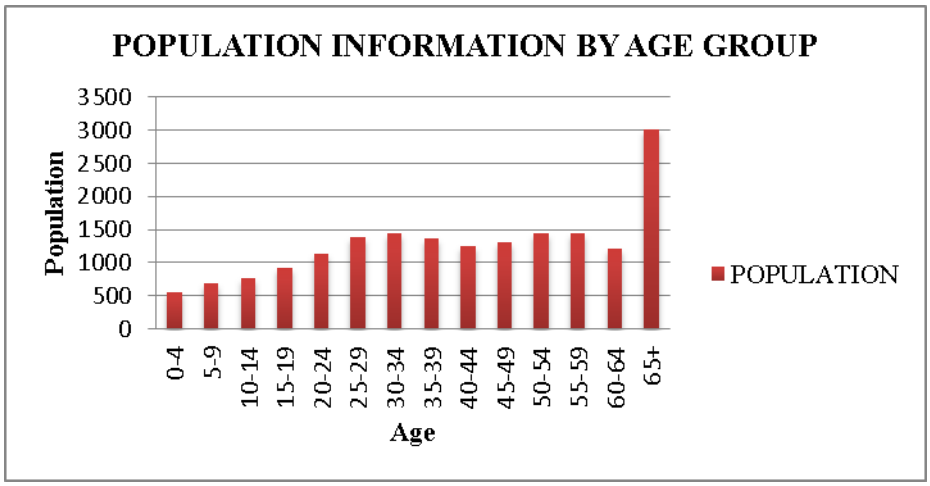

Figure 4.6. Population Information by Age Group in Güzelyalı.
(Source: Final Report Summary of İzmir Transportation Master Plan 2010)

The first floor land use distribution shows that Güzlyalı Neighbourhood and the neighbourhods adjacent to Güzelyalı mostly consist of residential units. The residential and commercial units continue along the İnönü and Mithatpaşa Streets although they are very common within the neighbourhoods.

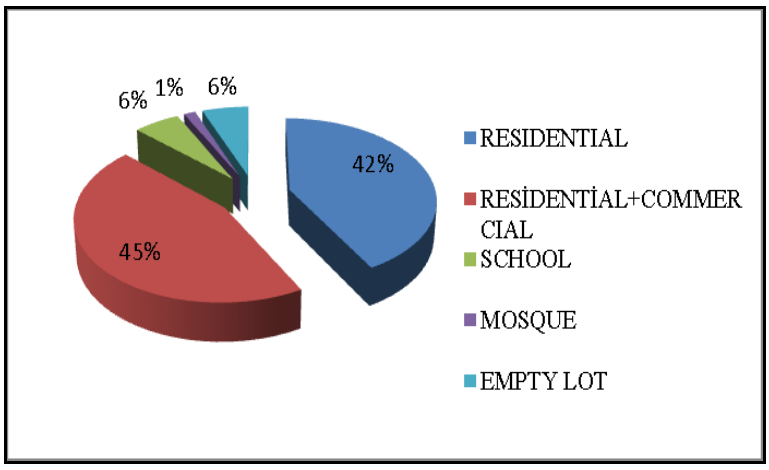

Figure 4.7. The Land Use Distribution

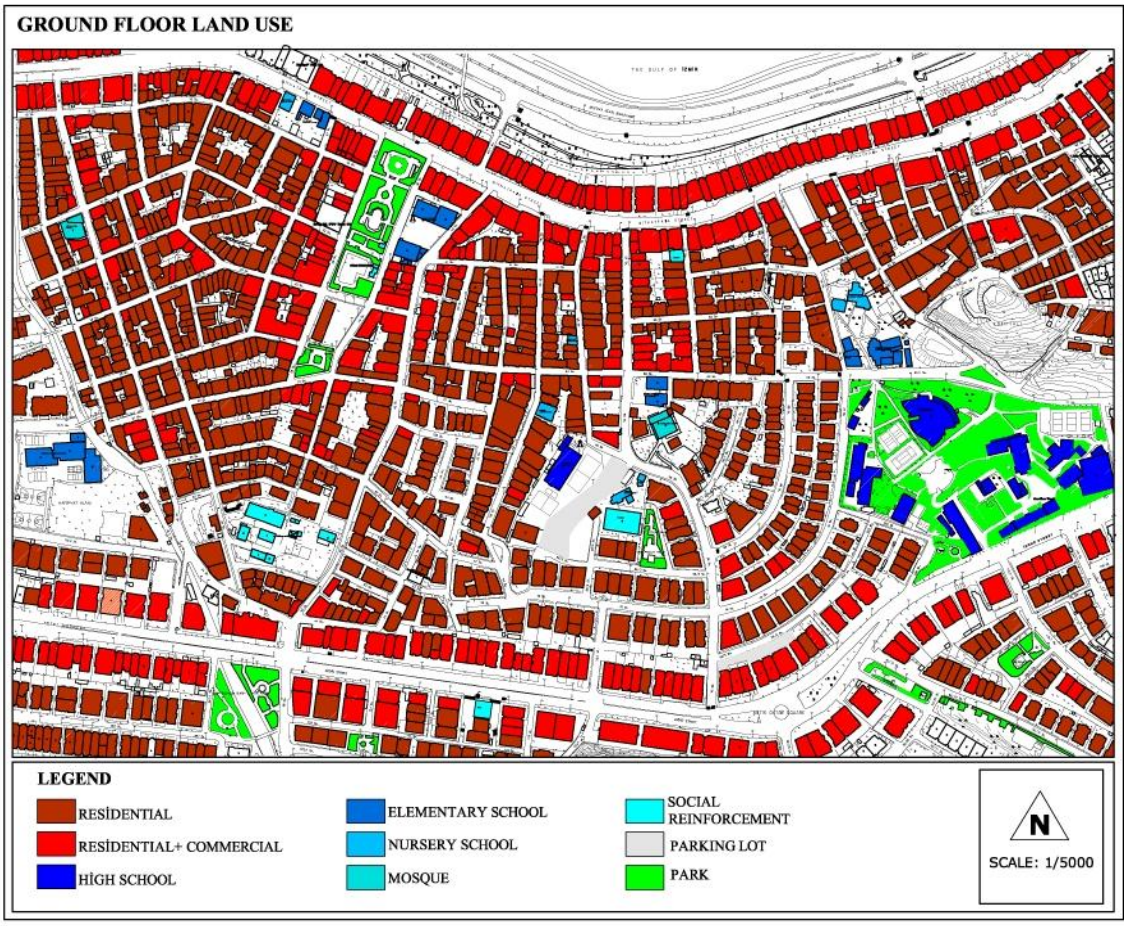

Figure 4.8. The Land Use Distribution.
(Source: Field Study September 2011)

The number of the storeys of the buildings changes between one-storey to ten-storeys. Highest number storey of the buildings locates along the İnönü and the Mithatpaşa Streets. But, generally the number of five-storey buildings is more than the others.

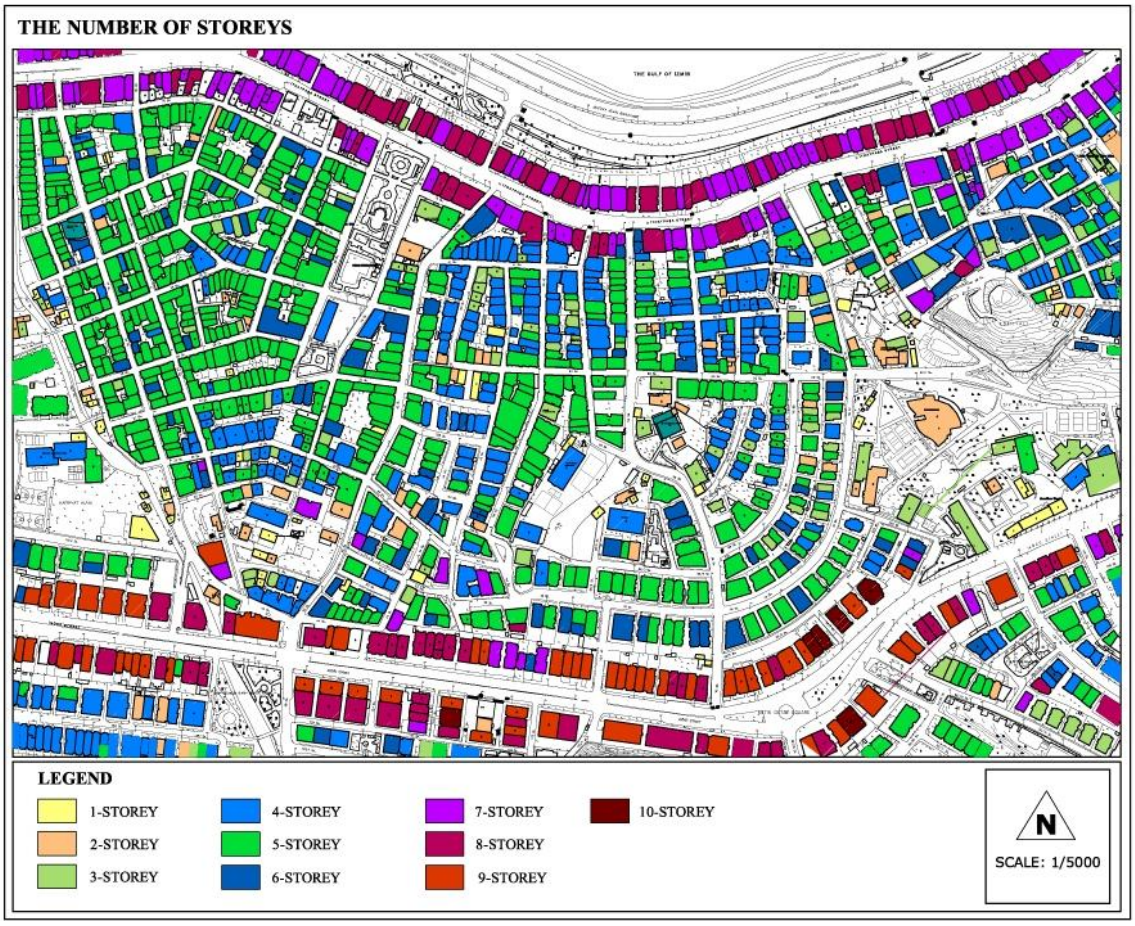

Figure 4.9. The Number of Storeys of the Buildings.
(Source: Field Study September 2011)

There are one-way applications on some streets in Güzelyalı Neighbourhoods and the neighbourhood around it. Since, some of the streets are too narrow while the density of buildings facing them is very high. As a consequence of this, traffic congestion and parking space constraints become the most crucial problems within the neighbouhoods.

Also, there is a metro work on the İnönü Street which is a permanent situation. But this work also caused some traffic changes within the neighbourhoods.

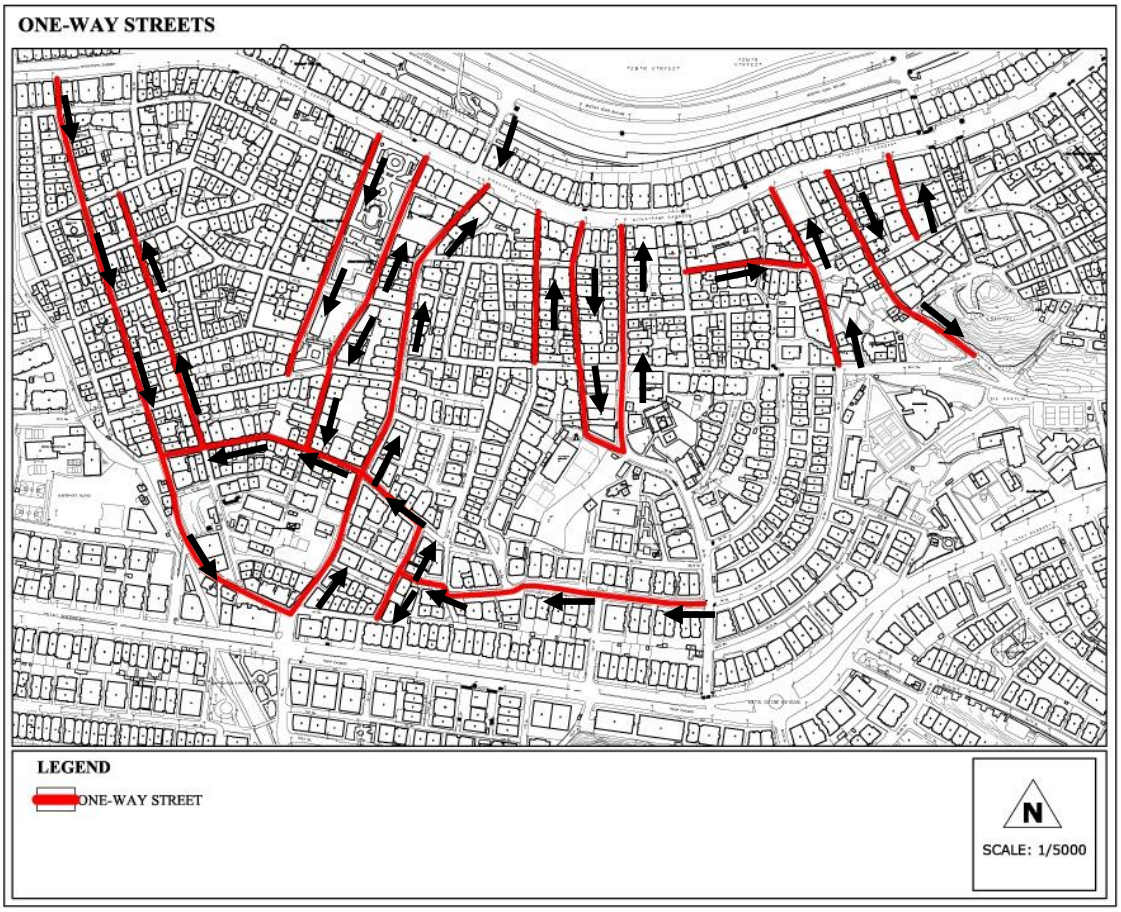

Figure 4.10. One-way Streets.
(Source: Field Study September 2011)

Güzelyalı was a Turkish neighbourhood starting to be developed in the beginning of 19th century. It is the end point of the series of Yalılar Neighborhood. Its name was Mamuretü'l Hamidiye before March 31 Event. After March 31 Event it was called as Reşadiye, however its name became Güzelyalı in 1933. It is known that the Güzelyalı Neighborhood called as "Mikrati" by non-Muslims smelled pretty bad especially during summer because of the stables of horse trams in the neighborhood and Halim Ağa Swamp. As the result of that bad smell it was also called as "Kokaryalı". At the time of the mayoralty of Behçet Uz one part of the swamp was dried and turned into a park by planting trees in 1934. The other part of it was demolished to start construction of the stadium in 1942 (Ürük 2011).

There are lots of important buildings in Güzelyalı Neighbourhood such as Mamuretü'l Hamidiye (Hakim Efendi) Mosque, Selma Yiğitalp High School, Melahat

Yılmayan Learning House, METU Science Museum, Fuat Göztepe Park, Güzelyalı Culture Center, Meteorology Regional Offices and Ahmet Adnan Saygun Art Center.

Kaya (2002) explains that CBD would expand along 4 axes in İzmir:

1-Mezarlıkbaşı-Eşrefpaşa axis: retail for low income;

2-Basmane-Tepecik-Kemer axis: retail and functions for agricultural groups and squatters;

3-Atatürk Statue Anıtı-1st and 2nd Kordon axis: retail for high income groups and service functions;

4-Konak-Güzelyalı axis: retail for high and middle income group.

Also, İnce-Kompil (2005) claims that residential areas presented as a differantiated structure based on income levels. And, Güzelyalı is one the neighbourhoods in İzmir where high-level income groups locate.

4.4. Description of the Study Site: 55 and 56 Streets in Güzelyalı

The case study comprises two streets in Güzelyalı Neighbourhood. It has been seen from the observations made in the limits of Güzelyalı Neighbourhood that cut-through transitions are made densely in some residential streets between the İnönü and Mithatpaşa Streets within Güzelyalı District. 40 Street, 30 Street, 39 Street, 55 Street and 56 Street have been seen as the streets which have heavy traffic volume in Güzelyalı District.

From these streets, which have heavy traffic flow, traffic count was made, intensity of pedestrian and pedestrian use were observed in 55 and 56 Sreeets and they were chosen as the study site. Because 55 and 56 Streets are the shortest route in order to cross from İnönü Road to Mithatpaşa Road, they are used as a cut-through route by drivers. Because of that congestion has appeared on the streets and they have become unsafe for pedestrians. Since, the 55 and 56 Streets are residential streets. Thereby, there are lots of commercial units along the streets, especially on the 56 Street. As a result of being both residential and commercial units, there are highly dense pedestrian activities. Also, there is one high school, one secondary school, one nursery school and one mosque on on the streets. Generally, there are four and five storey apartments along the streets, and entrances to the buildings are made from the street.

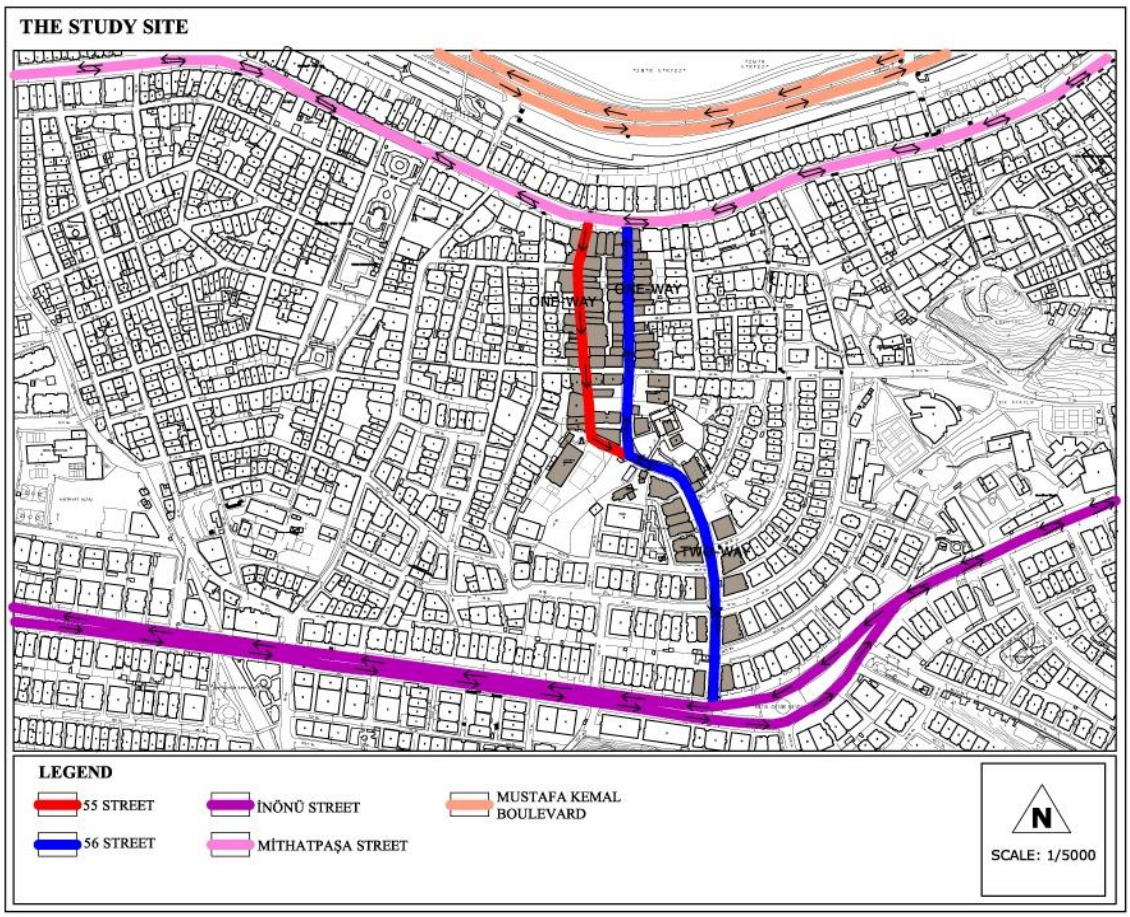

Figure 4.11. Location of the 55 and 56 Streets in Güzelyalı Neighbourhood in İzmir. (Source: Citysurf Globe of İzmir Metropolitan Municipality)

They locate between Mithatpaşa Road and İnönü Road. 55 Street is one-way towards İnönü Road. 56 Street is both one-way and two-way. It is one-way towards Mithatpaşa Road from beginning the intersection point of 55 Street, and two-way from the intersection point of 55 Street towards İnönü Road.

55 Street is 240 meters length. The number of building that face the street is 30. From these buildings 23 is residential, 5 is commercial and residential, 1 is learning house and 1 is high school. Also, 3 lot is empty. The entrance of all of the buildings except the high school is from the street. Street-width varies between 6 and 8 meters.

56 Street is 500 meters length. The number of building that face the street is 53. From these buildings 26 is residential, 24 is commercial and residential, 1 is nursery school and 1 is mosque. Street-width varies between 9 and 11 meters.

Middle or high-income groups live at the site as just like the older periods. It has been also seen that there are strong neighborly relationship at the site.

Land use distribution shows that most of the buildings facing the streets are residential building. Also there are many commercial+residential buildings facing the streets. In 56 Street, there are two supermarkets, one mosque, one elementary school and one nursery school.These uses are important in terms of pedestrian uses. At weekday at hours of school entrance, there are crucial safety problems for pedestrian especially for children. Also, it was seen from the observations that the density of pedestrian is very high on Fridays at around noon.

In 55 Street, there are mostly residential buildings. There is one high school, which is an important school for İzmir in general, and one learning house. The hours of school entrances are important for the density of pedestrian use and safety. There is also one private parking space adjacent to the high school. This empty lot is crucial in terms of finding a parking space that can be a solution for parking problems on the streets.

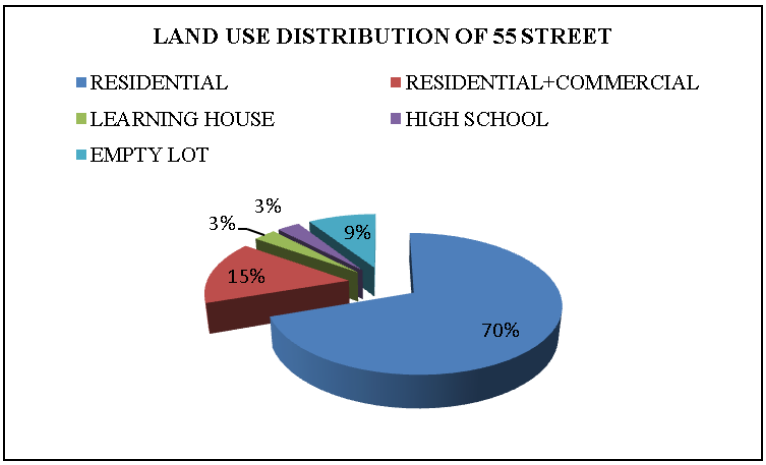

Figure 4.12. The Land Use Distribution of the Buildinngs Facing 55 Street
(Source: Field Study September 2011)

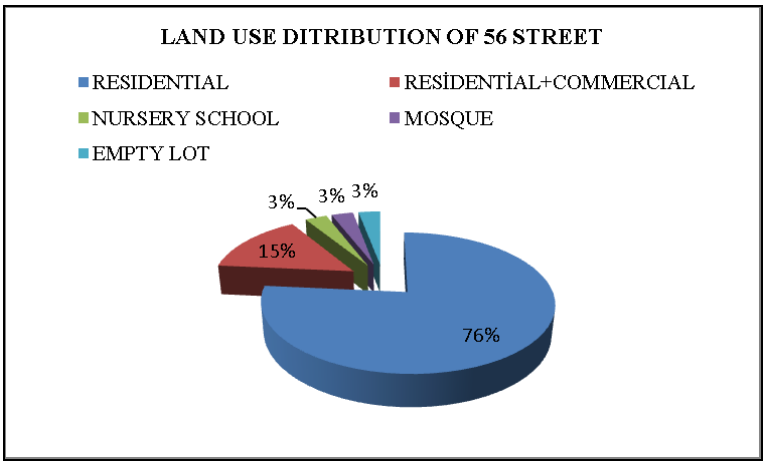

Figure 4.13. The Land Use Distribution of the Buildinngs Facing 56 Street
(Source: Field Study September 2011)

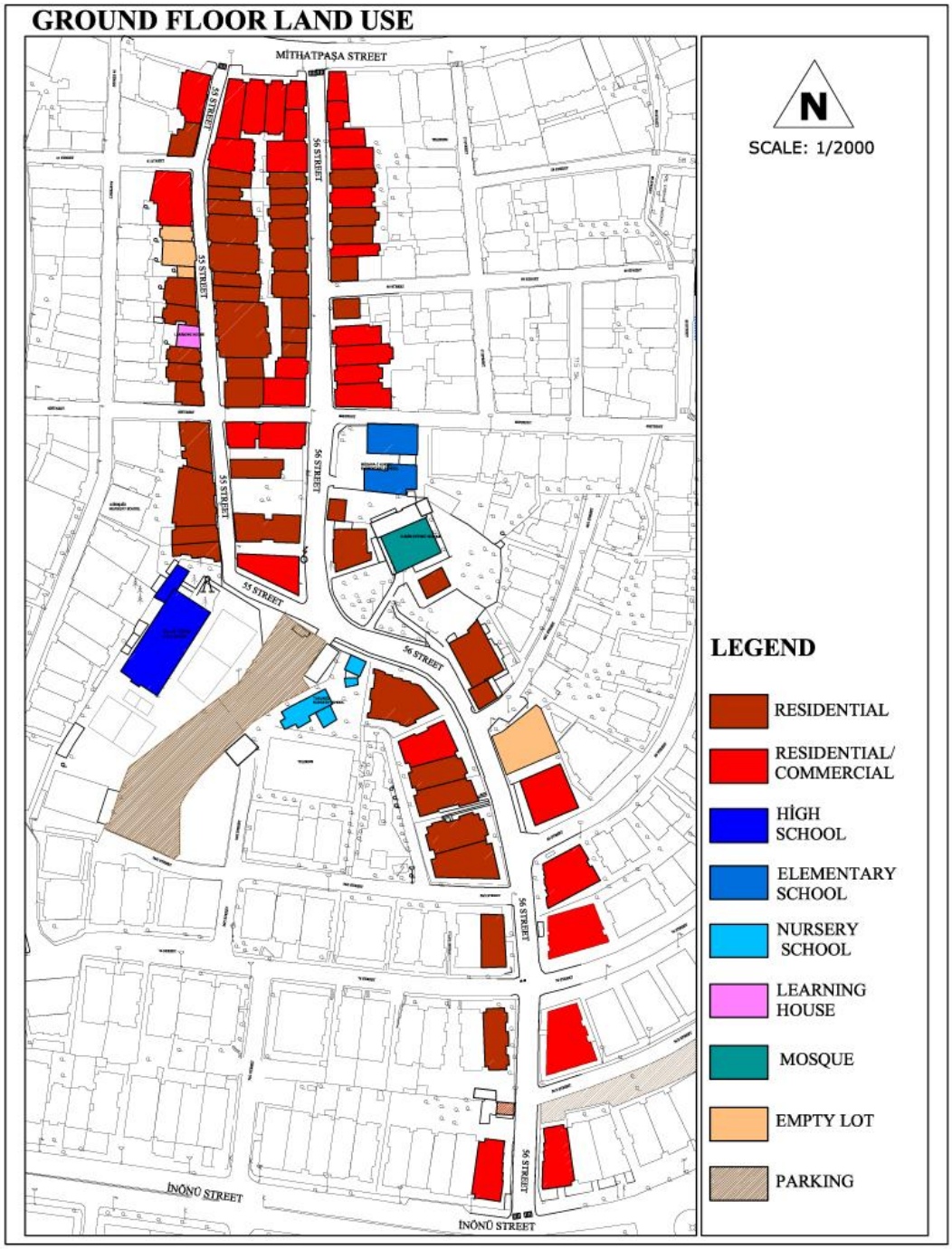

Figure 4.14. The Land Use Distribution in the 55 and 56 Streets.
(Source: Field Study September 2011)

The number of the storeys of the buildings changes between one-storey to nine-storey. Highest number storey of the buildings locates along the İnönü and the Mithatpaşa Streets. But, generally the number of five-storey buildings is more than the others. The total number of the buildings facing the 55 and 56 Streets is 70. 4 of them are one-storey, 3 of them are two-storey, 7 of them are three-storey, 15 of them are four-

storey, 37 of them are five-storey, 9 of them are six-storey, 2 of them are seven–storey, 4 of them are eight-storey and 1 of them is nine-storey. In this study, the number storeys of the buildings were idendified in order to pretend the population of the study streets. As the result of this study, it was identified that the population in the streets are approximately 1050 people if the average household size is taken as 3.5.

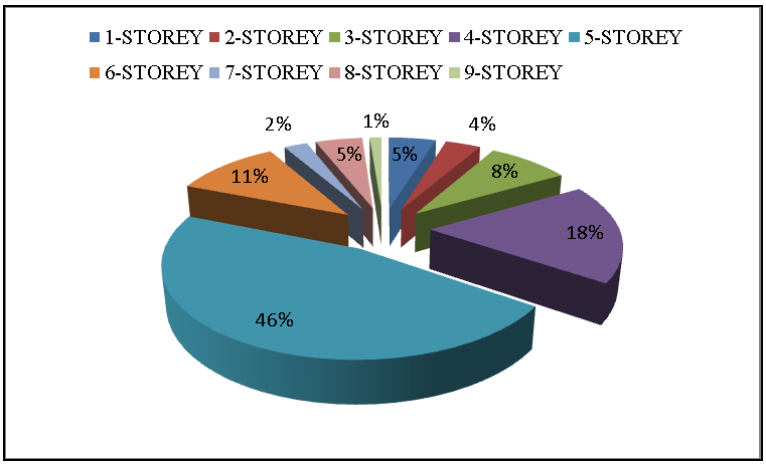

Figure 4.15. The Number of Storeys of the Buildings in the 55 and 56 Streets.
(Source: Field Study September 2011)

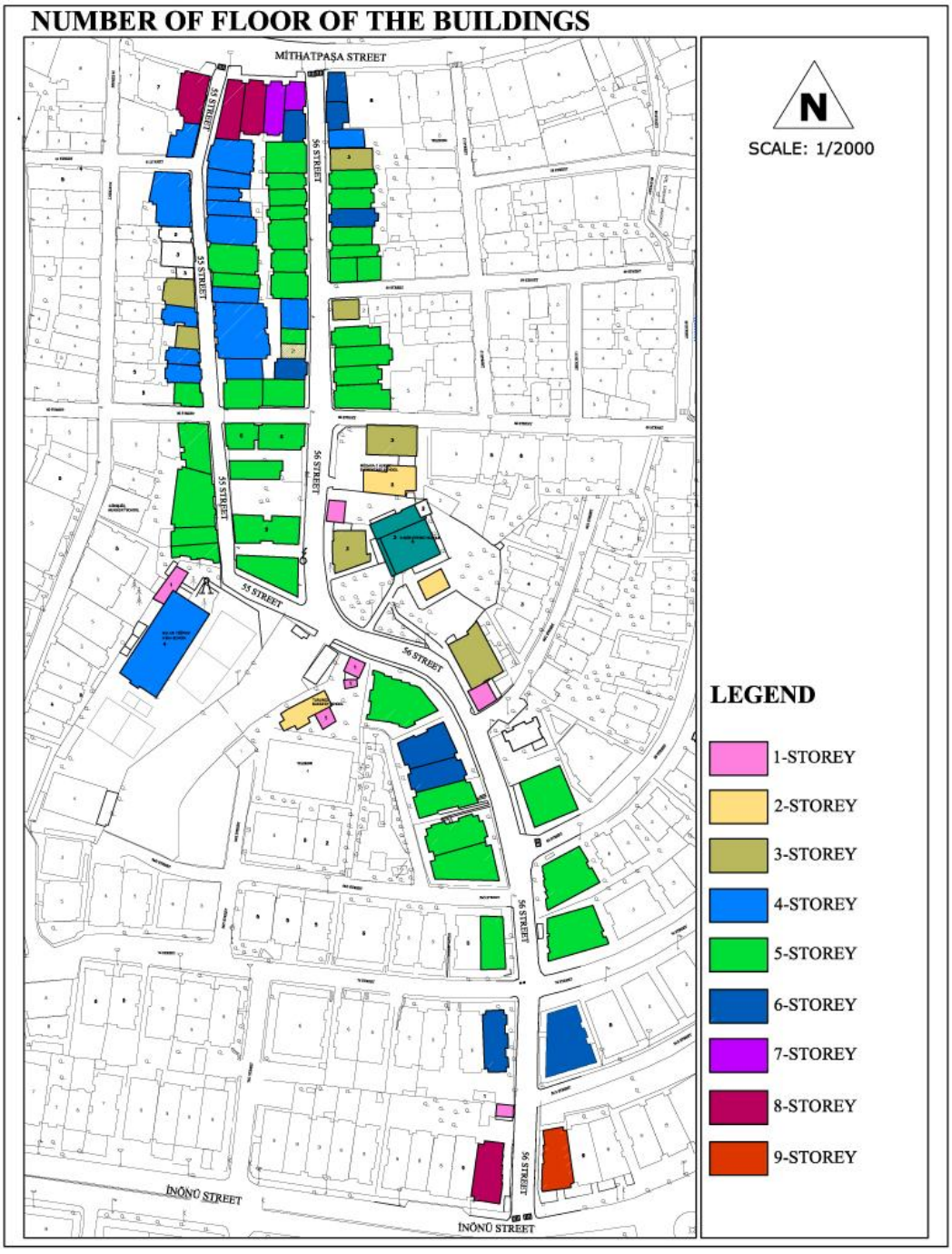

Figure 4.16. The Number of Storeys of the Buildings Facing the 55 and 56 Streets. (Source: Field Study September 2011)

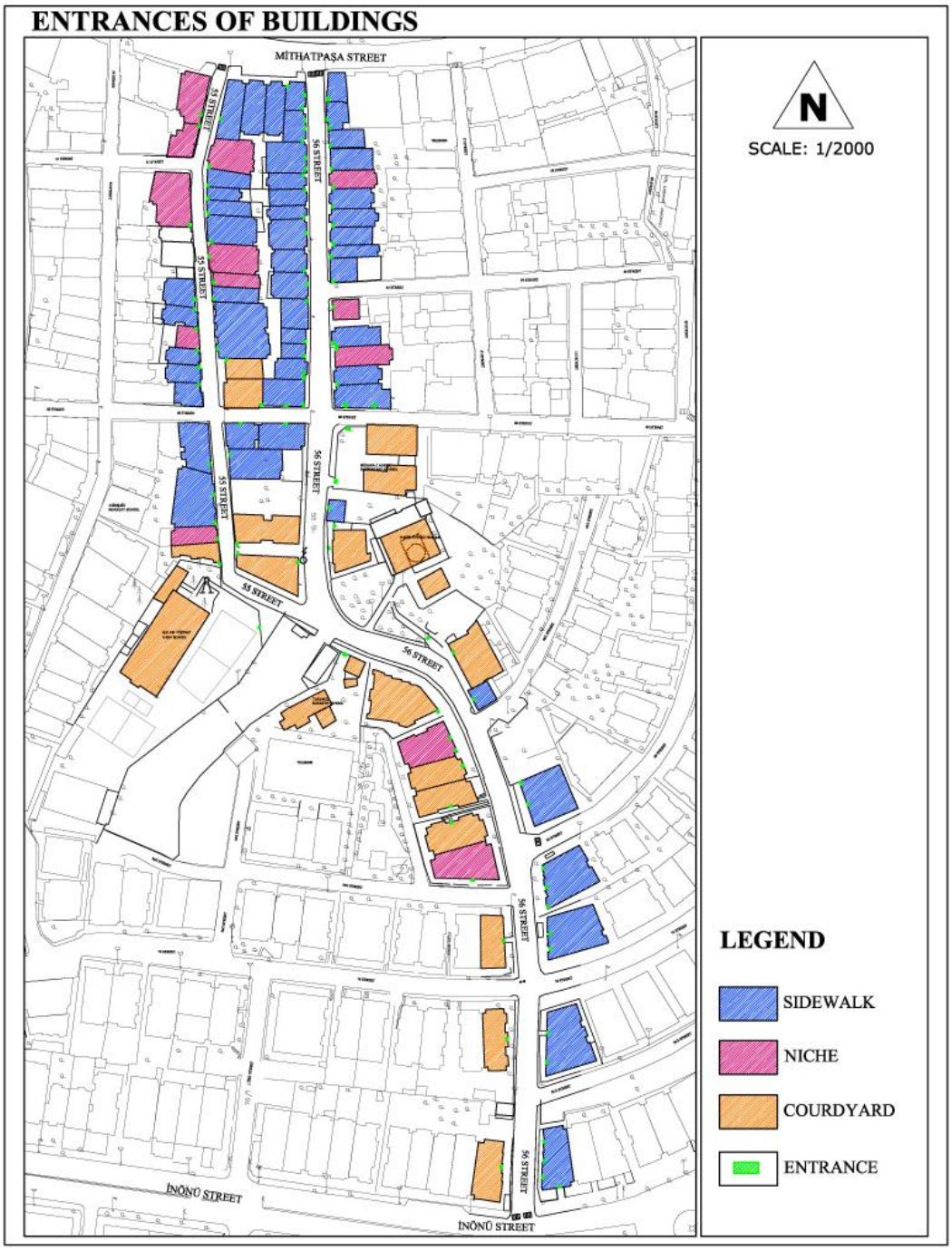

Figure 4.17. Entrances of the Buildings Facing the 55 and 56 Streets.
(Source: Field Study September 2011)

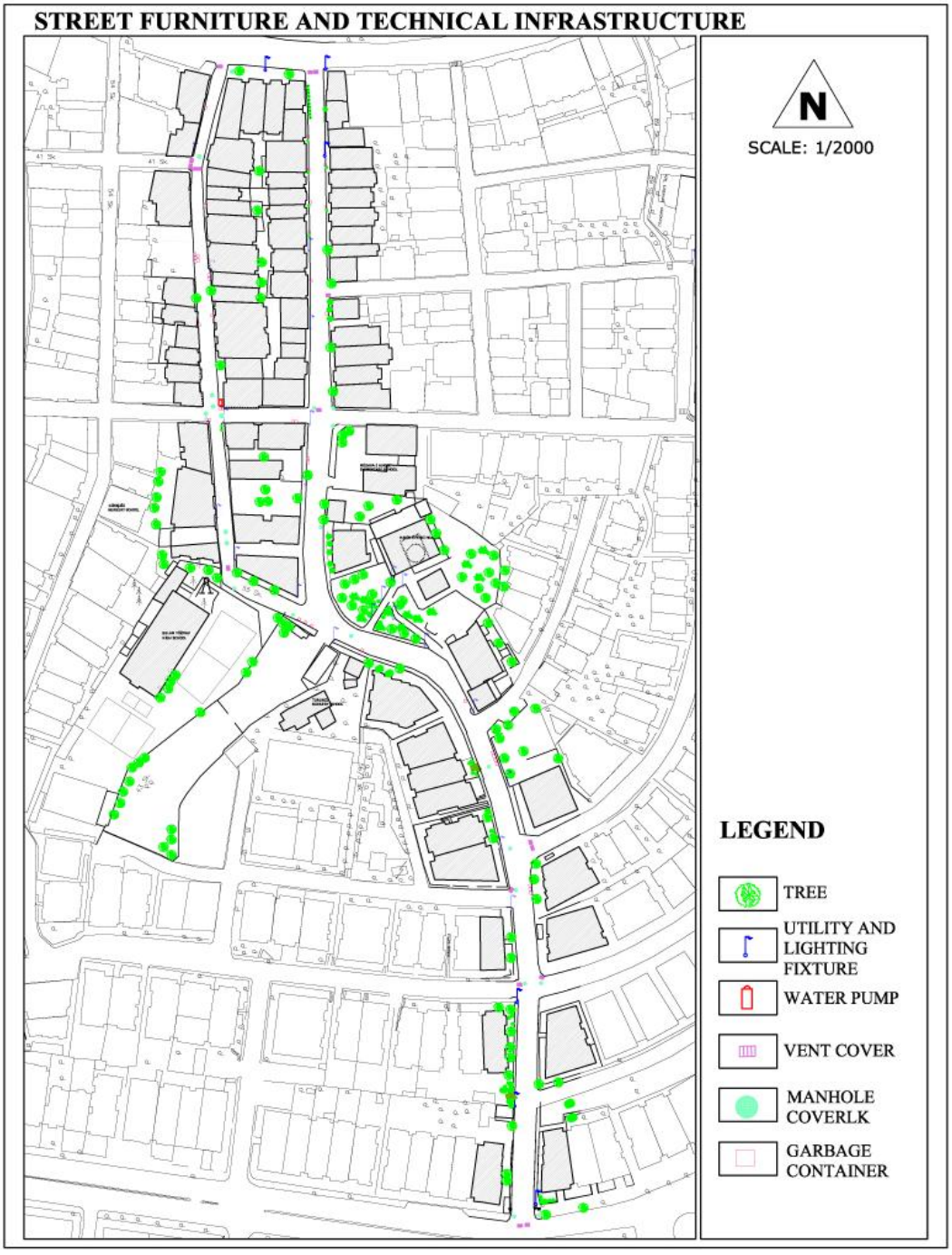

Figure 4.18. Street Furniture and Technical Infrastructure of 55 and 56 Streets. (Source: Field Study September 2011)

4.5. Traffic Volume Data of the 55 and 56 Streets in Güzelyalı

Traffic Volume is defined as “the number of vehicles passing a point on a highway or lane during a specified period. The collection of volume data at any particular location is basically quite simple in concept: count the number of vehicles as they pass the point of interest, and classify them as desired by vehicle type, lane, turning movement, or other parameters” (McShane and Roess 1990:84-86).

Traffic volume data-collection techniques are:

-Manuel counting methods,

-Portable mechanical counters, and

-Permanent counters.

In this thesis, manuel counting method was used. As part of the study, a traffic analysis was undertaken which measured peak hourly traffic volumes travelling within the study area over a five and seven days period. Vehicle counting were made On weekdays and weekends, at morning between the hours 08.30 and 09.30, at midday between the hours 12.00 and 14.00, 14.00 and 15.00 and at evening between the hours 17.30 and 19.00. Two person were noted the licence plate number of vehicles entering from the 55 Street to the site and exiting the site from the 56 to Mithatpaşa Road. Also, two person were noted the licence plate number of vehicles entering the 56 Street from İnönü Road and exiting the same street from İnönü Road. Then, the number vehicles entering and exiting to the streets were calculated, and the number of vehicles making cut-through at peak hours were tried to be determined.

As the result of this study, it was founded that the rate of the traffic volume and the rate of cut-through traffic is high.

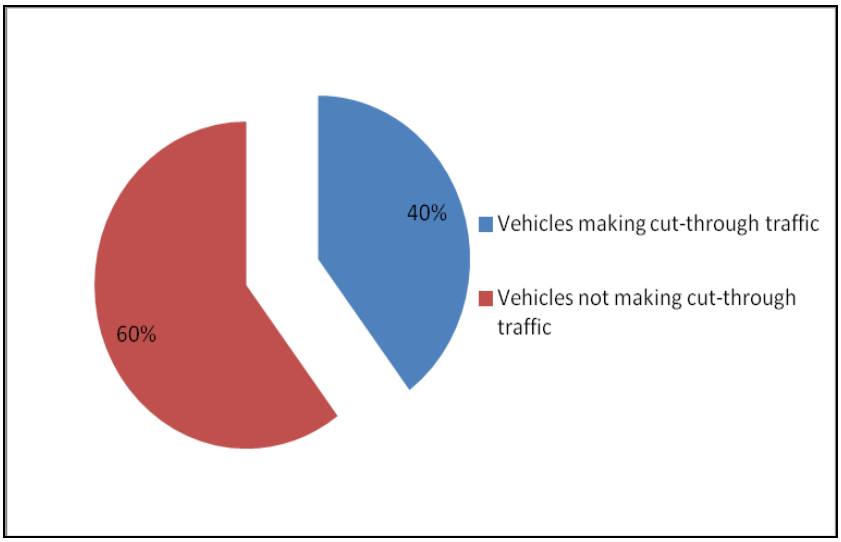

Figure 4.19. The Rate of Vehicles Making and Not Making Cut-through Traffic

Table 4.3. The Average Number of Daily Vehicles Making and Not Making Cut-through Traffic (from İnönü Street to Mithatpaşa Street)

Day	The Average Number of Vehicles Making Cut-through Traffic	The Average Number of Vehicles Not Making Cut-through Traffic	Total
Monday	572	783	1355
Tuesday	519	714	1233
Wednesday	473	779	1252
Thursday	414	715	1129
Friday	615	782	1397
Saturday	206	718	924
Sunday	250	624	874

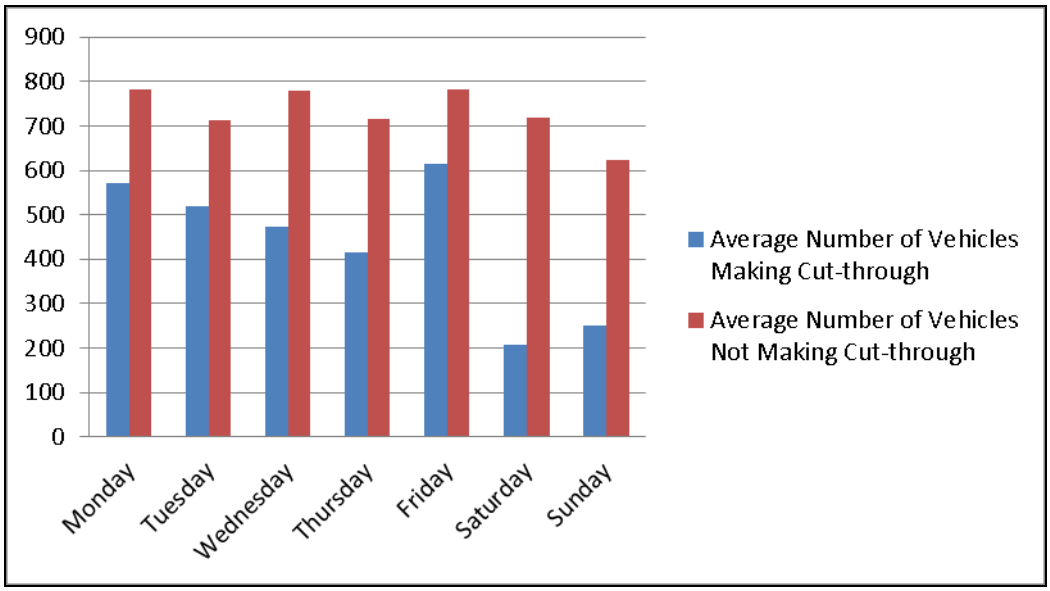

Figure 4.20. The Average Number of Daily Vehicles Making and Not Making Cut-through Traffic (from İnönü Street to Mithatpaşa Street)

Table 4.4. The Average Number of Daily Vehicles Making and Not Making Cut-through Traffic (from Mithatpaşa Street to İnönü Street)

Day	The Average Number of Vehicles Making Cut-through Traffic	The Average Number of Vehicles Not Making Cut-through Traffic	Total
Monday	193	235	428
Tuesday	179	215	394
Wednesday	177	223	400
Thursday	193	211	404
Friday	199	230	429
Saturday	210	242	452
Sunday	203	214	417

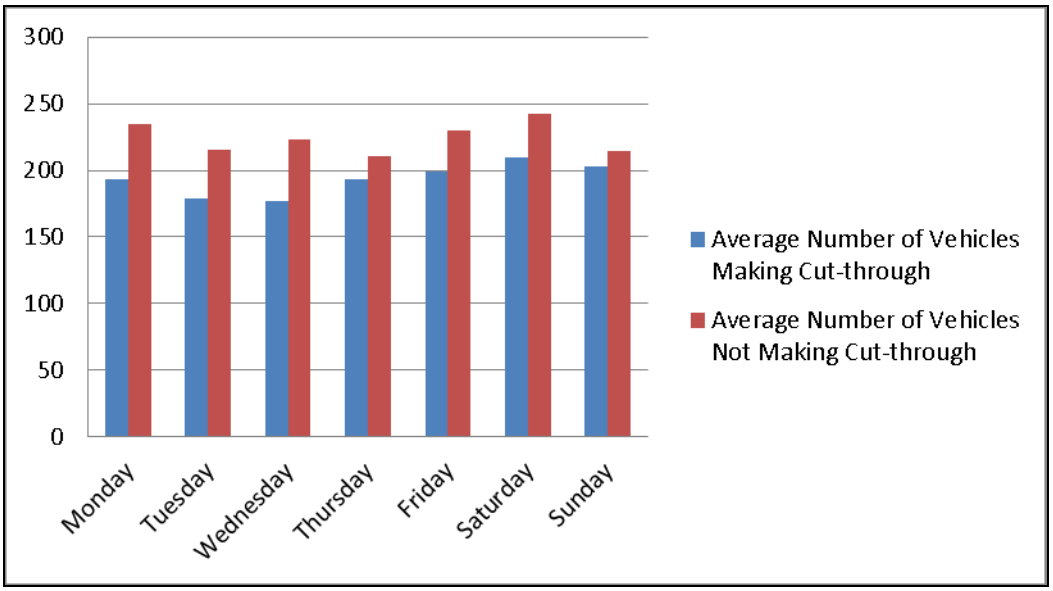

Figure 4.21. The Average Number of Daily Vehicles Making and Not Making Cut-through Traffic (from Mithatpaşa Street to İnönü Street)

4.6. The Current Situation and the Problems of the 55 and 56 Streets

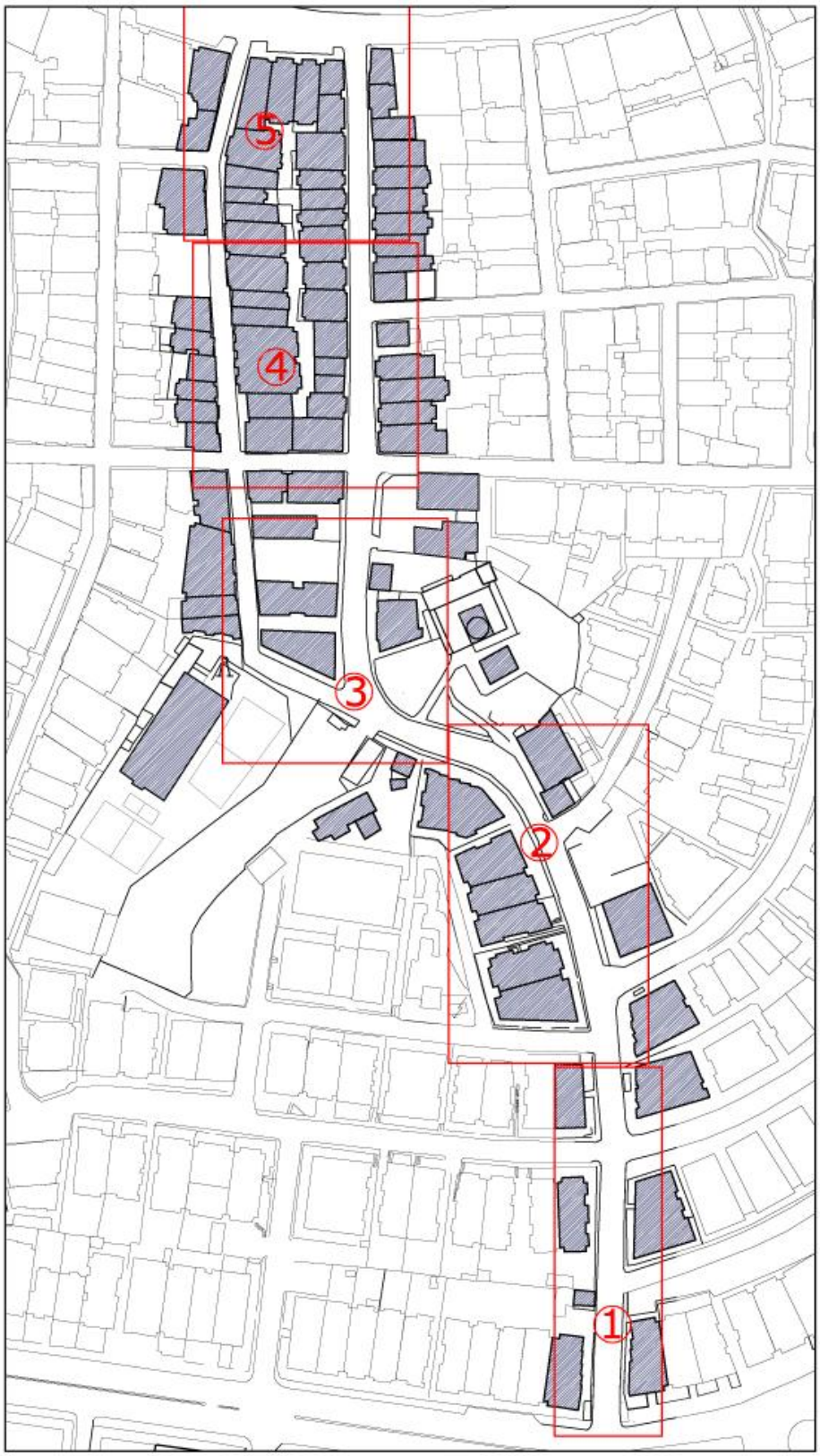

Figure 4.22. Analysis zones for the current situation.
(Source: Field Study September 2011)

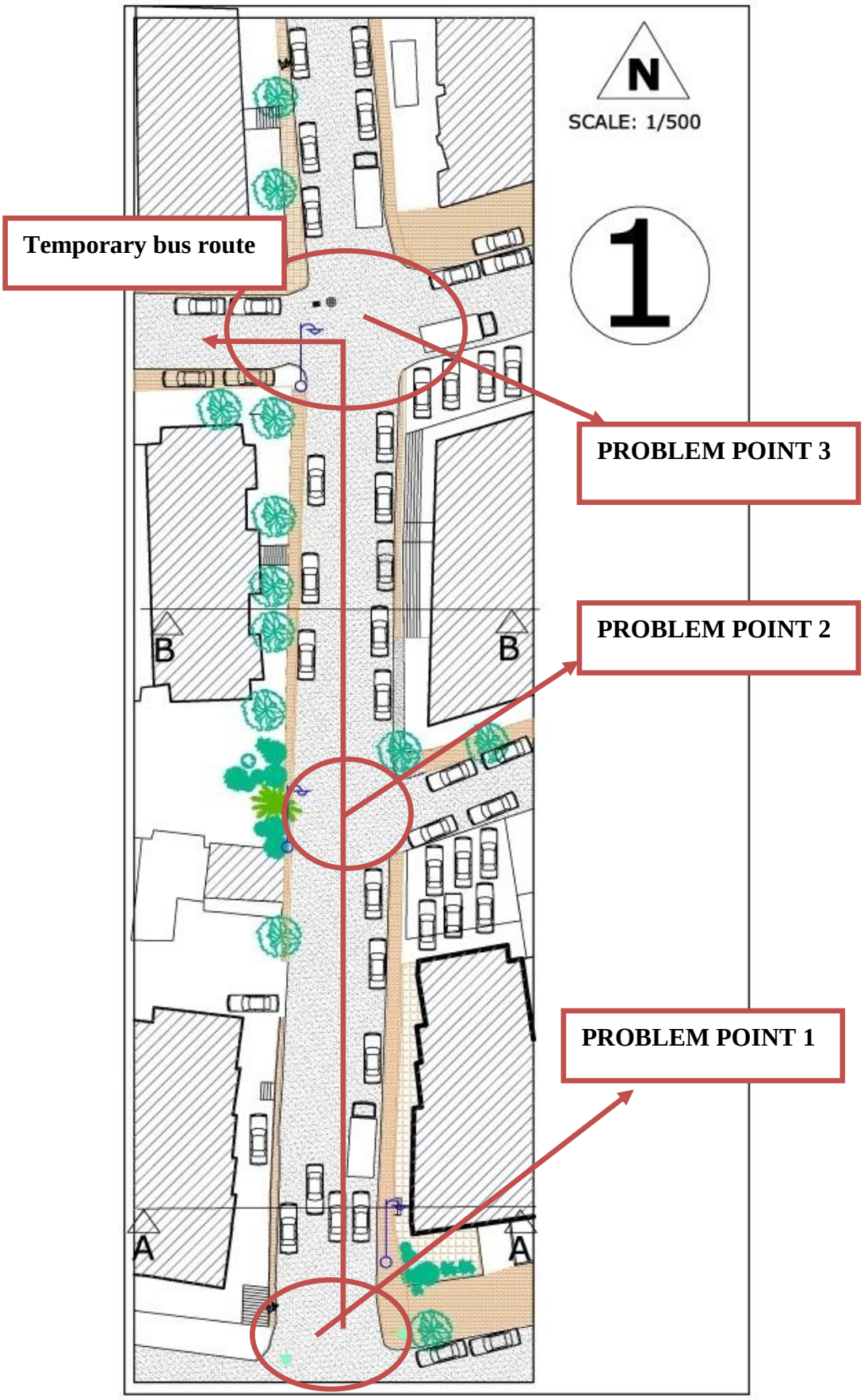

Figure 4.23. Analysis Map 1.

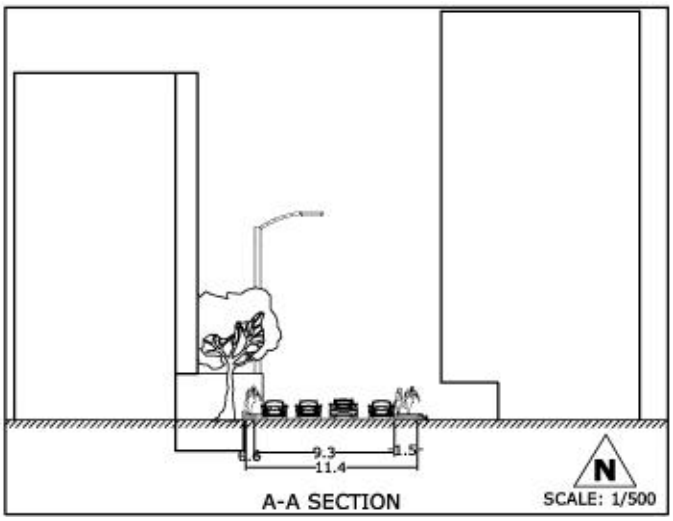

Figure 4.24. A-A Section.

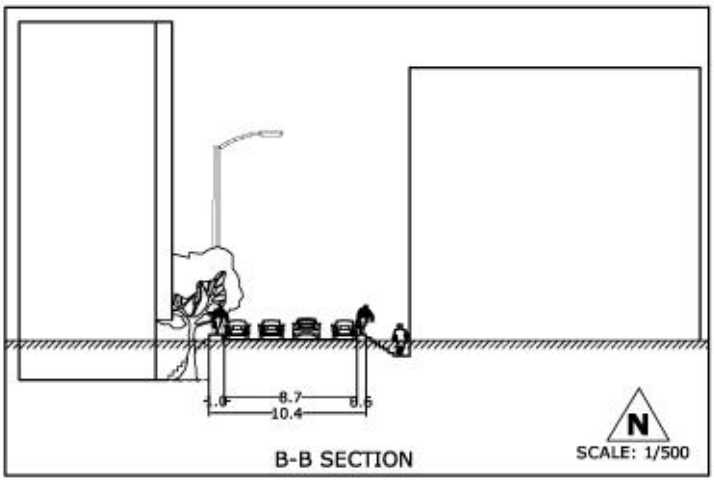

Figure 4.25. B-B Section.

Analysis Map 1 shows the current situation of the part of 56 Street. 56 Street is two-way at this part. The width of it changes between 9 m and 10 m at this part.

Problem Point 1 is the entrance from İnönü Street to the 56 Street. Witdh of street here is 9.2 m, the width of sidewalks are 0.6 m and 2.2 m. The speed of vehicles is very fast at this point. Problem Point 2 and 3 are the crossing points which cause safety problems for pedestrians. They shows the T-intersection that there is both pedestrian-vehicle and vehicle-vehicle conflict. There are commercial uses at this part of the 56 street. As a result pedestrian density is high. So, the conflict between pedestrians and vehicles causes safety problems.

The “Number of Vehicles=1.62+(0.2xStreet Length (m)” formulation was used in order to find the number of vehicles that can park on this part of the 56 Street. The length of this part of the street is approximately 123 meters. According to this formulation approximately 26 cars can park on the street.

Figure 4.26. Problem Point 1.

Figure 4.27. Problem Point 2.

Figure 4.28. Problem Point 3.

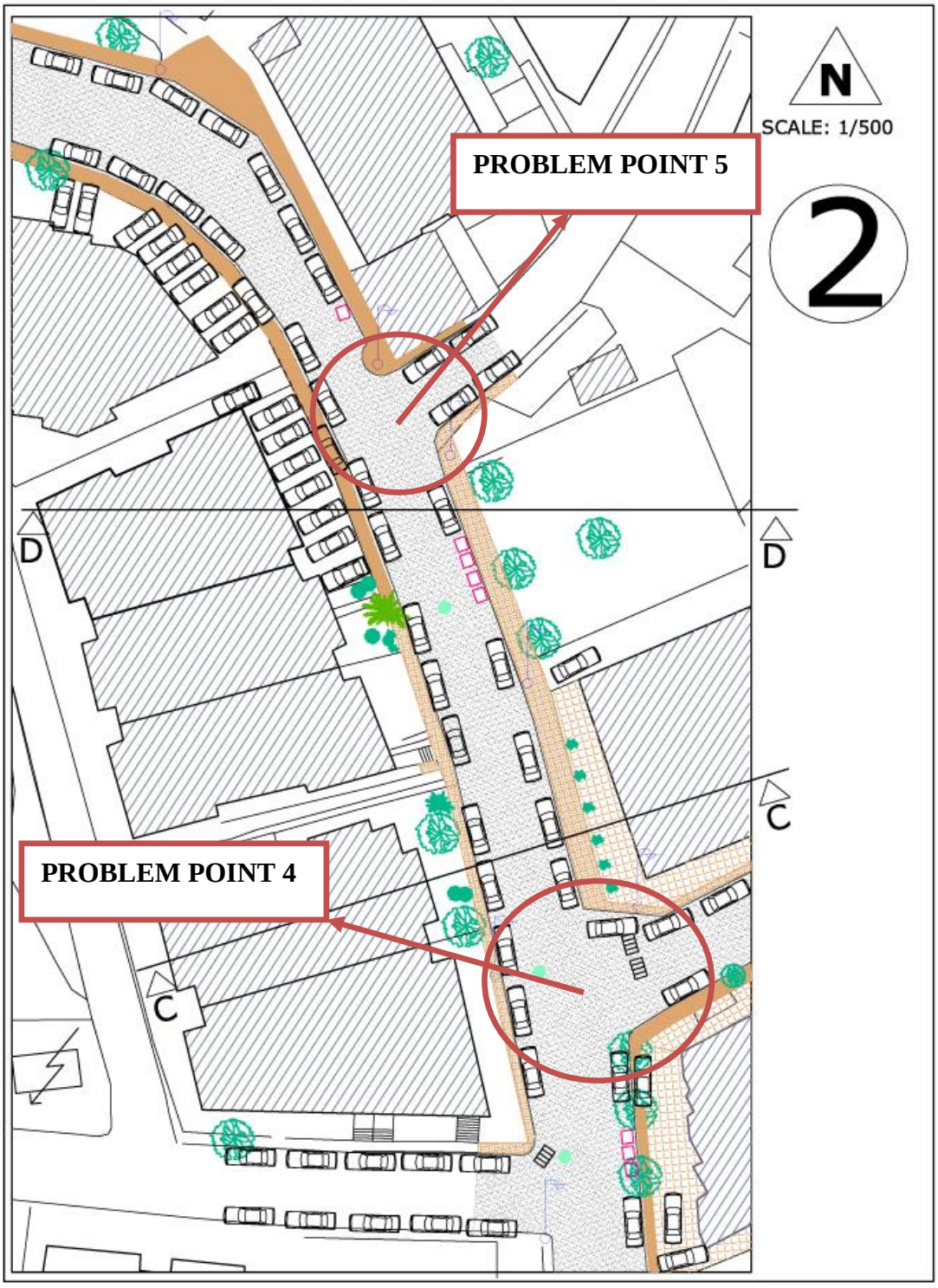

Figure 4.29. Analysis Map 2.

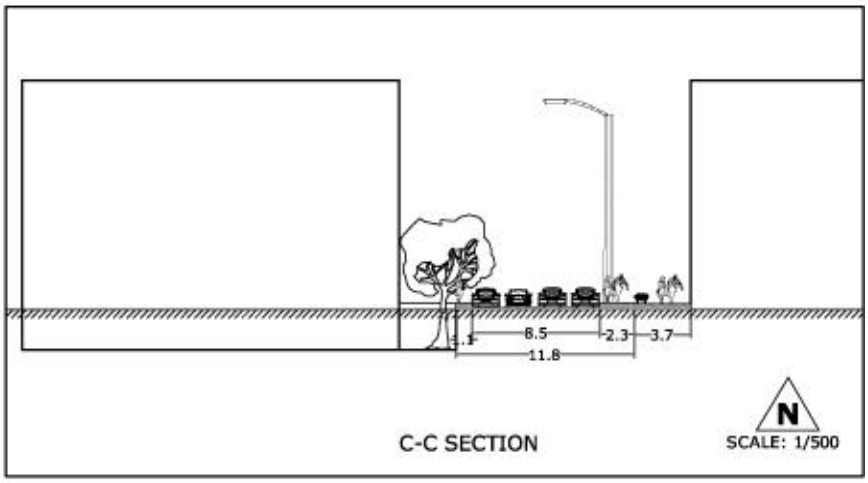

Figure 4.30. C-C Section.

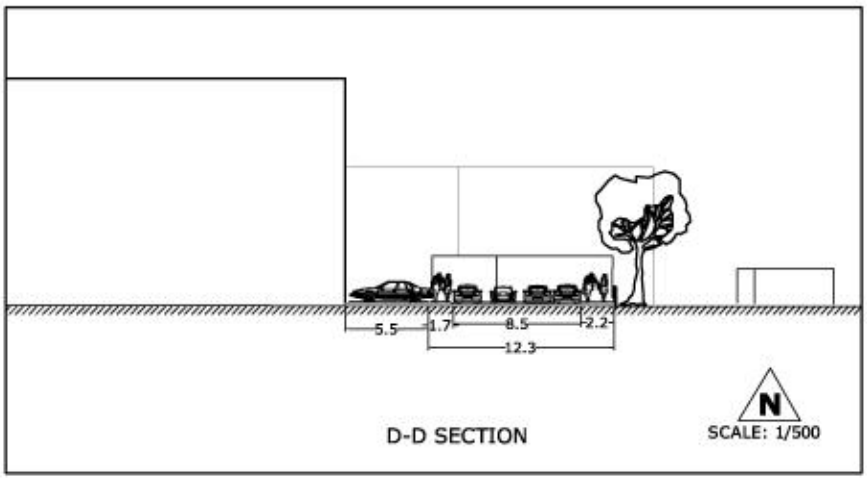

Figure 4.31. D-D Section.

Analysis Map 2 shows the current situation of the part of 56 Street. It is also two-way at this part. The width of it changes between 11 m and 15 m at this part. The width of sidewalks changes between 1 m and 5 m. The speed of vehicles is also very fast at this part. Problem Point 4 and 5 are the crossing points which cause safety problems for pedestrians. There are commercial uses at this part of the 56 street. Also, one of the entrances of the mosque is at this part of the street. As a result pedestrian density is high. So, the conflict between pedestrians and vehicles causes safety problems.

The length of this part of the street is approximately 128 meters. Approximately 28 cars can park on the street.

Figure 4.32. Problem Point 4.

Figure 4.33. Problem Point 5.

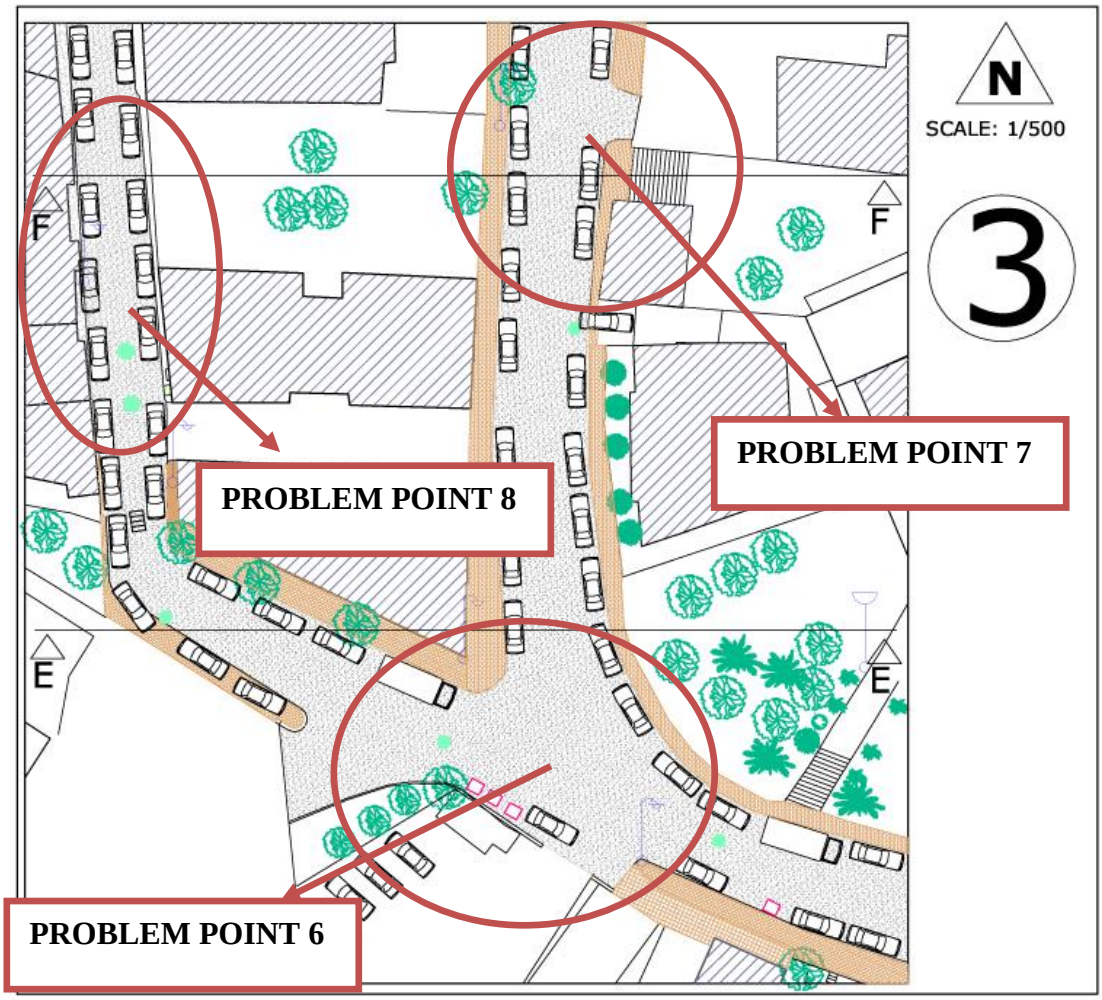

Figure 4.34. Analysis Map 3.

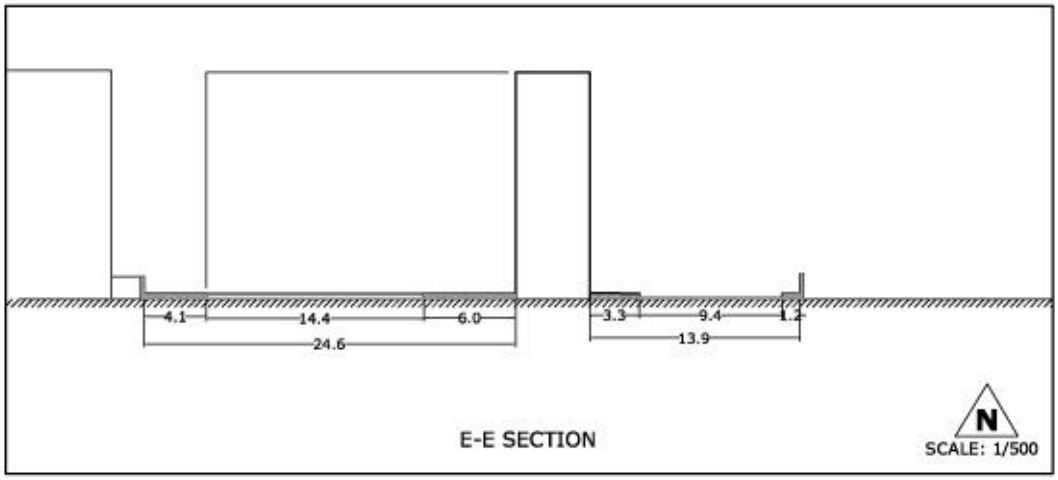

Figure 4.35. E-E Section.

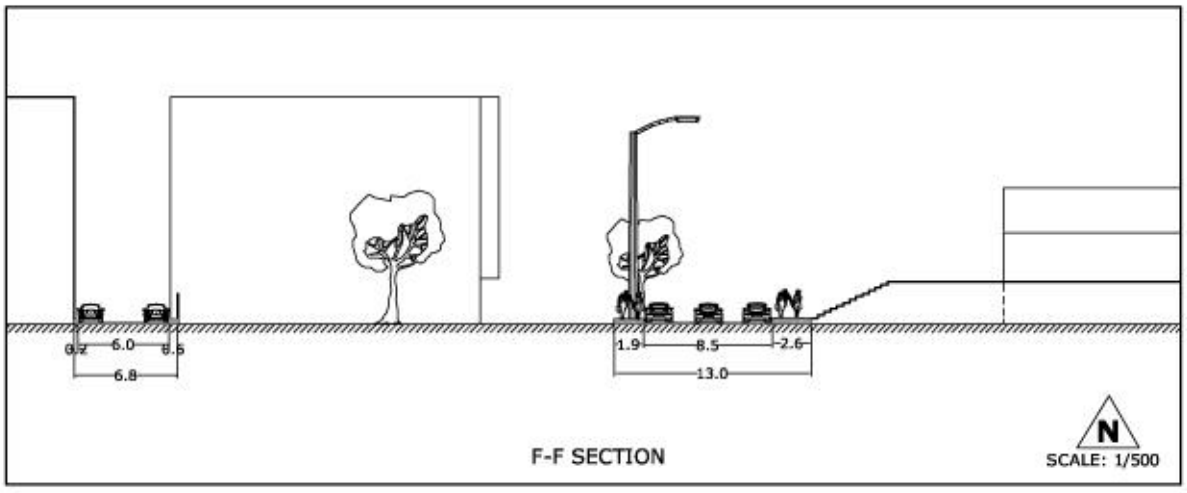

Figure 4.36. F-F Section.

Analysis Map 3 shows the current situation of the part of the 55 and 56 Streets. Problem Point 6 is the intersection point of the 55 and 56 Streets. The conflict between pedestrians and vehicles causes safety problems. There is a high school, nursery school and private parking spaces. Private parking space is a potential space for solution the parking problem in the area. Problem Point 7 shows the entrance of the elementary school. There is a mosque near the elementary school. So, the pedestrian density is very high at this part of the 56 Street. Problem Point 8 shows the narrowing of the 55 Street. Also, the sidewalks are too narrow at this point. Vehicles park in front of the entrances of the buildings.

The width of the 56 Street changes between 10 m and 13 m at this part. The width of sidewalks changes between 0.7 m and 2.5 m. The width of the 55 Street changes between 6.7 m and 11.5 m at this part. The width of sidewalks changes between 0.4 m and 2.5 m.

The length of this part of the 56 Street is approximately 95 meters. Approximately 21 cars can park on the street. The length of this part of the 55 Street is approximately 91 meters and approximately 20 cars can park on the street.

Figure 4.37. Problem Point 6.

Figure 4.38. Problem Point 7.

Figure 4.39. Problem Point 8.

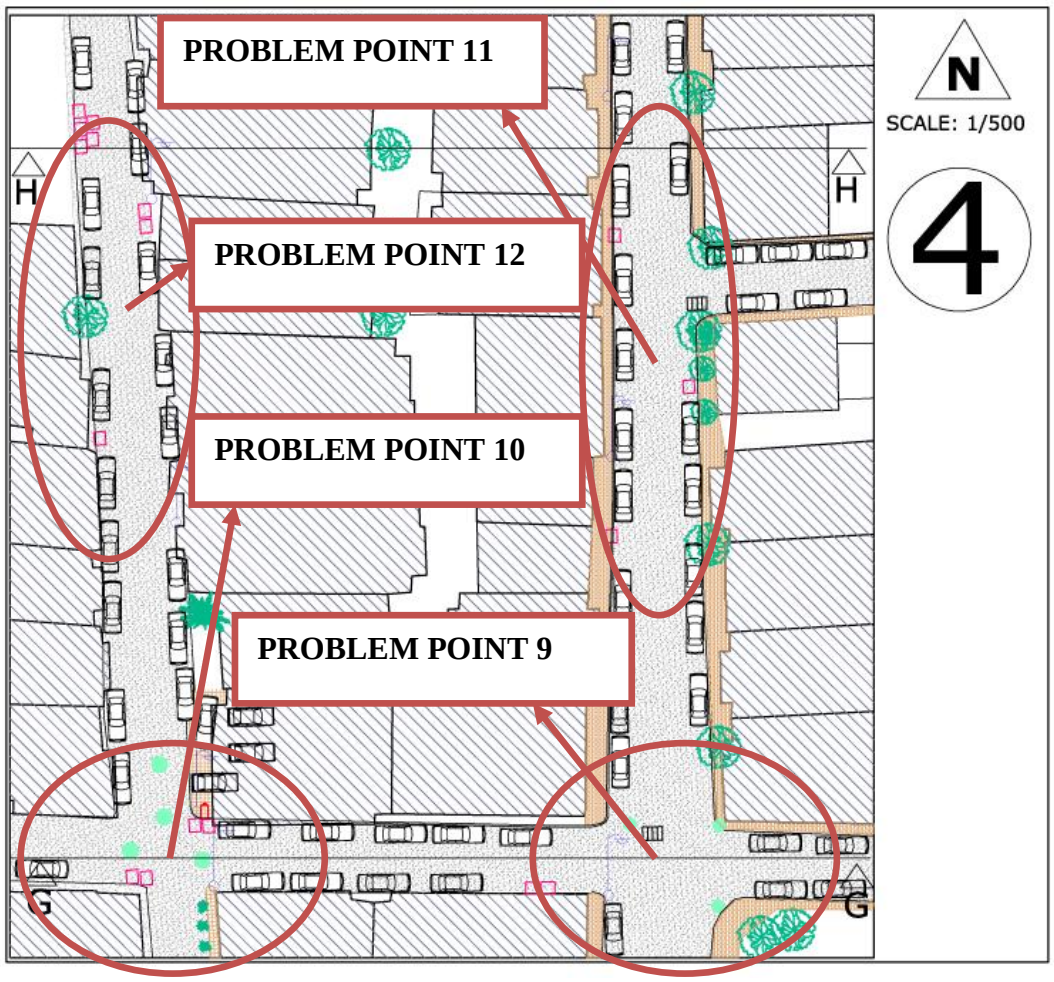

Figure 4.40. Analysis Map 4.

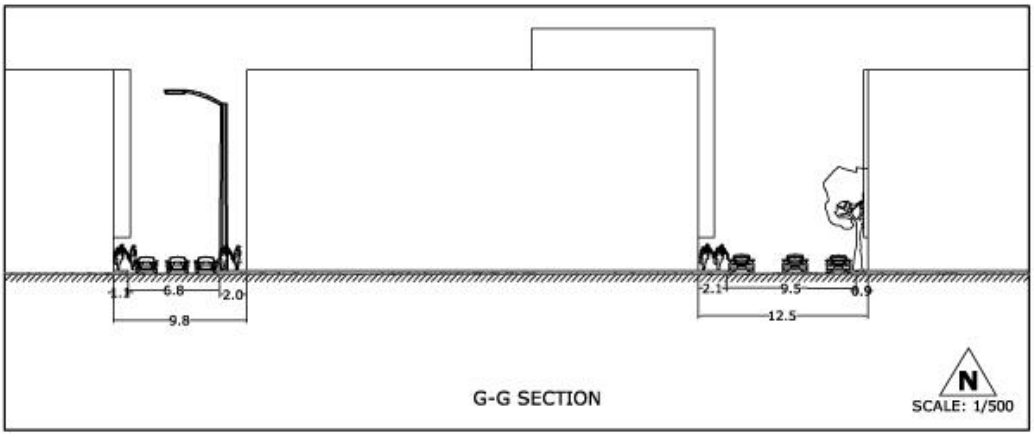

Figure 4.41. G-G Section

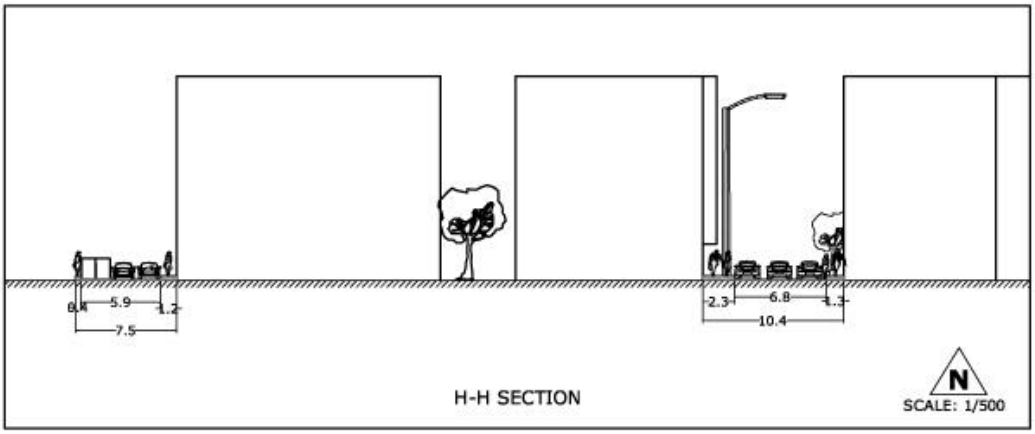

Figure 4.42. H-H Section

Analysis Map 4 shows the current situation of the part of the 55 and 56 Streets. Both the 55 and the 56 Street are one-way at this part. The width of 55 Street changes between 6.8 m and 10 m at this part. The width of sidewalks changes between 0.2 m and 2.3 m. The width of 56 Street changes between 11 m and 13 m at this part. The width of sidewalks changes between 1.4 m and 2.2 m. Problem Point 10 and 11 are the intersection points which cause safety problems for pedestrians. Accidents happen at these points. Because there is an elementary school at Problem Point 10, the safety must be provided maximumly. Moreover, the speed of vehicles is not high as a result of congestion at the entrance and exit hours of the school. Problem Point 12 and 13 show the irregular double-sized parking problems. At Problem Point 13, although the

sidewalks are too narrow, vehicles park on them. As result there no space for pedestrians to walk safely.

The length of this part of the 55 Street is approximately 84 meters. Approximately 19 cars can park on the street. The length of this part of the 56 Street is approximately 84 meters. Approximately 19 cars can park on the street. Totally, 38 cars can park on this part of the streets.

Figure 4.43. Problem Point 9.

Figure 4.44. Problem Point 10.

Figure 4.45. Problem Point 11.

Figure 4.46. Problem Point 12.

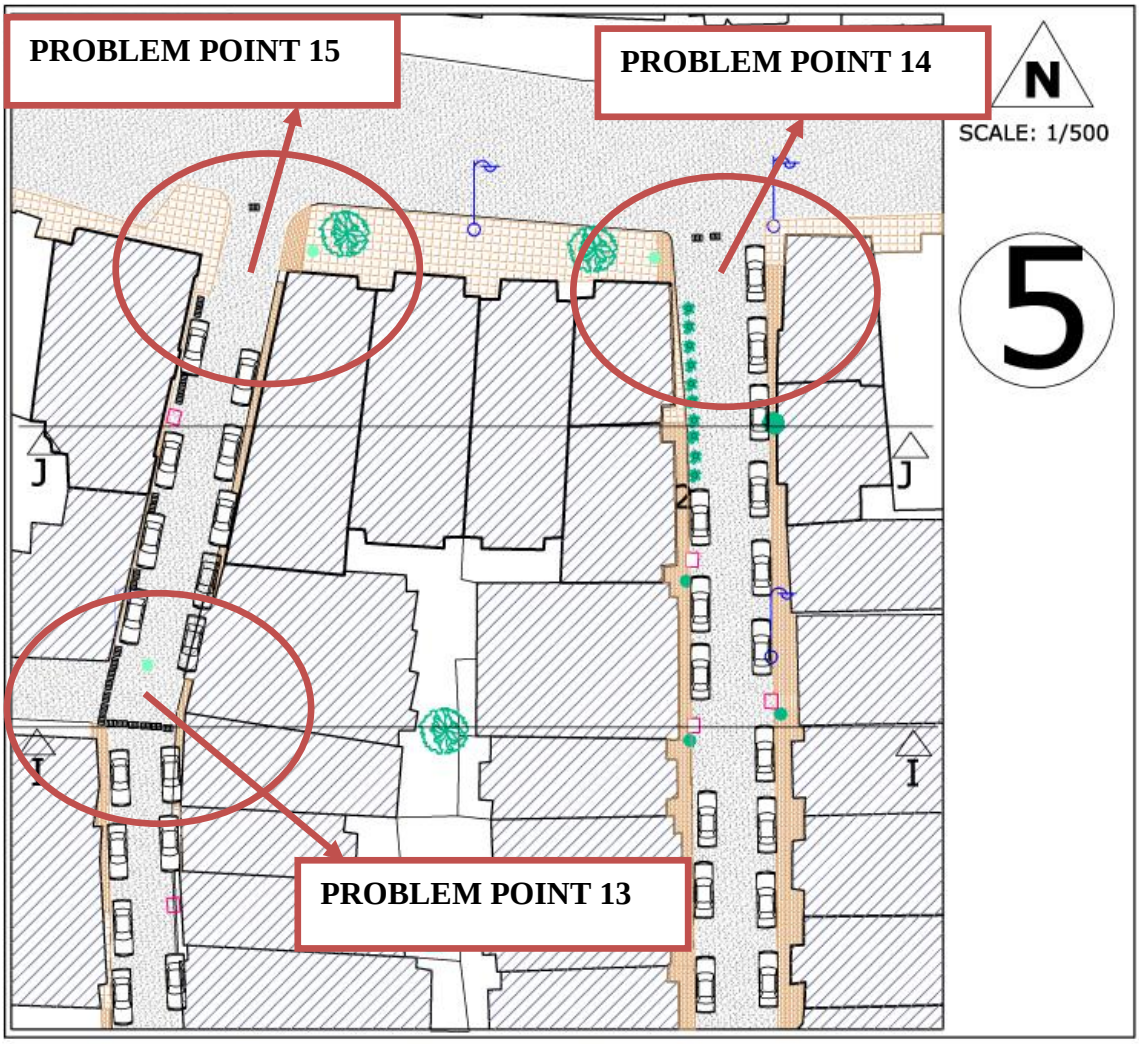

Figure 4.47. Analysis Map 5.

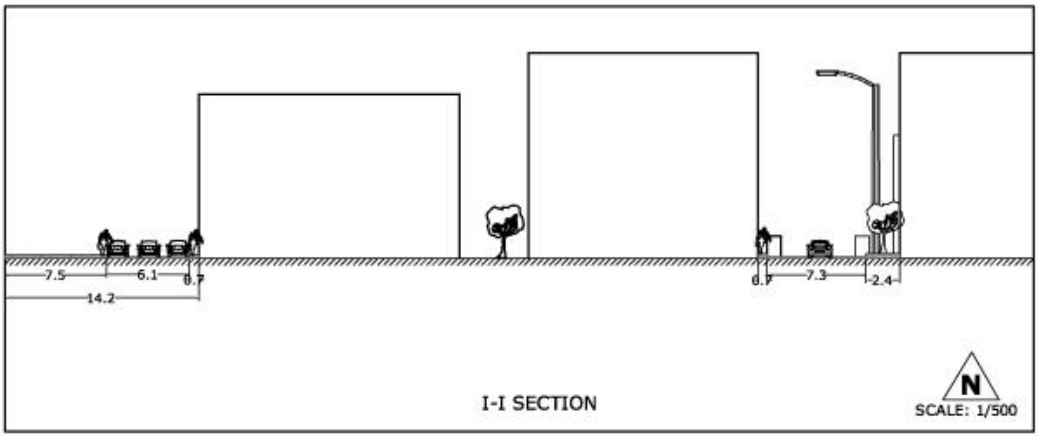

Figure 4.48. I-I Section

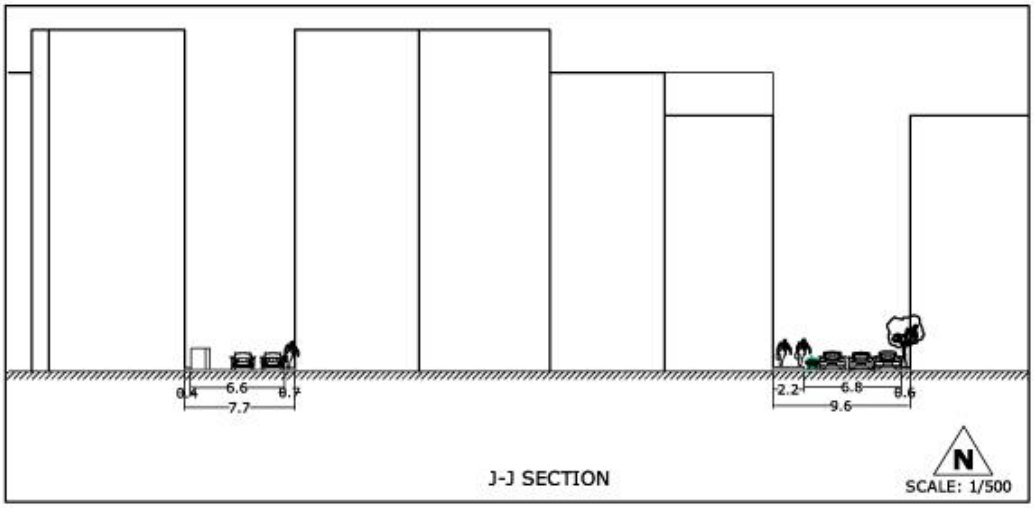

Figure 4.49. J-J Section

Analysis Map 5, also, shows the current situation of the part of the 55 and 56 Streets. Both the 55 and the 56 Street are one-way at this part. The width of 55 Street changes between 7 m and 7.5 m at this part. The width of sidewalks changes between 0.3 m and 1 m. The width of 56 Street changes between 9.5 m and 11 m at this part. The width of sidewalks changes between 1.1 m and 2.2 m. Problem Point 14 is the intersection point which causes safety problems for pedestrians. Problem Point 15 and 16 show the entrance and exit points. There are not speed problems because of the congestion at these points. But, there are commercial activities densely. So, irregular double-sized parking is a problem for pedestrians.

The length of this part of the 55 Street is approximately 69 meters. Approximately 16 cars can park on the street. The length of this part of the 56 Street is approximately 66 meters. Approximately 15 cars can park on the street. Totally, 31 cars can park on this part of the streets.

Figure 4.50. Problem Point 13.

Figure 4.51. Problem Point 14.

Figure 4.52. Problem Point 15.

In general, the most important problems of the 55 and 56 Streets are cut-through traffic and high volume traffic. The Streets are used as a cut-through route, since the streets are the shortest route between Mithatpaşa and İnönü Roads. As a result of this

driver behviour, the number of vehicle using the streets is much more then they have to be. Since, residential streets are for accessing to the buildings in that neighbourhood. Moreover, the communication is essential rather thar transportation on such like these streets.

Secondly, the speed of the vehicles making short-cut through the street is higher than it has to be although on-street parking makes them slow. As the result of high speed of vehicles, pedestrians do not feel themselves comfortable and safe.

Thirdly, the pavements of the streets are so uncomfortable. And footways are very narrow and high that they are unuseless for pedestrians.

Finally, all these problems cause also very poor environment in the site.

4.7. The Evaluation of the Survey Made in the Study Streets

Questionnaires were completed in the site for getting opinions of the residents about proposed solutions for the problems on streets. The questionnaires were done with 75 residents. Developed questions were focused on the problems on the streets and having an idea about traffic calming and traffic calming elements. The questionnaires were developed according to quality of life of the streets and the problems for residents on the streets. Also, the questions were used as a guide for the interviews. The interview format was one of a structured conversation rather than questionnaire administration. Since, it was aimed for a holistic understanding of the residents' ideas about traffic calming elements. As a result, the interviews did not always cover every single question in equal detail, but did identify the main issues as each respondent saw them.

There are eight different data collection techniques which may be employes for the surveys:

-Documentary searches,

-Observational searches,

-Household self-completion surveys,

-Telephone surveys,

-Intercept surveys,

-Household personal intervies surveys,

-Group surveys,

-In-dept surveys (Richardson et al. 1995).

In this study, observational and household personal interviev surveys were made.

According to results of the survey, 45% of the respondents are male and 55% of the respondents are female.

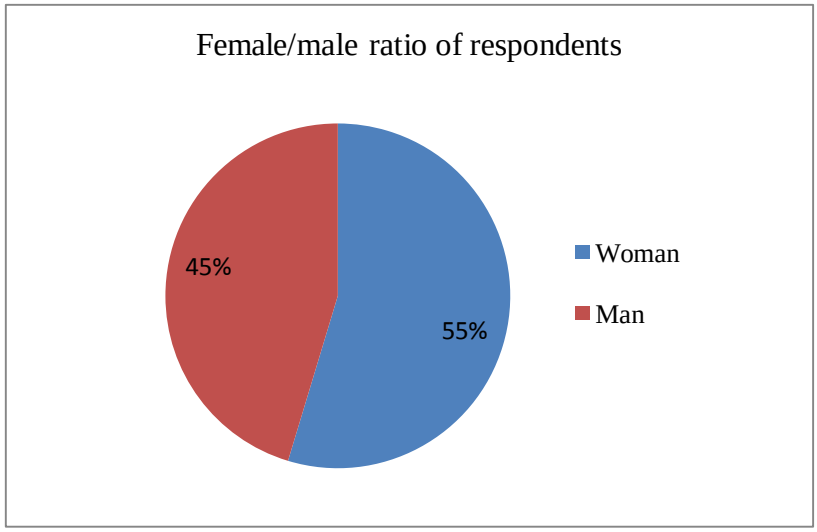

Figure 4.53. Female/male ratio of respondents

The (Figure 4.54) shows that most of the respondents are retired and housewife. Also, because there are many commercial units in the site, the percentage of the tradesmen is high.

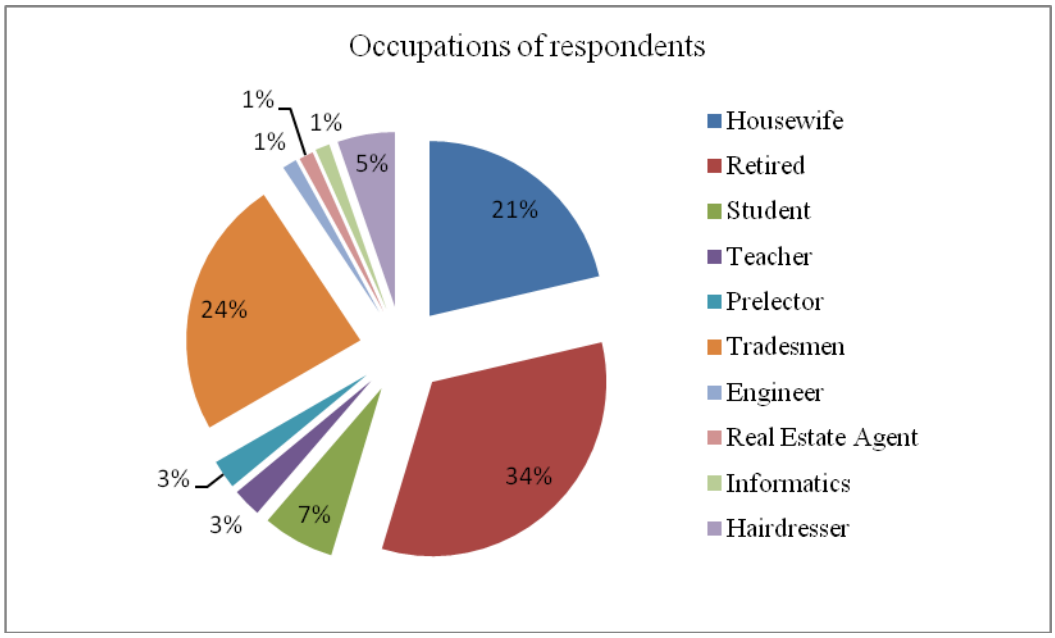

Figure 4.54. Occupations of respondents

The ages of the respondents mostly changes between 48 and 57.

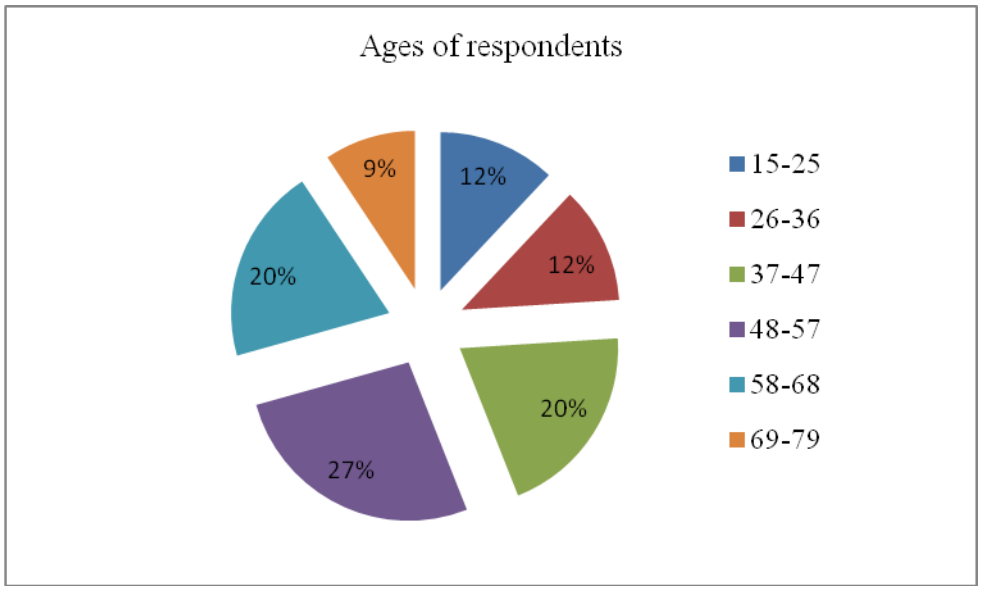

Figure 4.55. Ages of respondents

According the answers of the question of having any children, most of the respondents have children, but they do not live with them.

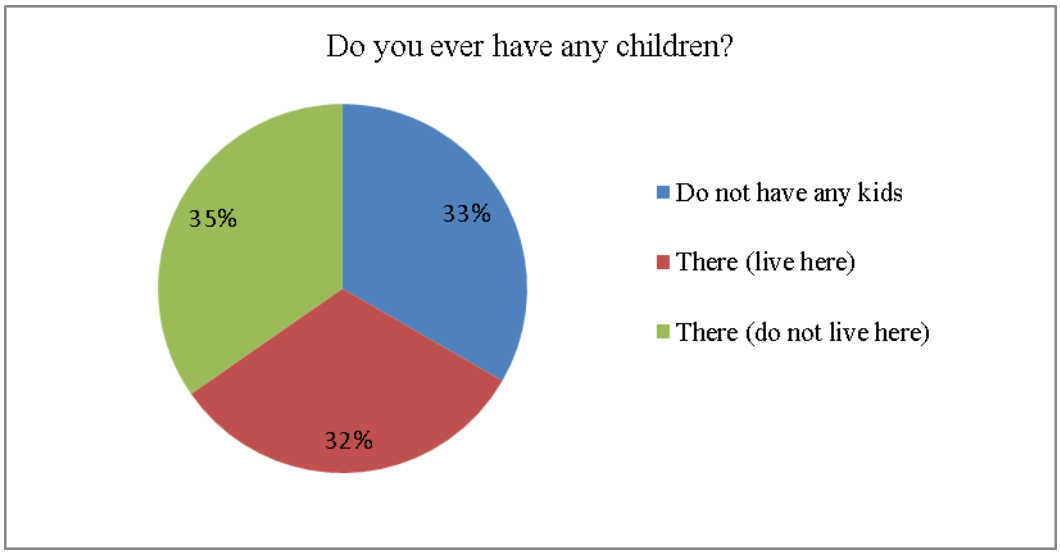

Figure 4.56. Percentage of having children

Most of the respondents live at this site mre tha 20 years. According to survey results, 22 % of respondents live here between 18 and 23 years, 15 % of respondents live here between 12 and 17 years, and 13 % of respondents between 30 and 35 years. This result shows that most of the respondents know the changing process of the streets.

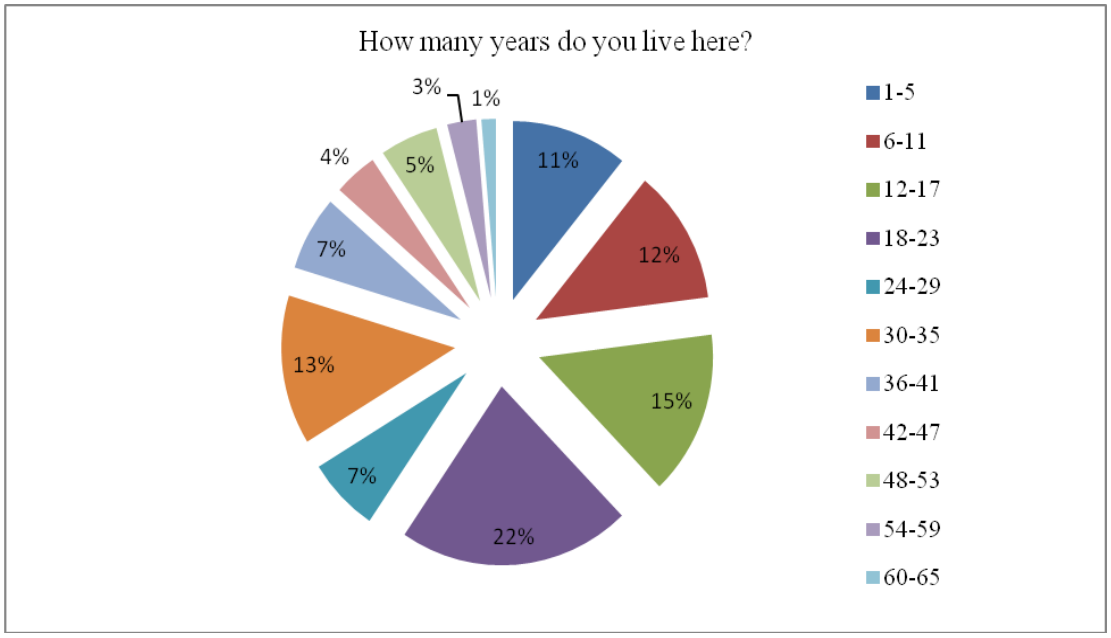

Figure 4.57. Percentage of living at the site

65 % of the respondents have a vehicle, and 35 % of the do not have any vehicle.

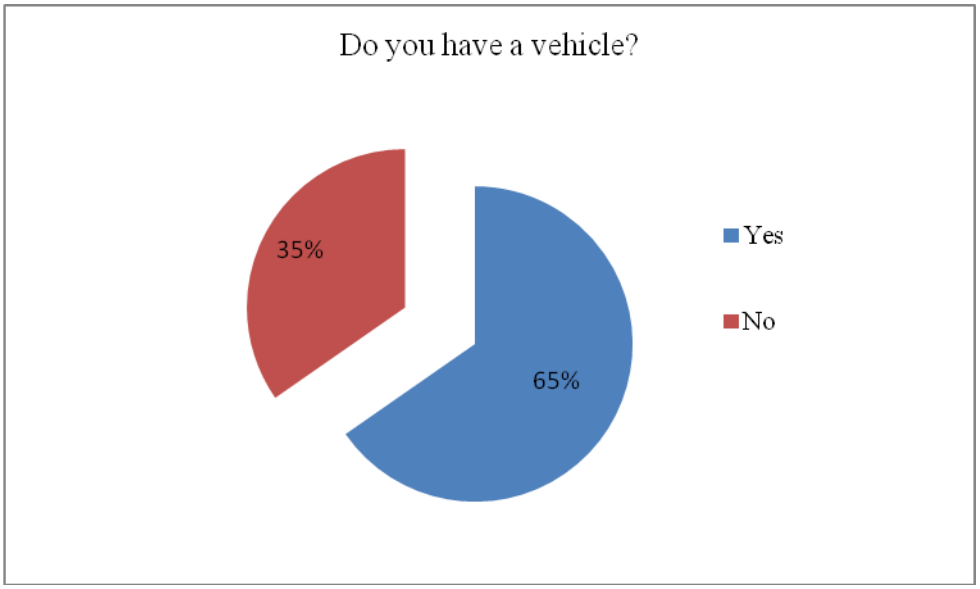

Figure 4.58. Percentage of having vehicle

Most of the respondents think that the streets are not safe for walking.

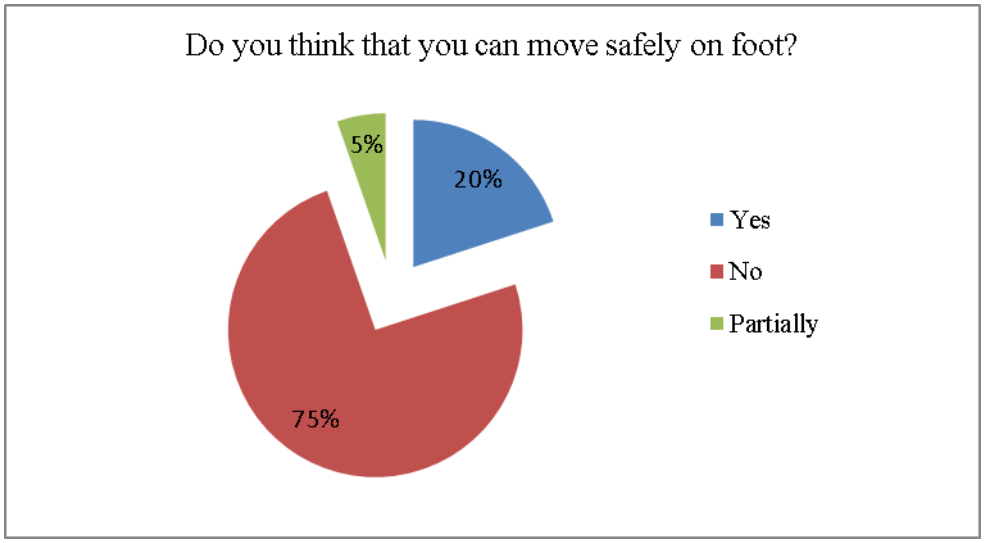

Figure 4.59. Percentage of people who think they move safely on foot

Finding a parking space is one of the most important problems in the site. According to the survey, 76 % of the respondents look for parking space in other streets. Respondents who have apartment parking space do not have any problems having parking space. There is a private parking area near the high school in the site. For 6 % of the respondents this private parking area is too expensive.

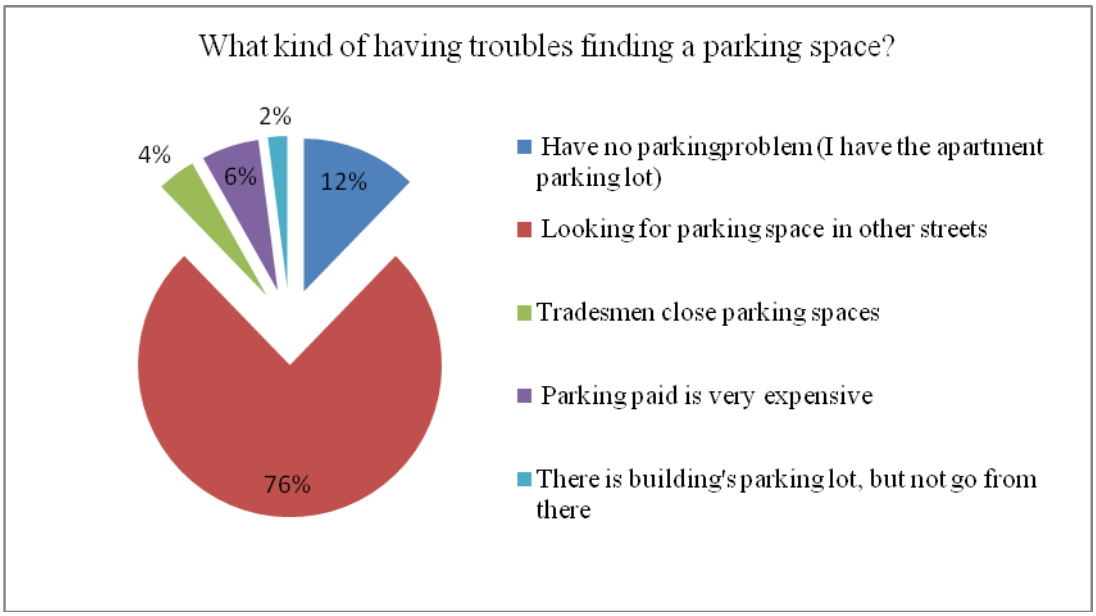

Figure 4.60. Percentage of finding parking space problems

Almost all the respondents want new arrengemnets for parking. However, some of them agree that new arrangement can not be nade because of the spatial constraints such as narrow streets, nao having empty lots in the site.

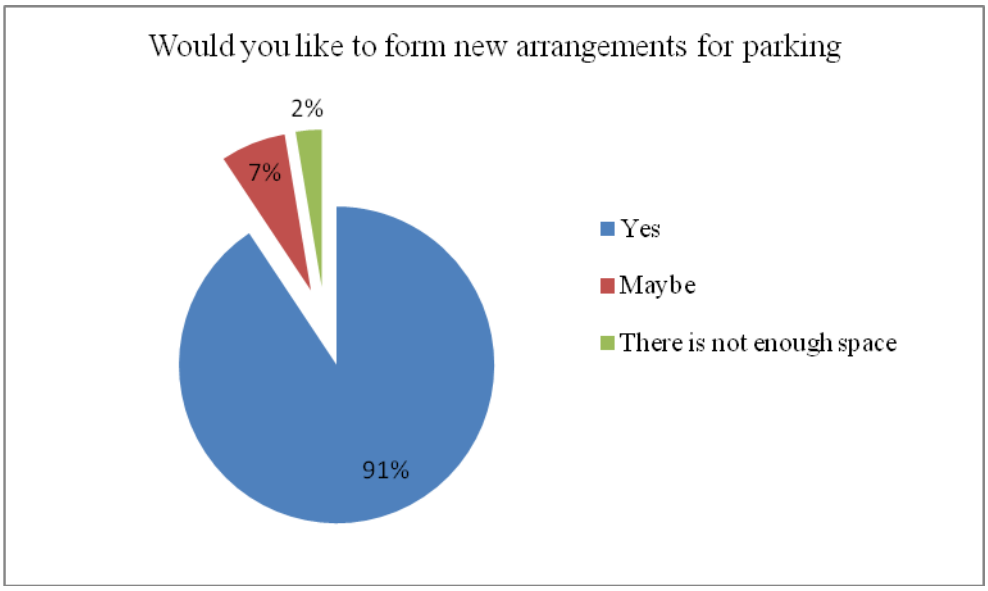

Figure 4.61. Percentage of willings new arrengements for parking

Almost all the respondents believe that parking space can not be maintained for everyone because of the spatial constraints.

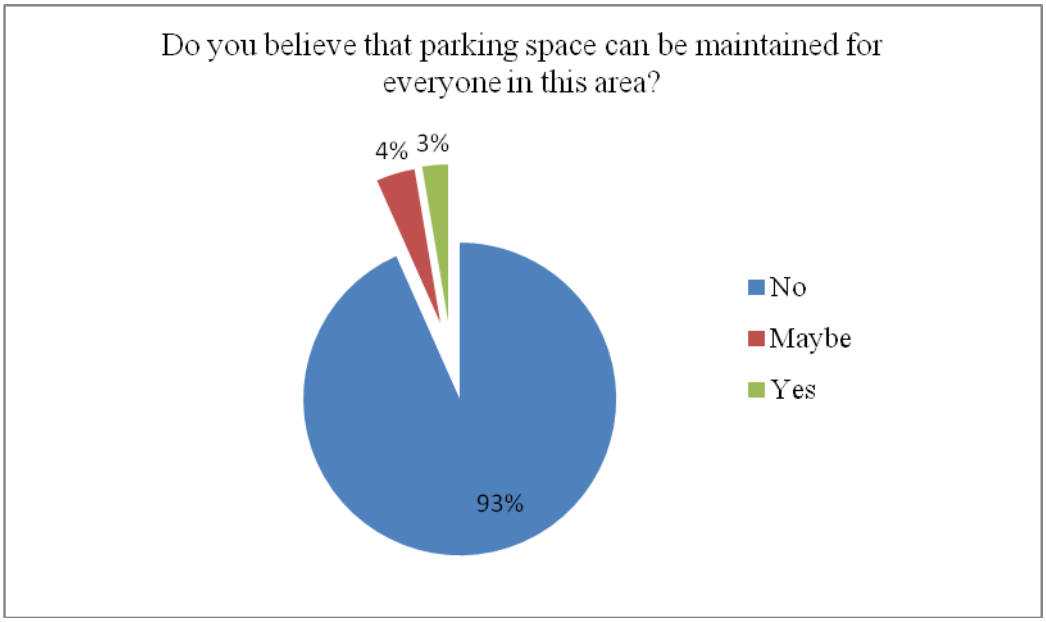

Figure 4.62. Percentage of respondents who believe that parking space can be maintained for everyone.

38 % of the respondents say that they can not use the sidewalks safely. However, 32 % of them say that they can use the sidewalks. Respondents living in the 55 Street can not use the sidewalks, since they are too narrow. Also, tradesmen and vehicles occupy the sidewalks. As a result of this residents can not use them.

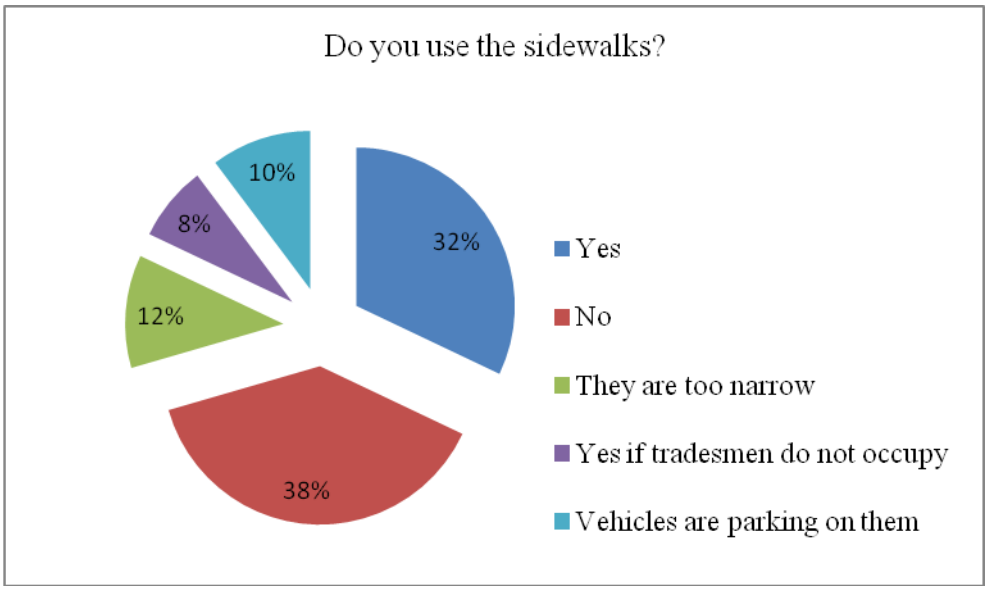

Figure 4.63. Percentage of respondents using the sidewalks.

Almost all the respondents thinh that removal of sidewalks cause safety problems. Most of the respondents say that where pedestrians will walk if the sidewalks are removed.

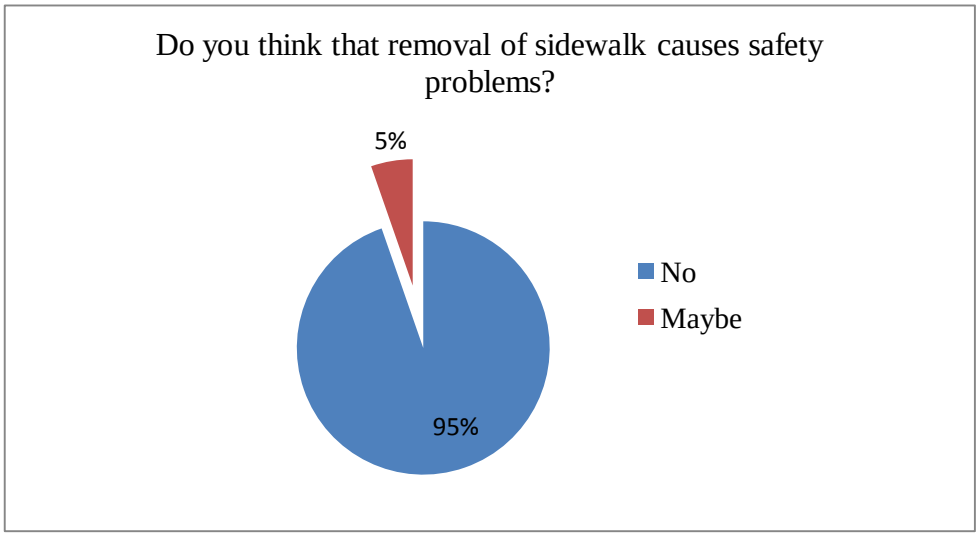

Figure 4.64. Safety problems caused by removal of sidewalks.

According to the survey results, the most important problems for pedestrians and drivers are, firstly, double-sided parking on the streets, secondly, being occupied of sidewalks by tradesmen and vehicles, and thirdly, parking space problem and congestion.

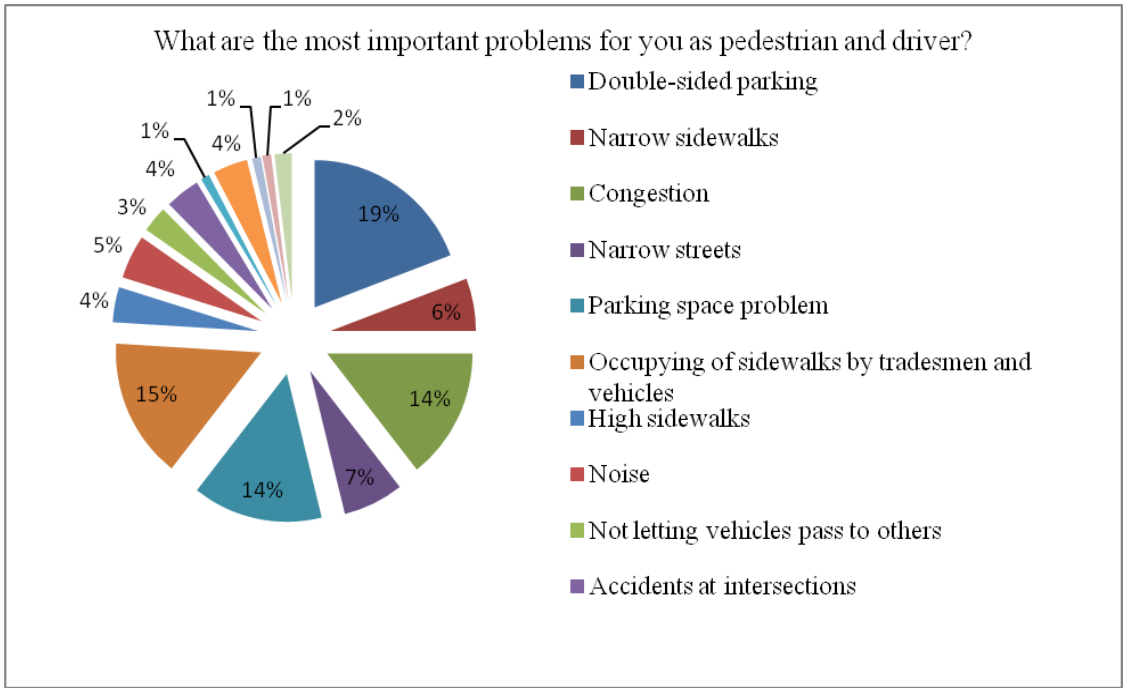

Figure 4.65. Most importants problems for pedestrians and drivers.

Survey results show that for 41 % of the respondent pedestrianization of the strets would be bad for the residents.

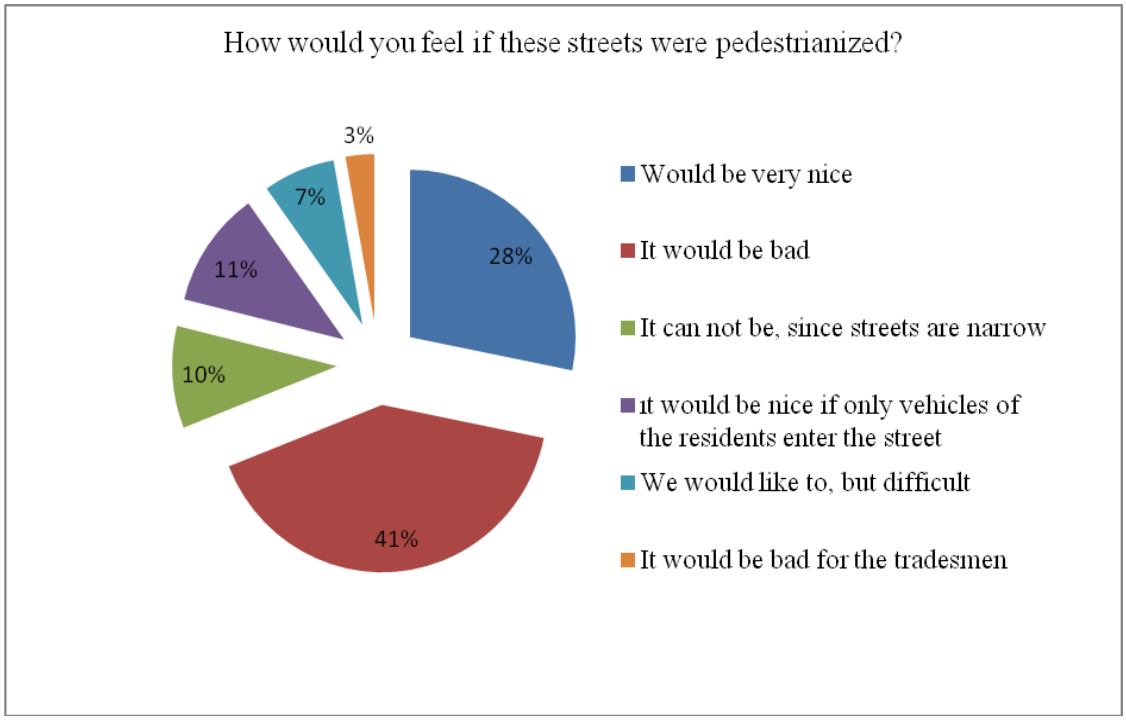

Figure 4.66. Pedestrianization of the streets.

Most of the respondent belive that pedestrians and vehicles can move together safly if the right arrengements are made.

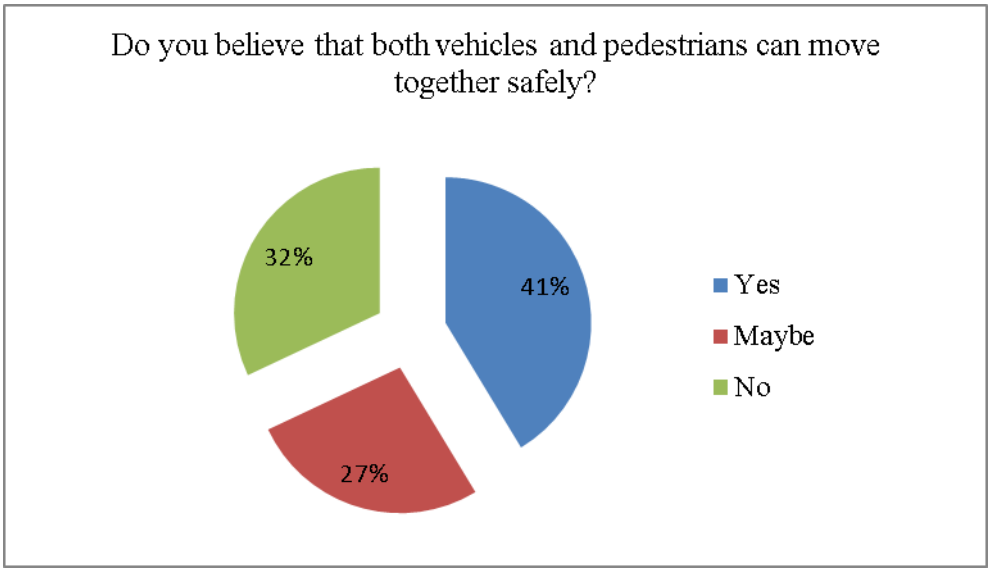

Figure 4.67. Believing of moving together safely of pedestrians and vehicles.

Survey results show that none of the respondent have any idea about traffic calming techniques.

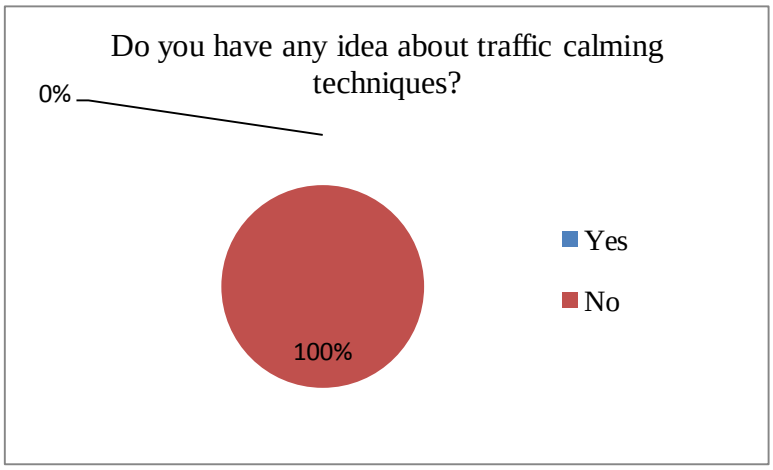

Figure 4.68. Percentage of respondents having any idea about traffic calming.

Although none of the respondent have any idea about traffic calming and its tecqniques, most of them belive that this kind of techniques can solve traffic problems on the streets.

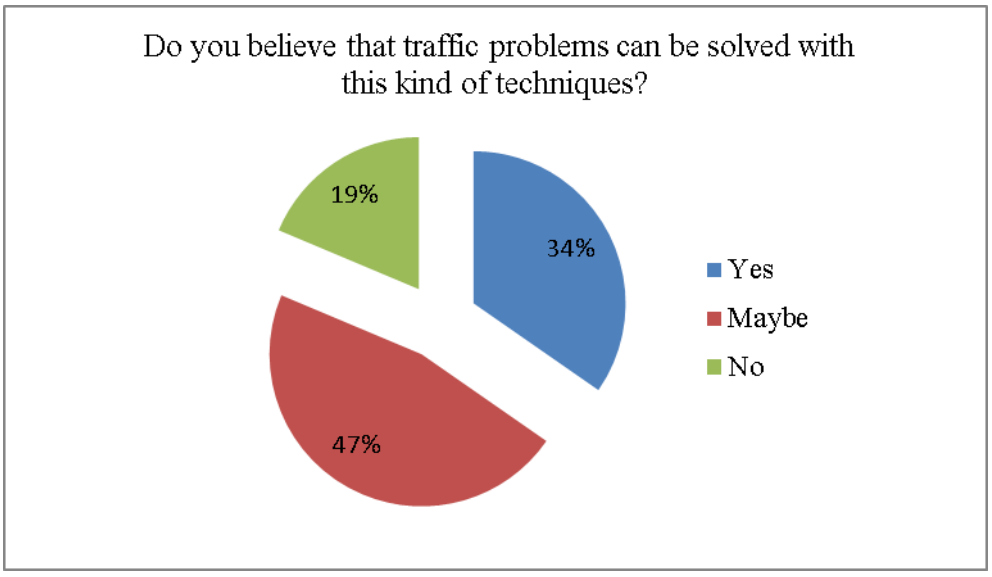

Figure 4.69. Percentage of respondents who believe that traffic problems canbe solved with the tecqniques such as traffic calming.

4.8. Proposed Traffic Calming Elements for the Study Streets

The proposed traffic calming elements were looked up from the quick response look-up table. Look-up table is formed only for these streets. However, this table can be useful for all kind of streets. According to look-up table, the most suitable elements are supposed to be as raised intersection, speed table, lateral shifts.

-Cut-through traffic tried to obstruct by narrowing the carriageway to 4.5m and by creating lateral shifts which are equal to the width of the traffic lane, were created by alternate o-street parking defined by planted areas and bollards.

-Five speed tables, five lateral shifts and two raised intersections were proposed for 56 Street. The cost of per speed table is minimum $2500, the cost of per raised intersection is minimum $25000 and the cost of per lateral shift is minimum $5000. The cost of proposed traffic calming elements for 56 Street is minimum $87500.

-Also, four speed tables and one lateral shift were proposed for 55 Street. The cost of proposed traffic calming elements for 56 Street is minimum $15000.

-On-street parking was regulated along the streets, mostly only one side of the street was allowed for parking. Approximately 80 vehicles can park on the streets. However, before the scheme approximately 200 vehicles could park on the streets. So, a parking space is crucially needed. In order to solve parking space problem, existing private parking space were proposed as mechanical parking space.

-The carriageway and footways were repaved different kind of textured materials.

-The carriageway and footways were aligned equally. They were separated only with the bollards and different kind of teaxtures.

-Suitable street furniture and street ligting were implemented along the streets.

-Parking in front of the entrances of the building was obstructed with trees.

By using the look-up table as a guide for these streets, a traffic calming scheme was formed.

Table 4.5. Quick Response Look-up Table

PROBLEM	TRAFFIC CALMING ELEMENT	COST	APPLICABLE STREET WIDTH	RESTRICT RESIDENT ACCESS	APPLIED IN EXAMPLE PROJECTS	BEST ELEMENT FOR PROBLEM POINTS (PP)
1.Cut-through	A. Street closures B. Diverter C. Median barrier L. Lateral shift T. On-street parking W. Entrance and Gateway	Expensive A-B-W	Wide C	Yes A-B	Yes L-T	1-L PP6, PP8, P11 1-T PP7, PP8, PP11, PP12, PP14, PP15
		Cheap C-L-T-W	Narrow and Wide L-T-W	No C-L-T-W	No A-B-C-W	
2. High speed	D.Speed hump E. Speed cushion F. Speed table G. Raised crosswalk H. Raised intersection I.Traffic circle L. Lateral shift N.Realigned intersection O.Curb extension R.Choker S.Center island narrowing T.On-street parking	Expensive F-G-H-N-O-S	Wide I-O-R-S	Yes	Yes D-F-G-L-O-T	2-F PP1, PP2, PP4, PP5, PP6, PP13, PP14, PP15 2-L PP1, PP6, PP8, P11 2-H PP3, PP9 2-T PP4, PP11, PP12
		Cheap D-E-F-G-I-L-O-R-T	Narrow and Wide D-E-G-L-N-T	No D-E-F-G-I-L-N-O-R-S-T	No E-H-I-N-R-S	
3.High volume	A. Street closures B.Diverter C. Median barrier L. Lateral shift M. Chicane R.Choker S. Centre island narrowing	Expensive A-B-S	Wide C-R-S	Yes A-B	Yes L-M	3-L PP6, PP8, P11
		Cheap C-L-R-T	Narrow and Wide L-M	No C-L-M-R-S	No A-B-C-R-S	

Table 4.5. (cont.)

4. Pedestrian-vehicle conflict	F. Speed table G.Raised crosswalk H. Raised intersection O. Curb extension S. Centre island narrowing	Expensive F-G-H-O-S	Wide O-S	Yes	Yes F-G-O	4-F PP1, PP2, PP4, PP5, PP6, PP13, PP14, PP15
		Cheap F-G-O	Narrow and Wide F-G-H	No F-G-H-O-S	No H-S	
5.Vehicular-vehicular conflict	I.Traffic circle	Cheap	Wide	No	No	
6. Poor pedestrian visibility	F. Speed table G.Raised crosswalk K. Curb radius reduction O. Curb extension	Expensive F-G-O	Wide O	Yes	Yes F-G-O	6-F
		Cheap F-G-K	Narrow and Wide F-G-K	No F-G-K-O	No K	
7. Poor environment	U. Textured and coloured pavement W. Entrance and gateway X. Street furniture and lighting Y. Planting/greenery	Expensive U-W-X-Y	Wide	Yes	Yes U-X-Y	7-U 7-X PP1, PP2, PP3, PP4, PP5, PP6, PP7, PP8, PP9, PP10, PP11, PP12, PP13, PP14, PP15 7-Y PP1, PP2, PP6, PP7, PP8, PP1O, PP11, PP12, PP13, PP15
		Cheap U-W-X-Y	Narrow and Wide U-W-X-Y	No U-W-X-Y	No W	

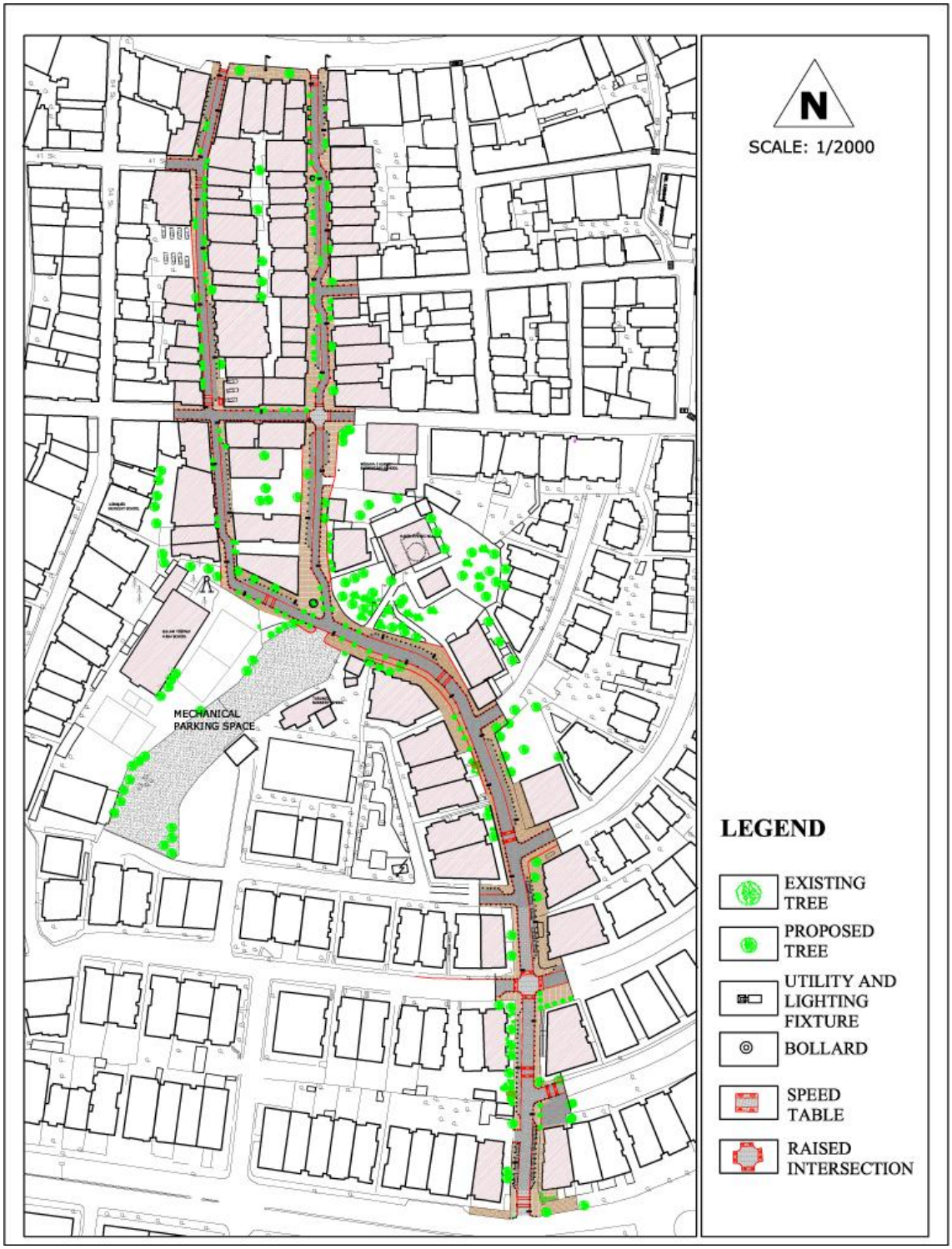

Figure 4.70. Proposed Traffic Calming Scheme

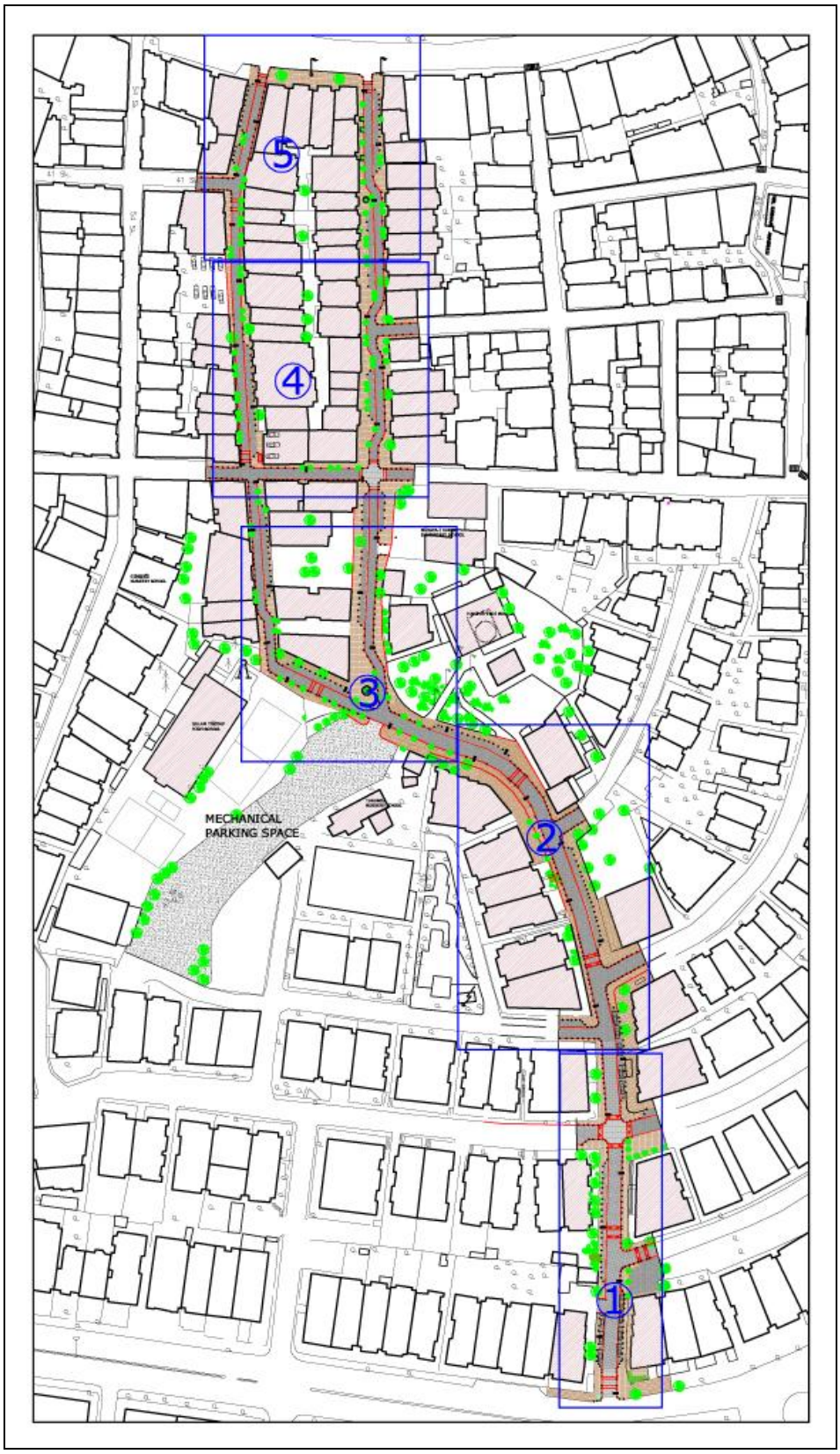

Figure 4.71. Proposed Traffic Calming Scheme Detail Maps

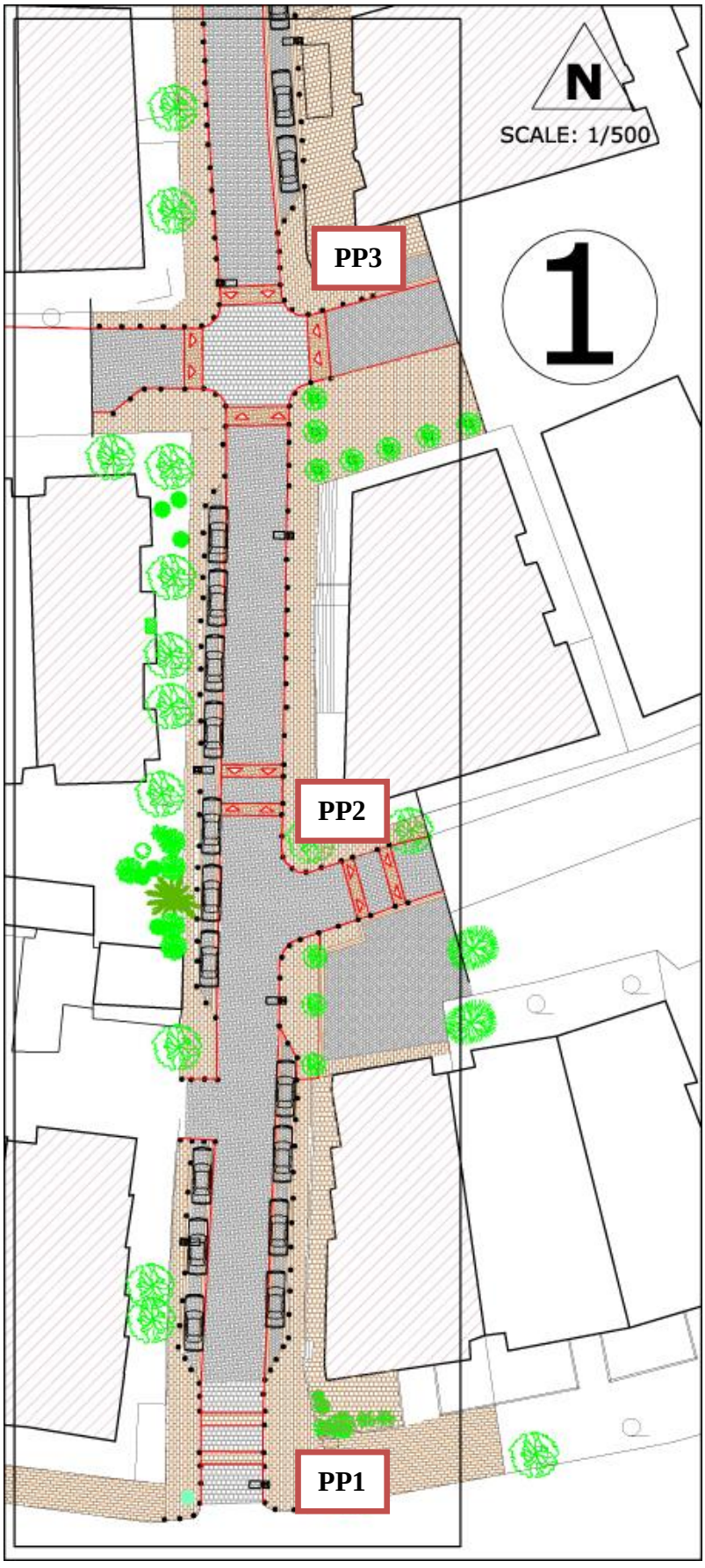

Figure 4.72. Detail Map 1.

Detail Map 1 shows the best traffic calming solutions for the Problem Point 1, 2 and 3. According to look-up table, the best solutions are speed table, raised intersection and on-street parking.

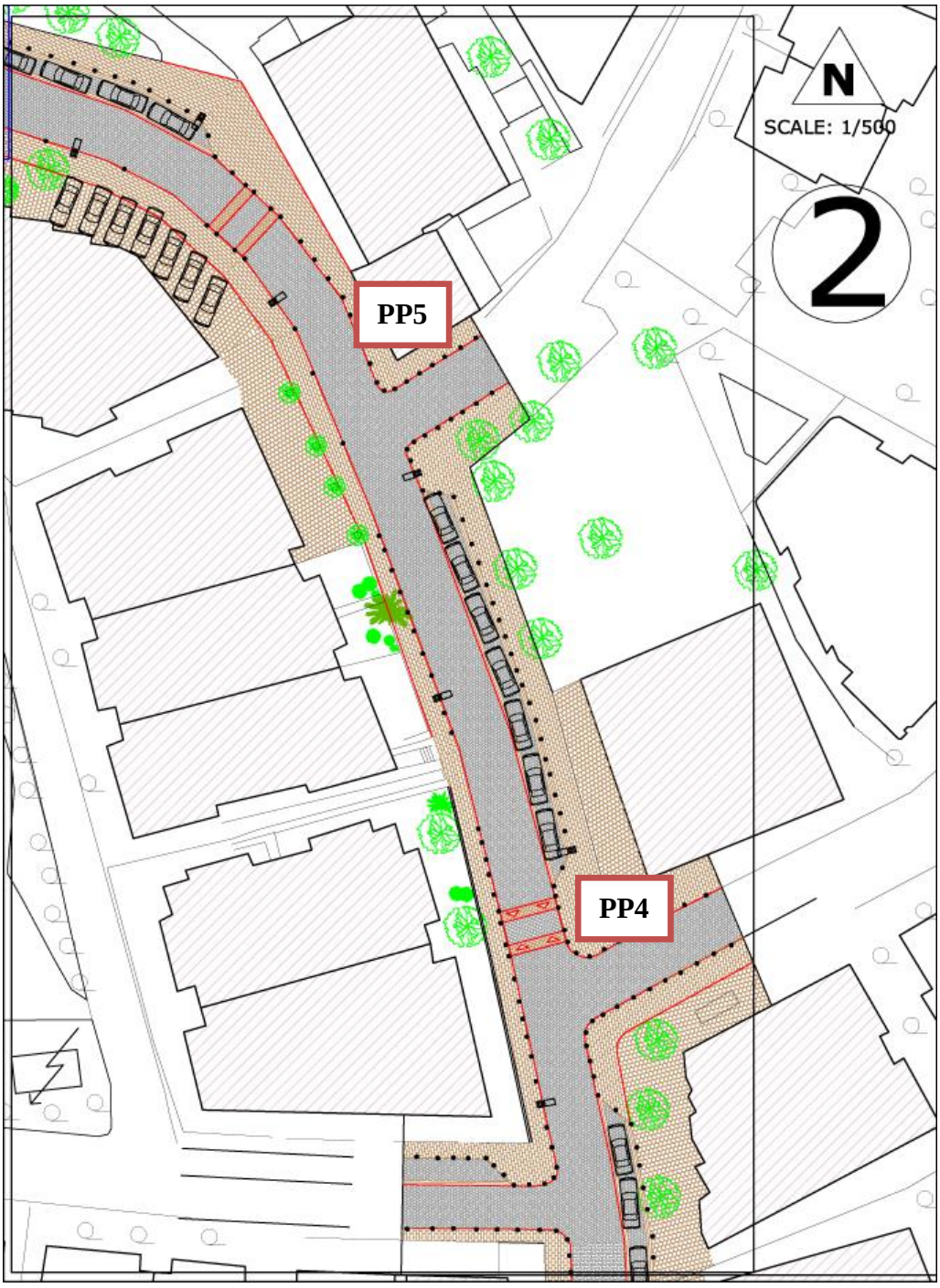

Figure 4.73. Detail Map 2.

Detail Map 2 shows the best traffic calming solutions for the Problem Point 4 and 5. According to look-up table, the best solutions are speed table and on-street parking.

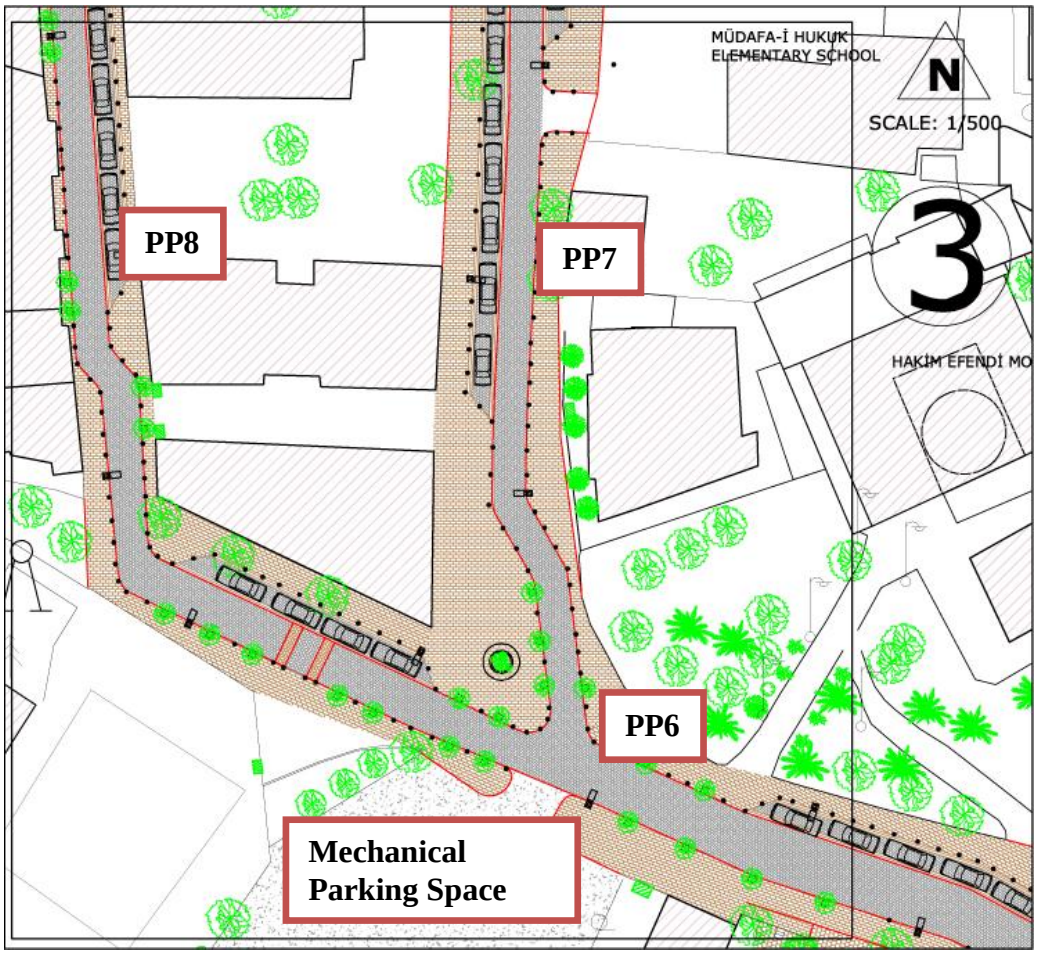

Figure 4.74. Detail Map 3.

Detail Map 3 shows the best traffic calming solutions for the Problem Point 6, 7 and 8. According to look-up table, the best solutions are speed table, lateral shift and on-street parking. Parking in front of the entrances of the building was obstructed with trees.

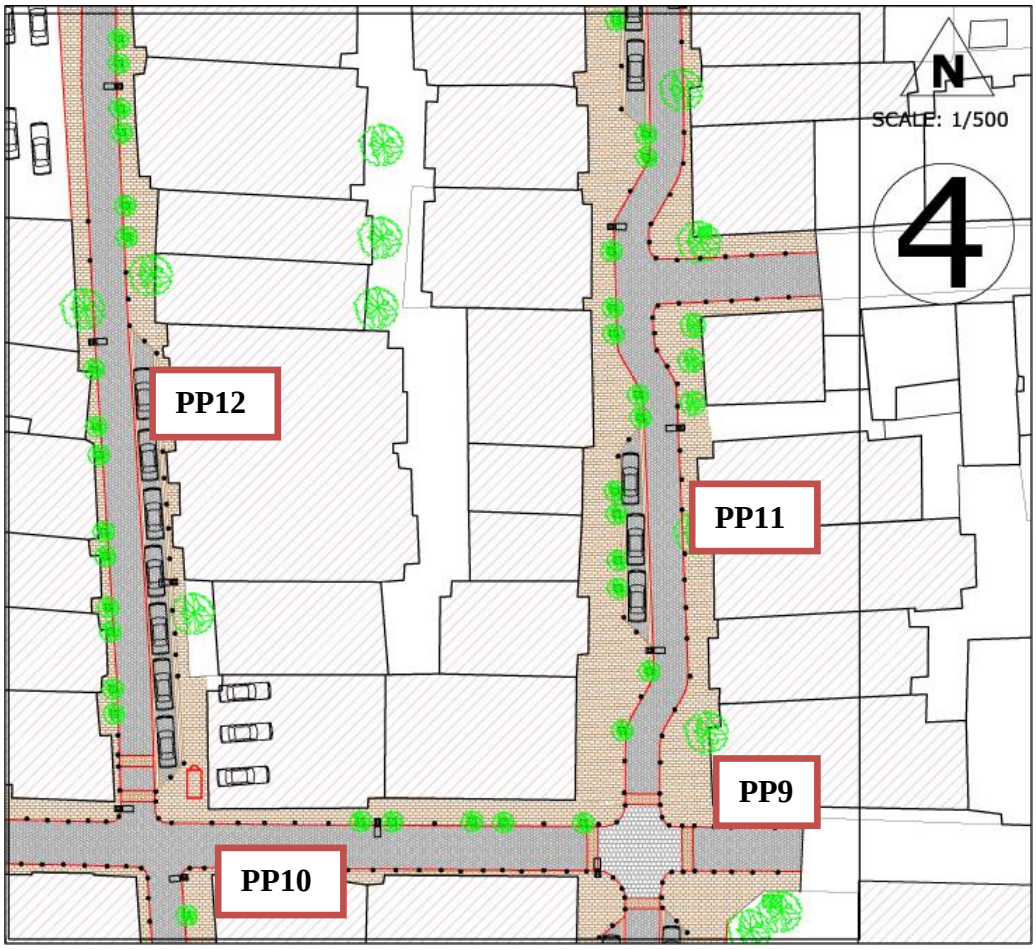

Figure 4.75. Detail Map 4.

Detail Map 4 shows the best traffic calming solutions for the Problem Point 9, 10, 11 and 12. According to look-up table, the best solutions are speed table, lateral shift raised intersectionand on-street parking. Parking in front of the entrances of the building was obstructed with trees.

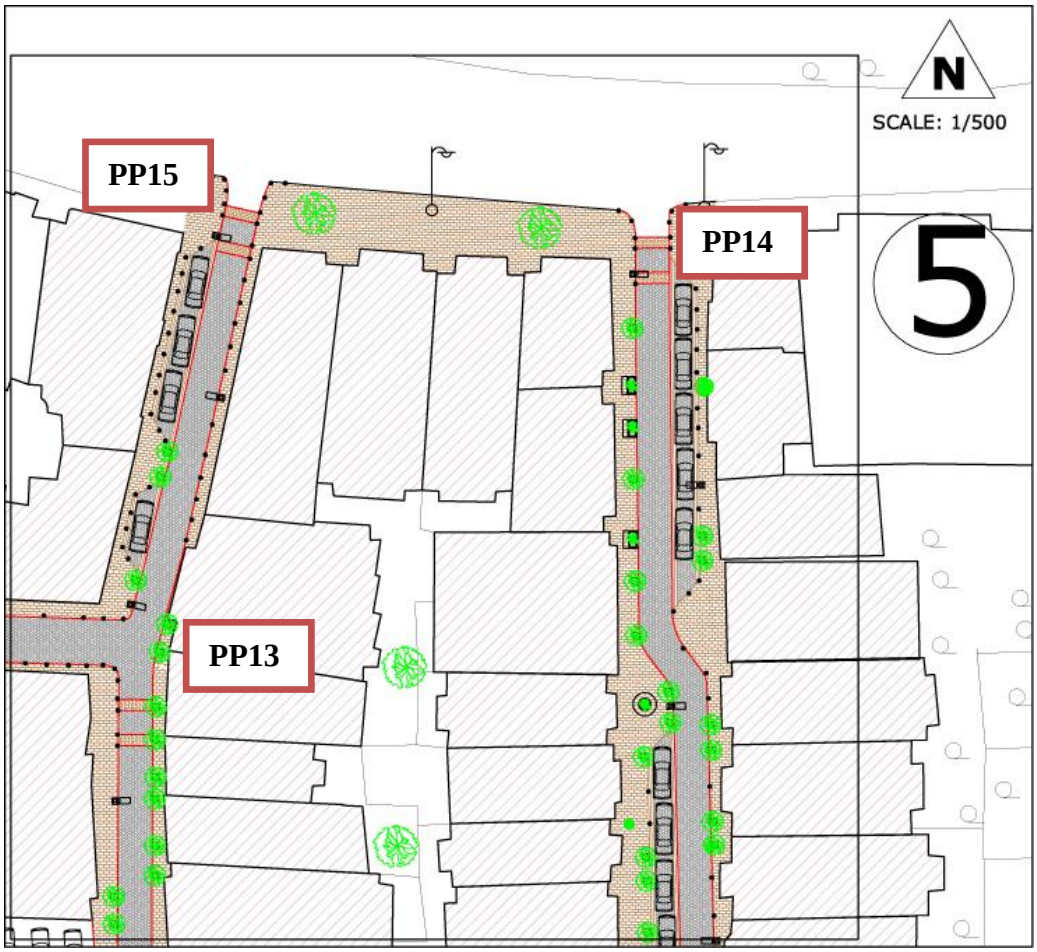

Figure 4.76. Detail Map 5.

Detail Map 5 shows the best traffic calming solutions for the Problem Point 13, 14 and 15. According to look-up table, the best solutions are speed table, lateral shift and on-street parking. Parking in front of the entrances of the building was obstructed with trees.

CHAPTER 5

CONCLUSION

The streets' purpose is for people to walk, stroll, look, gaze, meet, play, shop and even work alongside cars but not dominated by them. Traffic calming is founded on the idea that streets should help create and preserve a sense of place. And to make this it has elements. The elements of traffic calming take a different approach from treating the street. They include techniques designed to lessen the impact of motor vehicle traffic by slowing it down, or literally "calming" it. This helps build human-scale places and an environment friendly to people on foot.

This thesis examined how traffic calming elements can be modified in order to reduce cut-through traffic and create better environment in terms spatial and cultural constraints of Turkish urban residential streets.

The primary objectives of the study include, firstly, discouraging cut-through traffic. 40 % of vehicles entering the case study streets make cut-through traffic. This rate is very high, since the streets within the neighbourhood are neighbourhood residential streets. They must only serve the residents in the neighbourhood. Second objective is minimizing conflicts between road users. Third one is encouraging proper driving behavior. Traffic calming mostly change the drivers' behaviours and minimize conflicts between road users. In Turkish urba streets, driver behaviours are one of the most cultural constraints. Las objective is to modify traffic calming elements according to cultural and apatial constraints of Turkish urban streets.

In order to reach these solutions, firstly, historical background of traffic calming was examined. Secondly, traffic calming elements were idendified and some traffic calming projects were given as example. These examples were chosen from Europe, since the structure of streets was more similar to the case study streets in terms of physical structure, problems and objectives. Thirdly, by using advantages, disadvantages, cost, eligibility for streets and given examples, a "look-up table" was prepared for using as a guide for case study streets. This look-up table helped to choose the most suitable traffic calming elements for the case study streets.

According to the look-up table, the most suitable traffic calming solutions were raised intersection, speed table, lateral shifts regulated on-street parking and textured pavement.

Also, it was examined in this study that the residents' opinions about traffic caming elements. As the results of the interviews doing with residents, most of the residents do not have any idea about traffic calming. However, they believe that the traffic problems on streets may be solved with this kind of solutions.

As a consequence of this study, look-up tables can be useful for locally traffic calming projects. By using this table, the most suitable traffic calming elements can be choosen. And with the most suitable elements, the behaviours of drivers and pedestrians can be changed. This, also, means the reducing of cultural constraints.

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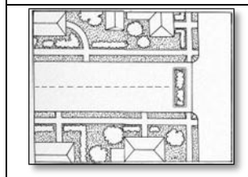
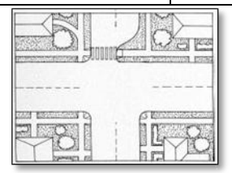
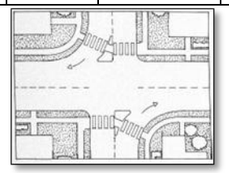
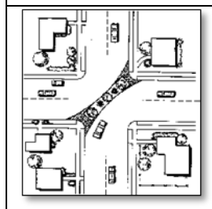
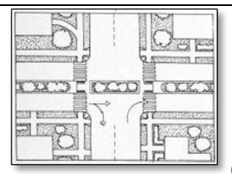
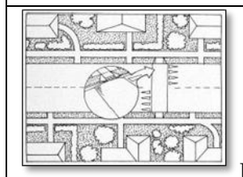
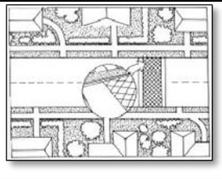
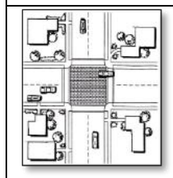
APPENDIX A

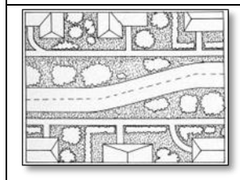
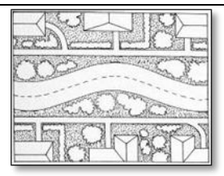
LOOK-UP TABLE FOR TRAFFIC CALMING

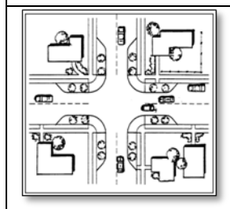
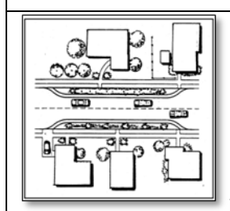
Table A.1. Look-up Table for Traffic Calming

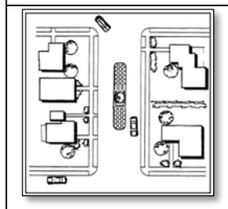
RULER FOR HELPING TO MODIFY TRAFFIC CALMING ELEMENTS										
TRAFFIC CALMING ELEMENTS	PURPOSE	BENEFITS	DISBENEFITS	ESTİMATED COST	ROAD CLASSIFICATION			OTHER CONSIDERATIONS		EXAMPLE PROJECTS WHICH ELEMENTS WERE APPLIED
					Local Road	Collector Road	Arterial Road	Emergency Response Route	Transit Route	
	 A.**Full Street Closure**		 A.**Half Street Closure-Directional Closure**		 A.**Forced-turn Island**					
	- to eliminate cut-through or through traffic - good for locations with extreme traffic volume problems in which several other elements have been unsuccessful	-eliminate all short-cutting or through traffic. -maintain pedestrian and bicycle access. -effective reducing volumes -	-legal procedures are required for street closures. -restrict resident access to the neighbourhood and business; -may be expensive; -may divert significant volume of traffic to parallel streets without traffic calming measures -cause circuitous routes for local residents and emergency services	-may change between $30.000 and $100.000	✓	×	×	✓	✓	
	 B.**Diverter**									
	-to obstruct short-cutting or through traffic -good for inner-neighbourhood locations with non-local traffic volume problems	-effective reducing volumes	-restrict resident access to the neighbourhood and business; -may divert significant volume of traffic to parallel streets without traffic calming measures	-although may change depending on the design $85.000	✓	×	×	✓	×	

 C.**Median Barrier**									
-to obstruct short-cutting or through traffic; -to reduce crossing distance for pedestrians	- reduce traffic volumes on a cut-through route that crosses a major street - improve safety at an intersection of a local street and a major street by prohibiting dangerous turning movements.	-restrict resident access to the neighbourhood and business; -may divert significant volume of traffic to parallel streets without traffic calming measures	-$5,000-$15,000 per island	✓	✓	✓	✓	✓	
 D.**Speed Hump**									
- to reduce vehicle speeds	-inexpensive -effectively slow traffic -benefit all pedestrians including people with disabilities	- increase noise and air pollution -some traffic may be diverted to parallel streets that do not have traffic calming measures -reduce the speed of emergebcy vehicles	$2,000-$3,000 per speed hump	✓	✓	×	×	×	**-Exeter–Burnhouse Lane, England** **Problems:** High traffic speed, high accident rate, poor environment **-Haringey–Mount Pleasant Road, England** **Problems:** high cut-through traffic, high traffic flows, vehicle speeds and accidents
 E.**Speed Cushion**									
- to reduce vehicle speeds	-inexpensive -effectively slow traffic -benefit all pedestrians including people with disabilities	- increase noise and air pollution -some traffic may be diverted to parallel streets that do not have traffic calming measures -reduce the speed of emergebcy vehicles	$2,000-$3,000 per speed cushion	×	✓	×	×	✓	
 F.**Speed Table**									
-reduce vehicle speeds -improve pedestrian visibilit -reduce pedestrian-vehicle conflicts	-smoother on large vehicles such as fire trucks than speed hump -reduce vehicle speeds -can be used as raised	- materials can be expensive - increase noise and air pollution -traffic may be diverted to parallel residential streets that do not have traffic calming	$2,500-$8,000 per speed table	✓	✓	×	×	×	**-Cologne-Wittekind Street, Germany** **Problems:** high cut-through traffic at evening peak hours, high through traffic, high vehicle speed **-Leicester Worthington Street, England**

	crosswalks to increase pedestrian visibility	measures							**Problems:** -high through traffic, high vehicle volume and speed **-Exeter–High Street/Queen Street, England** **Problems:** overwhelming domination by motor vehicles which resulted in a hostile and unsafe environment for pedestrians **-Exeter–Bedford Street, England** **Problems:** safety problems for pedestrians
 G. **Raised Crosswalk**									
-reduce vehicle speeds -improve pedestrian visibilit -reduce pedestrian-vehicle conflicts	-smoother on large vehicles such as fire trucks than speed hump -reduce vehicle speeds	- materials can be expensive - increase noise and air pollution -traffic may be diverted to parallel residential streets that do not have traffic calming measures	$2,500-$8,000 per raised crosswalk	✓	✓	×	×	✓	**-Vt route 9 / Monument Avenue, Old Bennington, Vermont, USA** **Problems***: Lack of sidewalks and crosswalks, unsafe crossing*, Lack of appropriate bicycle right-of-way, Limited sight distance for those vehicles turning left, Confusing roadway design **--Exeter–Bedford Street, England** **Problems:** safety problems for pedestrians
 H. **Raised Intersection**									
-reduce vehicle speeds; -better define crosswalk areas; and -reduce pedestrian-vehicle conflicts	- It improve safety for pedestrians and vehicles -vehicles are forced to slow through intersection area -pedestrian area is better defined. -calm two streets at once -have positive aesthetic value if designed well	- materials can be expensive - may divert traffic to parallel residential streets that do not have traffic calming -slow emergency vehicles to approximately 25 km/h	-although dependent on the size of the roads, they can cost from $25,000 to $70,000	✓	×	×	×	×	
 I. **Traffic Circle**									
-reduce vehicle speeds -reduce vehicle-vehicle conflicts at intersections	-reduce traffic speed -reduce traffic carashes	- require removal of some on-street parking - divert a significant volume of traffic to parallel streets without	$3,500-$15,000 each	✓	✓	×	✓	✓	

		traffic calming measures -fire emergency response vehicles can be delayed 5 to 10 seconds per traffic circle encountered while on route to an emergency							
 J. **Roundabout**									
	-unlike many other forms of traffic calming, roundabout benefits are aimed primarily at motorists -improve traffic flow -maximize vehicular capacity - eliminating the need for stop signs and traffic signals	- unsafe for pedestrians while crossing		×	✓	✓	×	✓	
K. Curb Radius Reduction									
-slow right-turning vehicles -reduce crossing distance for pedestrians -improve pedestrian visibility.	-reduce speeds of right-turning vehicles -improve pedestrian safety	-long trucks, buses and other large vehicles may need to cross into adjacent travel lanes in order to negotiate turns at the intersection		✓	✓	×	✓	✓	
 L. **Lateral Shift**  M. **Chicane**									
to discourage cut-through or through-traffic -reduce vehicle speeds	-reduce vehicle speeds and volume	-divert significant volume of traffic to parallel streets without traffic calming	Per set costs $5,000-$15,000	✓	×	×	×	×	**-Cologne-Wittekind Street, Germany** **Problems:** high cut-through traffic at evening peak hours, high through traffic, high vehicle speed **-Exeter–Burnhouse Lane, England** **Problems:** High traffic speed, high accident rate, poor environment
 N. **Realigned Intersection**									
-to reduce vehicle speeds -to increase safety	- effective reducing speeds and improving safety at a T-intersection that is commonly ignored by motorists	-high cost - require some additional right-of-way to cut the corner	varies by curve radii and size of right-of-way	✓	✓	✓	✓	✓	

				acquisition						
	 O. **Curb Extension**									
	-reduce vehicle speeds -reduce crossing distance for pedestrians -increase pedestrian visibility -prevent parking close to an intersection	-reduce vehicle speed -reduce pedestrian crossing distance -improve visibility -reduce vehicle-pedestrian conflicts	- require the removal of on-street parking	$2,000 to $20,000 per corner	✓	✓	✓	✓	✓	-**Haringey–Mount Pleasant Road, England** **Problems:** high cut-through traffic, high traffic flows, vehicle speeds and accidents -**Plymouth-Vivtoria Road, St.Budeaux, England** **Problem:** drivers use it as a cut-through route, traffic flow had increased from under 8,000 to over 11,000 vehicles per 12 hour day, poor environment --**Exeter–High Street/Queen Street, England** **Problems:** overwhelming domination by motor vehicles which resulted in a hostile and unsafe environment for pedestrians
	 P. **Neckdown/Bulbout**									
	-to “pedestrianize” intersections	-iprove pedestrian circulation and space -through and left-turn movements are easily negotiable by large vehicles -create protected on-street parking bays -reduce speeds, especially for right-turning vehicles.	-effectiveness is limited by the absence of vertical or horizontal deflection -may require the elimination of some on-street parking near the intersection	$40.000-$80.000	✓	✓	✓	✓	✓	-**Haringey–Mount Pleasant Road, England** **Problems:** high cut-through traffic, high traffic flows, vehicle speeds and accidents
	 R. **Choker**									
	-to reduce vehicle speeds and to increase safety - good for arreas with substantial speed problems and no on-street parking shortage.	-easily negotiable by large vehicles such as fire trucks -can have positive aesthetic value if designed well -reduce both speeds and volumes -preferred by emergency	-require the elimination of some on-street parking	-$7,000-$10,000 per pair -$5,000 to $20,000, depending on site conditions	✓	✓	×	✓	✓	

	response personnel compared to other traffic calming measures		and landscaping						
 S. **Centre Island Narrowing**									
-to reduce vehicle speeds -to reduce pedestrian-vehicle conflicts -good for entrances to residential areas and wide streets where pedestrians need to cross.	-increase pedestrian safety -have positive aesthetic value if designed well -reduce traffic volumes	-require elimination of some on-street parking -speed reduction effect is limited by the absence of any vertical or horizontal deflection.	$8.000-$15.000						
 **T. On-street Parking**									
-to reduce vehicle speeds; -to reduce short-cutting or through traffic	-parked vehicles provide a buffer between traffic and pedestrians on sidewalks. -traffic noise may be reduced due to a reduction in traffic volumes or speeds.	-reduce visibility of pedestrians crossing the roadway		✓	✓	✓	✓	✓	**-Exeter–Bedford Street, England** **Problems:** safety problems for pedestrians **--Eindhove–Leenderverg, Netherlands** **Problems:** cut-through traffic
 U. **Textured and Colured Pavement**									
-to distinguish between different surface functions -to improve street appearance -to reinforce speed reduction measures -to simplify construction of traffic calming measures in the carriageway -to improve visual impact, particularly in poor light and under street lighting	-reduce vehicle speeds over and extended length. -have positive aesthetic value if designed well. -a clear contrast can be provided for different intended uses of the available space	-materials may be expensive. -if they are used on a crosswalk, they can make crossing more difficult for wheelchair users and the visually impaired	varies depending on the materials	✓	✓	✓	✓	✓	**-Vt route 9 / Monument Avenue, Old Bennington, Vermont, USA** **Problems***: Lack of sidewalks and crosswalks, unsafe crossing*, Lack of appropriate bicycle right-of-way, Limited sight distance for those vehicles turning left, Confusing roadway design **- Exeter–Burnhouse Lane, England** **Problems:** High traffic speed, high accident rate, poor environment **-Leicester Worthington Street, England** **Problems: -**high through traffic, high vehicle volume and speed **--Exeter–High Street/Queen Street, England** **Problems:** overwhelming domination by

										motor vehicles which resulted in a hostile and unsafe environment for pedestrians **--Eindhove–Leenderverg, Netherlands** **Problems:** cut-through traffic **- Barnstable-High Street, England** **Problems:** Conflict between vehicular traffic and pedestrians, unpleasant environment **-Dartmouth–Town Centre, England** **Problems:** unpleasant environment
	 V. **Occasional Strip**									
	-To allow reduction of carriageway width while retaining access for buses and lorries -to improve the optical effect for slow driving -to provide greater safety for pedestrians crossing the street, for cyclists, and for on-street parking/loading activity	-can reinforce speed reduction and other traffic calming objectives while retaining access for moderate volumes of larger vehicles -provide greater functional and design flexibility especially where street width is limited, as in historic towns and villages for example	-probably unsuitable where larger vehicles form a high proportion of traffic -textured surfaces may discourage their use by cyclists							
	 W. **Entrance and Gateway**									
	-to mark the beginning and end of areas where different rules or expectations for drivers apply, or where special functions occur	-have important effect on drivers' perception ofchange of street priorities -add visual interest to the streetscape	-structures may be too large for the scale of the street if all classes of vehicle are allowed through		✓	✓	✓	✓	✓	
	 X. **Street Furniture and Lighting**  Y. **Planting/Greenery**									
	-to improve the functional and aesthetic qualities of the street -to encourage the use of public space -to enhance the safety and security of pedestrians -to provide vertical elements	-help to enhance the functional and aesthetic qualities of the street, and thus to reinforce its "living" character -planting makes a major contribution to the required change of street character in	-planting may increase maintenance costs unless sponsored or adopted by frontagers or other bodies		✓	✓	✓	✓	✓	**-Exeter–Burnhouse Lane, England** **Problems:** High traffic speed, high accident rate, poor environment **-Leicester Worthington Street, England** **Problems:** -high through traffic, high vehicle volume and speed

	adjacent to the carriageway. -to limit forward views -to reduce physical and optical width -to define street spaces and activities -to improve street appearance and the environment, including micro climate, noise and dust absorption	traffic calming schemes								**-Plymouth-Vivtoria Road, St.Budeaux, England** **Problem:** drivers use it as a cut-through route, traffic flow had increased from under 8,000 to over 11,000 vehicles per 12 hour day, poor environment **-Exeter–High Street/Queen Street, England** **Problems:** overwhelming domination by motor vehicles which resulted in a hostile and unsafe environment for pedestrians **-Eindhove–Leenderverg, Netherlands** **Problems:** cut-through traffic **--Dartmouth–Town Centre, England** **Problems:** unpleasant environment

APPENDIX B

TRAFFIC VOLUME DATA

Table B.1. The Average Number of Daily Vehicles Making and Not Making Cut-through Traffic (from İnönü Street to Mithatpaşa Street)

Number of vehicles **making** cut-through traffic (from **İnönü** Street to **Mithatpaşa** Street)						
Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
07.05.2011 Saturday	8:00-9:00	40	2	4	5	51
	12:00-13.00	35	1	5	3	44
	14:00-15:00	37	3	6	5	51
	18:00-19:00	51	4	3	4	62
09.05.2011 Monday	8:00-9:00	212	17	3	5	237
	12:00-13.00	110	15	5	7	138
	14:00-15:00	62	11	3	1	77
	18:00-19:00	158	12	4	5	179
10.05.2011 Tuesday	8:00-9:00	249	34	11	18	312
	12:00-13.00	61	16	5	8	90
	14:00-15:00	59	11	3	1	74
	18:00-19:00	114	26	10	4	154
13.05.2011 Friday	8:00-9:00	220	18	4	6	248
	12:00-13.00	69	12	2	3	86
	14:00-15:00	56	7	6	7	75
	18:00-19:00	175	9	3	10	197
15.05.2011 Sunday	8:00-9:00	61	3	5	4	73
	12:00-13.00	38	1	5	4	48
	14:00-15:00	35	2	6	5	48
	18:00-19:00	68	4	3	8	83
Number of vehicles **not making** cut-through traffic (from **İnönü** Road to **Mithatpaşa** Road)						
Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
07.05.2011 Saturday	8:00-9:00	120	21	5	5	161
	12:00-13.00	116	15	11	13	155

	14:00-15:00	125	15	9	10	159
	18:00-19:00	211	21	3	11	246
09.05.2011 Monday	8:00-9:00	141	27	14	26	208
	12:00-13.00	105	11	12	13	141
	14:00-15:00	98	10	4	13	125
	18:00-19:00	183	29	9	24	245
10.05.2011 Tuesday	8:00-9:00	115	18	2	15	150
	12:00-13.00	105	12	4	13	134
	14:00-15:00	101	10	5	10	126
	18:00-19:00	207	13	4	4	228
13.05.2011 Friday	8:00-9:00	231	26	10	13	280
	12:00-13.00	118	12	5	14	149
	14:00-15:00	102	10	7	15	134
	18:00-19:00	195	30	12	20	157
15.05.2011 Sunday	8:00-9:00	103	19	4	12	138
	12:00-13.00	112	15	9	13	149
	14:00-15:00	121	16	8	10	155
	18:00-19:00	201	20	2	7	230

Number of vehicles **making** cut-through traffic
(from **İnönü** Road to **Mithatpaşa** Road)

Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
26.12.2011 Monday	8:00-9:00	200	21	3	8	232
	12:00-13.00	108	14	5	7	134
	14:00-15:00	71	12	5	5	93
	18:00-19:00	135	12	4	4	155
27.12.2011 Tuesday	8:00-9:00	155	32	12	18	217
	12:00-13.00	62	15	5	8	90
	14:00-15:00	61	11	3	2	77
	18:00-19:00	117	21	11	5	154
28.12.2011 Wednesday	8:00-9:00	213	16	4	6	239
	12:00-13.00	110	14	5	7	136
	14:00-15:00	63	14	3	5	85
	18:00-19:00	154	12	4	5	175
29.12.2011 Thursday	8:00-9:00	100	18	6	8	132
	12:00-13.00	65	12	4	9	90

	14:00-15:00	57	9	3	2	71
	18:00-19:00	113	25	10	5	153
30.12.2011 Friday	8:00-9:00	118	17	6	7	148
	12:00-13.00	220	17	4	6	247
	14:00-15:00	54	6	4	7	71
	18:00-19:00	168	9	4	12	193
31.12.2011 Saturday	8:00-9:00	75	5	6	4	90
	12:00-13.00	38	8	4	5	55
	14:00-15:00	41	8	3	5	57
	18:00-19:00	80	8	4	8	100
01.01.2012 Sunday	8:00-9:00	55	4	5	5	69
	12:00-13.00	41	1	4	5	51
	14:00-15:00	36	4	6	4	50
	18:00-19:00	71	5	2	4	82

Number of vehicles **not making** cut-through traffic
(from **İnönü** Road to **Mithatpaşa** Road)

Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
26.12.2011 Monday	8:00-9:00	187	15	4	15	221
	12:00-13.00	165	14	5	12	196
	14:00-15:00	145	12	4	15	176
	18:00-19:00	192	12	5	15	224
27.12.2011 Tuesday	8:00-9:00	200	14	8	14	236
	12:00-13.00	115	18	10	12	155
	14:00-15:00	114	15	9	14	152
	18:00-19:00	198	18	12	17	245
28.12.2011 Wednesday	8:00-9:00	219	18	11	14	262
	12:00-13.00	118	14	7	15	154
	14:00-15:00	124	15	8	13	160
	18:00-19:00	230	15	5	16	266
29.12.2011 Thursday	8:00-9:00	225	24	10	15	274
	12:00-13.00	111	12	9	15	147
	13:00-14:00	121	15	5	9	150
	18:00-19:00	128	14	3	16	161
30.12.2011 Friday	8:00-9:00	229	25	14	14	282
	12:00-13.00	117	15	6	13	151
	14:00-15:00	105	11	8	12	135

	18:00-19:00	200	32	10	18	260
31.12.2011 Saturday	8:00-9:00	132	20	4	5	161
	12:00-13.00	114	17	15	9	155
	14:00-15:00	135	10	8	11	164
	18:00-19:00	220	24	3	14	261
01.01.2012 Sunday	8:00-9:00	98	12	5	14	129
	12:00-13.00	100	15	9	14	138
	14:00-15:00	125	14	9	11	159
	18:00-19:00	215	19	3	8	245

Number of vehicles **making** cut-through traffic
(from **İnönü** Road to **Mithatpaşa** Road)

Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
06.01.2012 Monday	8:00-9:00	105	12	3	8	128
	12:00-13.00	69	8	5	7	89
	14:00-15:00	71	13	6	5	95
	18:00-19:00	142	15	4	8	169
07.01.2012 Tuesday	8:00-9:00	87	8	7	7	109
	12:00-13.00	65	8	5	8	86
	14:00-15:00	63	8	1	3	75
	18:00-19:00	105	5	1	9	120
08.01.2012 Wednesday	8:00-9:00	67	5	1	6	78
	12:00-13.00	55	8	3	3	69
	14:00-15:00	64	11	3	5	83
	18:00-19:00	88	4	2	5	92
09.01.2012 Thursday	8:00-9:00	101	7	1	8	117
	12:00-13.00	60	5	2	6	73
	14:00-15:00	59	9	3	2	73
	18:00-19:00	102	8	3	7	120
10.01.2012 Friday	8:00-9:00	118	17	6	7	148
	12:00-13.00	168	9	6	6	189
	14:00-15:00	52	6	3	5	66
	18:00-19:00	155	8	5	10	178
11.01.2012 Saturday	8:00-9:00	81	6	6	7	90
	12:00-13.00	40	7	5	5	57
	14:00-15:00	45	8	4	3	60
	18:00-19:00	83	7	6	7	103

12.01.2012 Sunday	8:00-9:00	48	6	8	4	66
	12:00-13.00	45	2	4	5	56
	14:00-15:00	40	3	6	5	54
	18:00-19:00	68	6	3	4	81
Number of vehicles **not making** cut-through traffic (from **İnönü** Road to **Mithatpaşa** Road)						
Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
06.01.2012 Monday	8:00-9:00	185	14	5	13	217
	12:00-13.00	159	13	2	15	189
	14:00-15:00	147	13	4	11	177
	18:00-19:00	198	15	5	14	232
07.01.2012 Tuesday	8:00-9:00	152	14	8	11	185
	12:00-13.00	109	18	8	12	147
	14:00-15:00	114	15	5	11	145
	18:00-19:00	192	17	13	17	239
08.01.2012 Wednesday	8:00-9:00	148	18	5	10	181
	12:00-13.00	117	14	7	15	153
	14:00-15:00	122	15	8	14	159
	18:00-19:00	224	15	5	11	255
09.01.2012 Thursday	8:00-9:00	201	17	10	15	243
	12:00-13.00	114	13	9	12	148
	14:00-15:00	122	9	3	10	144
	18:00-19:00	129	14	5	16	164
10.01.2012 Friday	8:00-9:00	214	23	10	17	264
	12:00-13.00	121	15	6	14	156
	14:00-15:00	104	15	8	13	140
	18:00-19:00	199	18	10	13	240
11.01.2012 Saturday	8:00-9:00	135	15	4	5	159
	12:00-13.00	113	13	9	10	145
	14:00-15:00	131	10	8	12	161
	18:00-19:00	198	20	3	8	229
12.01.2012 Sunday	8:00-9:00	94	12	5	5	116
	12:00-13.00	65	9	5	7	86
	14:00-15:00	112	14	9	10	145
	18:00-19:00	165	11	3	5	184

Table B.2. The Number of Daily Vehicles Making and Not Making Cut-through Traffic (from Mithatpaşa Street to İnönü Street)

Number of vehicles **making** cut-through traffic (from **Mithatpaşa** Road to **İnönü** Road)						
Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
07.05.2011 Saturday	8:00-9:00	49	5	1	1	56
	12:00-13.00	32	4			36
	14:00-15:00	38	3			43
	18:00-19:00	72	5		1	78
09.05.2011 Monday	8:00-9:00	38	3	1	4	46
	12:00-13.00	35	4	1	2	42
	14:00-15:00	29	2			31
	18:00-19:00	65	1			66
10.05.2011 Tuesday	8:00-9:00	31	4			35
	12:00-13.00	32	3	1	2	38
	14:00-15:00	25	1			26
	18:00-19:00	67	5		2	74
13.05.2011 Friday	8:00-9:00	33	5	1	1	40
	12:00-13.00	25	4			29
	14:00-15:00	32	5	1	1	39
	18:00-19:00	65	4	1	2	72
15.05.2011 Sunday	8:00-9:00	50	4	1	1	56
	12:00-13.00	33	5		1	39
	14:00-15:00	27	3			30
	18:00-19:00	62	4	1	2	69
Number of vehicles **not making** cut-through traffic (from **Mithatpaşa** Road to **İnönü** Road)						
Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
07.05.2011 Saturday	8:00-9:00	59	6	2	3	70
	12:00-13.00	38	5	1	1	45
	14:00-15:00	48	4		4	56
	18:00-19:00	81	5	1	4	91
09.05.2011 Monday	8:00-9:00	45	8	3	6	72
	12:00-13.00	42	4	1	3	50
	14:00-15:00	32	3			35
	18:00-19:00	78	4	1	1	84

10.05.2011 Tuesday	8:00-9:00	40	4	1	2	47
	12:00-13.00	36	3		3	42
	14:00-15:00	32	1	1	2	35
	18:00-19:00	79	5	1	3	88
13.05.2011 Friday	8:00-9:00	58	6	1	1	66
	12:00-13.00	34	5		2	41
	14:00-15:00	37	2	1	1	41
	18:00-19:00	71	5		2	78
15.05.2011 Sunday	8:00-9:00	65	5	1	1	72
	12:00-13.00	37	5			42
	14:00-15:00	35	4			39
	18:00-19:00	70	5	1	1	77
Number of vehicles **making** cut-through traffic (from **Mithatpaşa** Road to **İnönü** Road)						
Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
26.12.2011 Monday	8:00-9:00	45	3		1	49
	12:00-13.00	38	2			40
	14:00-15:00	35	3			38
	18:00-19:00	68	5		1	74
27.12.2011 Tuesday	8:00-9:00	38	3	1	2	44
	12:00-13.00	35	5	1	1	42
	14:00-15:00	30	2			32
	18:00-19:00	67	1			68
28.12.2011 Wednesday	8:00-9:00	33	5			38
	12:00-13.00	30	3	1	1	35
	14:00-15:00	28	1			29
	18:00-19:00	70	3		2	75
29.12.2011 Thursday	8:00-9:00	35	4	2	1	42
	12:00-13.00	30	5		1	36
	14:00-15:00	31	6	1	1	39
	18:00-19:00	71	3	1	1	76
30.12.2011 Friday	8:00-9:00	58	5	1	3	67
	12:00-13.00	36	2	1	2	41
	14:00-15:00	30	4	1		35
	18:00-19:00	65	6	1	3	75
	8:00-9:00	50	4	1	1	56

31.12.2011 Saturday	12:00-13.00	35	5		1	41
	14:00-15:00	32	4			36
	18:00-19:00	70	4	1	1	76
01.01.2012 Sunday	8:00-9:00	45	3	2	1	51
	12:00-13.00	35	5			40
	14:00-15:00	36	4		1	41
	18:00-19:00	75	3		2	80
Number of vehicles **not making** cut-through traffic (from **Mithatpaşa** Road to **İnönü** Road)						
Date	Hour	Vehicle Type				Total
		Car	Taxi	Pickup Truck	Minibus	
26.12.2011 Monday	8:00-9:00	41	6	3	8	58
	12:00-13.00	37	4	1	3	45
	14:00-15:00	30	2		1	33
	18:00-19:00	86	5	1	2	94
27.12.2011 Tuesday	8:00-9:00	47	5		6	58
	12:00-13.00	37	4		1	42
	14:00-15:00	30	2	1	1	34
	18:00-19:00	75	5			80
28.12.2011 Wednesday	8:00-9:00	55	6	2		63
	12:00-13.00	36	6		3	45
	14:00-15:00	35	3	2	3	43
	18:00-19:00	66	5		1	72
29.12.2011 Thursday	8:00-9:00	52	4			56
	12:00-13.00	32	6	1	3	42
	14:00-15:00	33	4		2	36
	18:00-19:00	71	5		1	77
30.12.2011 Friday	8:00-9:00	58	4			62
	12:00-13.00	30	5		1	39
	14:00-15:00	38	4	2	4	48
	18:00-19:00	77	5	1	1	84
31.12.2011 Saturday	8:00-9:00	55	4		3	59
	12:00-13.00	30	2	1	2	35
	14:00-15:00	45	5	1	3	54
	18:00-19:00	70	4		1	75
01.01.2012	8:00-9:00	54	7	1	3	65
	12:00-13.00	40	4			44

Sunday	14:00-15:00	31	5	1	1	38
	18:00-19:00	63	3			66

APPENDIX C

QUESTIONAIRE

Adı: İşi: Yaşı: Mesleği:

1-Çocuğunuz var mı? Varsa yaşları?

2-Kaç yıldır burada yaşıyorsunuz?

3-Aracınız var mı?

4-Yaşadığınız sokak üzerinde yaya olarak güvenli bir şekilde hareket edebildiğinizi düşünüyor musunuz?

5-Park yeri bulmada ne tür sıkıntılar yaşıyorsunuz?

6-Park etme için yeni düzenlemeler getirilmesini ister misiniz?

7-Bu alanda herkes için bir park yeri sağlanabileceğine inanıyor musunuz?

8-Kaldırımları kullanıyor musunuz?

9-Kaldırımlar kaldırılması sokak üzerinde güvenlik problemlerine yol açar mı?

10-Yaya ve sürücü olarak bu sokaklarda gördüğünüz en önemli problemler nelerdir?

11-Bu Sokak tamamen taşıt trafiğine kapatılsa nasıl hissederdiniz?

12-Yaya ve taşıtların birbirlerini tehlike ye sokmadan güvenli bir şekilde hareket edebileceklerine inanıyor musunuz?

13-Trafik Durultma Yöntemleri olarak tanımlanan, taşıt ve yayanın güvenli bir şekilde hareket etmelerini sağlayan yöntemler konusunda hiç bilginiz var m

14- Sokaklarda yapılacak bu tarz düzenlemelerle bu sokak üzerindeki trafik sıkışıklığı probleminin çözülebileceğine inanıyor musunuz?