

3.1 Introduction

Based on situational crime prevention strategy, physical and environmental conditions can influence the chances of occurrence of a crime. It assumes that offending behaviour is opportunistic and therefore situational features can be more easily manipulated than the behaviour of offenders to inhibit crime. This chapter discusses the assumptions that link the urban physical and environmental features with occurrences of vandalism and graffiti.

Since the study aims to explore the teenage students' perception of safety in relation to non-political graffiti vandalism with reference to outdoor lighting levels in urban areas of Tehran, the first part of this chapter focuses on lighting in urban environment. This part looks at the relation between outdoor lighting qualities, urban development and also looks at effective lighting design, its principles and issues. It continues with a critical review of the available literature on the effectiveness and costs benefit of the lighting interventions to improve perception of safety, to reduce crimes and such other antisocial behaviour. Finally the chapter points to different theories that link the lighting level and vandalism occurrences.

The purpose of this study is to discuss the results from relevant available literature on this topic that might lead to a better understanding of the problem and helps to identify the knowledge gap.

To identify situational and urban environmental variables that correlated with high degree of graffiti damages in Tehran urban areas, it is necessary to study the physical features of the study area.

The major sets of the physical features that are emphasised in this study are:

- i. Block layout*
- ii. Housing design*
- iii. Street design*
- iv. Lighting design*

This chapter describes urban characteristics of Tehran and discusses how urban environmental variables such as lighting design, housing design, block layout and street design in Tehran urban areas can provide opportunities or limitations to occurrence of vandalism and graffiti. It explores how these physical features effects on implementation of SCP strategies to combat graffiti and vandalism in urban areas of Tehran. Individual characteristics of the city, demography and socioeconomic status of residents would be discussed.

3.2 Outdoor Lighting

Lighting is to provide comfortable, safe and effective vision at night. It can enhance visually structured urban space and provide both place promotion and sense of place after dark.

Cities are generally planned by day to provide a pleasing experience for citizens but when darkness falls, the urban environment often changes in character. Illumination of the cities is necessary for safety, security, city appearance as well as for the aesthetics. It aims to emphasise historical and artistic values of a city through outdoor lighting sources. In general, cities have identities because of their qualities. When the daylight disappears, the night-time lighting becomes important. As a result lighting takes the primary role to strengthen the quality of nightscape for cities.

Although, there are economic and environmental reasons why some organisations may wish to control and limit the amount of lighting, there are safety reasons as to why

lighting needs to be available. “Energy consumption and adverse effect of lighting on the environment in the form of greenhouse gases and the increase in light pollution are often cited as the reasons to switch off lighting” (The Institution of Lighting Engineers [ILE], 2006, P.2) but the assumption that improved lighting can make substantial contribution to reduce crime and fear of crime, lead authorities and policy makers to encourage investigating the actual effects of improved lighting on crime prevention.

3.2.1 Outdoor Lighting in Urban Environment

Lighting is an important aspect of the urban environment. Major, Speirs and Tischhauser (2005, P.1) noted that “The built environment is designed not only to provide light but also to be experienced in light”. Rateau (2002, P.75) pointed out that “it should not be denied that lighting plays an essential role in influencing the way in which we apprehend the environment”.

The primary propose of lighting in urban areas is to provide a safer, more inviting, attractive, appropriate and positive image for the people that live and work in the neighbourhood (NYSERDA 2002, American Association of State Highway and Transportation Officials [AASHTO],2003).

According to Lang (1994), lighting in public areas provide illumination for activities, it entertains and gives visual order to the cities. He added that lighting gives identity to places and brings attention to specific features. Lighting serves aesthetic purposes and can enhance sense of pride, if well executed. According to Lang (1994), “well lighted places contributes not only to peoples’ feeling secure but also to their sense of well being” (Lang (1994, P.295). Schreuder (2008) pointed to the advancement of human well being as the main function of lighting and Carmona et al. (2003, P.187) stated that “artificial lighting makes a positive contribution to the character and utility of urban spaces”.

According to Rateau (2002), artificial lighting shapes the cities and it can disguise the blemishes revealed during day time. Lighting can link different components of the city by giving them a recognisable and identifiable personality.

Generally street lighting are installed for practical reasons and sometimes simply for aesthetics. Tanner and Tiesdell (1997) explained that the aesthetic properties of good lighting make urban areas attractive places and add urban quality. Watson (1990 as cited in Lang,1994), explained that the way the urban areas are illuminated, the patterns, degree of illumination, types of light and light sources are contributing factors to aesthetic effects of a city.

According to Schreuder (1998) the benefits of public lighting is social and includes communication between people and the promotion of safety and makes an important contribution to increase social life by enhancing the night time environment.

Narisada and Schreduder (2004) points to the contribution of outdoor lighting to the efficiency of human activities at night and that the existence of outdoor lighting makes the continuous works possible. It helps to save time, energy and indirectly contributes to efficiency of human activities.

But with the benefits of lighting, comes a need to protect travellers or adjacent properties from the use of inappropriate lighting practices and systems (Schreuder 1998, Eley Associates 2002, Clark 2009).

According to International Dark-Sky Association (2002), careless use of outdoor lighting damages the night time environment and often decreases security and safety. It also points to excessive use of outdoor lighting that causes extensive damage to the aesthetics of the night.

Clark (2009) considers the widespread application of outdoor lighting and notes that although it transformed the civilisation and enhanced the quality of life but “it was accompanied by a large hidden cost of substantial ecological and environmental degradation as well as undesirable social and health consequences” (Clark, 2009, P11).

Energy savings by more efficient lighting has been a major priority of most groups concerned with environmental issues (Thompson & Sorvig, 2000). Energy for outdoor lighting is the biggest part in the energy usage of a city. Electric power usage, maintenance and operation of the lighting system are a considerable expense for cities (Baenziger & Progetti, 2002).

According to US Department of Energy for outdoor lighting design (2010), it is important to consider the primary purpose of lighting along with the basic methods for achieving energy efficiency.

Due to the need to build a sustainable world community, necessary steps should be taken to reduce the negative aspects of lighting on our environment that has increased in the last half century at an alarming rate (Fowles, 2008).

The new outdoor lighting system for the cities is trying to increase the sustainable energy outcomes, while considering “people and structures within the environment, the effects of glare and sparkle, suitability of light sources for colour appearance and colour rendering, the effect of the lighting on the environment, the effect of lighting on night time crime and the general aesthetics of the lighting equipment used” (Guide to the lighting of urban areas [CIE], 2000).

3.2.1.1 Outdoor Lighting Design Issues and constraints

According to Walton and Rowan (1978) and Iowa State wide Urban Design and Specifications [SUDAS] (2008) “Lighting design is concerned with the selection and location of equipment so as to provide improved visibility and increase safety while making the most efficient use of energy within minimum expenditure”.

Good lighting is a matter of having the right amount of light in the right place and it relates to the quality of the light as much or more than quantity of the light (Fowles, 2008, P.1). US Department of Energy (2002) asserted that more light is not necessarily better and explains that visual performance depends on light quality as well as quantity.

According to Veitch and Newsham (1998), IESNA Quality of the Visual Environment Committee (QVE) reported in 1994 that quality of lighting differs from quantity and explained that “lighting quality is a term used to describe all of the factors in a lighting installation not directly connected to quantity of illumination” (P.92)

Gerken et al. (2003) points to the quality of lighting as “refers to ability of the light available to provide the contrast difference in the visual scene in such a manner that people may recognise the cues required for the seeing tasks” (P.2).

Good Street light design, known as "effective efficient energy street lighting" needs designers and planners to understand design issues and constraints to determine the best approach considering safety, security, economic development and aesthetic for lighting installation (NYSERDA, 2002) and the characteristics of the people who use or experience the space also influence the need to achieve a good lighting quality (National Research Council Canada [NRCC] 2006, Veitch & Newsham 1998).

According to NYSERDA (2002), considering the situation, Street light designing can be done in two different ways: Retrofit/replace or new construction

Retrofit/replace: It means the locations of the poles will remain and lamps, ballasts, luminaires or poles and in some cases all will be changed according to new design (See Appendix C). Sometimes the lighting pole also needs to be replaced because of not distributing the light correctly. As the poles location will not change, to achieve desired performance, retrofitting should be carefully evaluated.

New construction: For new construction poles, bases and wiring will be removed and a new system will be installed. New construction will impact design with greater flexibility for location and number of poles.

Before developing recommendations for street lighting, designers should be aware of lighting goals and characteristics of the area, project funding, utility funding, energy and maintenance costs that can impact on street lighting design (Lighting Research Centre [LRC], 2007).

According to Alliance for Solid State Illumination System and Technologies [ASSIST] (2009), good lighting incorporates the need for visibility, aesthetic appeal, and economy and energy efficiency and also to provide a sense of safety and security attracts patrons and deter criminals while limiting light pollution. Effective outdoor lighting requires careful consideration of a variety of issues.

Lighting design issues and constraints consist of five components as follows:

i. Lighting Requirements

The lighting level of illumination, distribution, uniformity and colour required in a lighting design project (according to standards) will help designers to determine the best efficient lighting system technology available.

Existing conditions such as types of street, traffic density and prevailing speed, types of building, special conditions related to street characteristics and future municipal plan for the area are determinative factors in designing (Project for Public Spaces [PPS], n.d.).

Designers and planners should be in contact with lighting manufactures to be aware of the latest technology and the most energy efficient types of street lighting in order to propose the best design solutions for the cities (NYSERDA, 2002).

ii. Cost Savings

Cost limitations are known as the main objective for outdoor lighting. Narisada and Schreduder (2004, P.13) explained that “the effectiveness of the lighting is the degree to which function is full fit and efficiency is the degree to which benefits suppress the cost”. The initial cost of maintenance and repairing, cost of operating and energy cost are the factors that must be considered to prevent unnecessary cost and minimise energy use while providing lighting requirements.

All projects should be designed to avoid excessive number of poles, wiring and digging to minimise the costs (NYSERDA, 2002). The goal of good lighting design is to have an optimum fixture on an optimum pole (Gazzar, n.d., P.5) and existing lighting

system condition should also be considered for an effective efficient street light design (IEE, 2007).

In order to minimise the cost of lighting systems, it is suggested to use proper fixture spacing and placement in order to use less poles and luminaires. By using lamps with longer life and layouts with proper spacing and placement, the costs for painting, fixing, replacing damaged poles will be reduced (“RMI’s Guide to Energy” n.d., NYSERDA 2002).

According to CIE (1992), long term operating costs shouldn’t be allowed to become unacceptable just to meet an initial cost consideration.

iii. Aesthetic Requirement

Lighting should enrich people’s perceptions of the city after night. It can make the city more attractive and enhancing the character and quality of the city (“City of Port Philip”, 2004). Salt City Street Lighting Master Plan (2006, P.4) suggested “combining street lighting projects with other urban design elements to create a holistic and aesthetic environment”.

Shaflik (1997) pointed out to clutter¹ as adverse aesthetic effect of lighting by considerable wasted light and asserted that “light design should enhance the aesthetics of the area not to destroy it” (P.8). Lighting can become an important tool in transforming spaces and buildings across the city based upon cultural significance and aesthetic value.

The aesthetics of the poles and fixtures are visually important during day and night in urban environments (NYSERDA 2002, “Salt City” 2006). The functional lighting

¹Light clutter is excessive brightness caused by groups of poorly placed lights. It is of most concern to drivers and pilots caused by considerable wasted lights when lights are placed too close together, or are excessively bright together, the effect tends to be distracting (www.osr.org, IDSA, 2002)

equipment should be appropriate in appearance. Using fixtures by historic and stylised appearance and good optical control is suggested to provide quality performance and attractive day time appearance (“City of Port Philip”, 2004).

iv. Light Pollution

Light pollution occurs when the fixtures send the light up to the sky instead of projecting it down (Mizon, 2002). “Light pollution is light in the wrong quantity, in the wrong place and in the wrong time” (The Royal Commission on Environmental Pollution 2009, Bailey 2006).

According to Cooke (2005, P.3), light pollution is adverse effects of lighting and “an increasing environmental problem which has documented deleterious implications for the visual environment, human health, wildlife and flora.”

Scriber (2008) added that “This nocturnal brightness can disorient humans and a host of other animals, confounding eyes and biological rhythms that evolved in a world without such light” (www.darksky.org). Schwarz (2003, P.61), explained that “life on earth developed with a day and night cycle and the alteration or extension of the length of the day can diminish habitat function (shelter, protection, food), disrupt natural diurnal rhythm of organism, may cause death and is particularly harmful to nocturnal animals”.

Light pollution can reduce the visibility of stars and change the whole character of the night sky, rift between neighbours, increase stress and irritability due to lack of sleep and some believe that too much lighting may cause cancer (Bailey 2006, Scriber 2008, The Royal Commission on Environmental Pollution 2009, Narisada & Schreduder 2004). Narisada and Schreduder (2004) pointed out to the considerable environmental and economical losses that are caused by this unwanted light.

According to American Planning Association (2006), inefficient light sources, certain types of light fixtures and lighting to excessive level cause the energy wastes. The Royal Commission on Environmental Pollution (2009) emphasised that light pollution is the consequence of poor lighting design, poor installation and maintenance.

Light pollution is a nuisance and serious concern to citizens and can be controlled by limiting the number of fixtures, shielding, replacing the poles and in some conditions by not installing street lights in some locations (NYSERDA, 2002). None of the aspects of poor lighting design help with visibility.

The wasted light in the form of glare, clutter, light trespass, light pollution waste energy and energy costs money (Schwarz 2003, Narisada & Schreduder 2004). Light pollution is one of the growing concerns and should be controlled to achieve sustainable night environment.

The majority of observers concentrated on main causes of 'light pollution' are poorly designed or out-of-date street and road fittings and the undoubtedly growth of security, sports, advertising and architectural lighting schemes; also unskilled technicians or operators have no considerations for the common lighting context or the surrounding environment as a whole; then the installations cause the light pollution (CIE, 1992).

A great number of lamps, fixtures don't necessarily improve lighting performance but it can have negative impacts (NYSERDA, 2002). It is suggested not to over light, dim or switch off light when the task is finished because generally lower level of lighting is sufficient to enhance the night time sense than that is required for safety and security (ILE 2005, Mizon 2002). They also added to use specifically designed equipment to minimise the upward lighting near to or above horizontal.



Figure 3.1: Light Pollution in Hong Kong obscures the view of the stars and planets in the night sky. Source: www.starrynightlights.com. 2009)

It has been estimated that up to 50% of all light pollution may be the result of roadway lighting ([www. Darksky.org](http://www.Darksky.org), Shaflik 1997).

Light trespass, glare and sky glow are different forms of light pollution.

Light trespass: Narisada and Schreduder (2004), ILE (2005), American Planning Association (2006), LRC (2007) explained that light trespass occurs when unwanted trespass of light falling into adjacent properties that cause disturbance and discomfort to those who have nothing to do with the lighting.

Glare: “Glare occurs when one part of the visual field is much brighter than the average brightness to which the visual system is adapted” (Communities and Local Government, 2007, P.128). According to Royal Astronomical Society of Canada (2005), direct glow is the result of the light source shining into the viewers eyes and indirect glow is resulting from objects that are too brightly lit and the excessive bright light shining to a person’s field of view can either reduce visibility or causes annoyance. It also can be a serious health and safety risk. If glare can effect on pedestrians and drivers visibility, it can be a safety concern.

There are two types of Glare namely (McColgan, 2007),

- *Discomfort glare that is ‘the sensation of annoyance or even pain induced by overly bright sources’*
- *Disability glare that causes “a loss of visibility from a stray light being scattered within the eyes*

Narisada and Schreduder (2004) and Shaflik (1997) added blinding glare to the types of glare and explained that when considering light pollution, the emphasis is more on disability glare.

Excessive number of fixtures and bulbs per pole, big size lamps and inadequate shielding can lead to glare problem. Institution of lighting engineers, UK (ILE, 2005) suggest that, to keep glare to a minimum, the main beam angle of the lights directed towards any potential observer shouldn't be more than 70 degrees (Figure 3.5).

Higher mounting heights allow lower main beam angle that helps to reduce glare. With low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment (ILE, 2005).



Figure 3.2: Photo on the left shows light shining into the sky and creating glare
Source: International Dark Sky Association, www.darksky.org

Sky Glow: Sky Glow is another conspicuous form of light pollution. According to Narisada and Schreduder (2004), The Royal Astronomical Society of Canada (2005) and ASSIST (2009), sky glow is the result of light that is projected upward and then scattered back to the surface of the earth by water droplets and dust in the air that is detrimental to astrologers and annoying to public.

According to Shaflik (1997) “Street lighting has been blamed for up to 50% of the urban sky glow due to 95% of the light directed down toward the pavement being reflected upward at reflectance rates ranging from 6% for asphalt to 25% for concrete” and Narisada and Schreduder (2004) and ASSIST (2009) pointed out that sky glow does not exclusively depend on street lighting but also depends on the atmosphere conditions such as humidity, aerosols, haze and atmospheric pollution. For reducing sky glow, the Institution of Lighting Engineers (ILE) (2005) suggested intelligent design, use of louvers, cowls and shield and limits on the amount of luminaire-emitted light that goes directly into the sky (LRC, 2007).

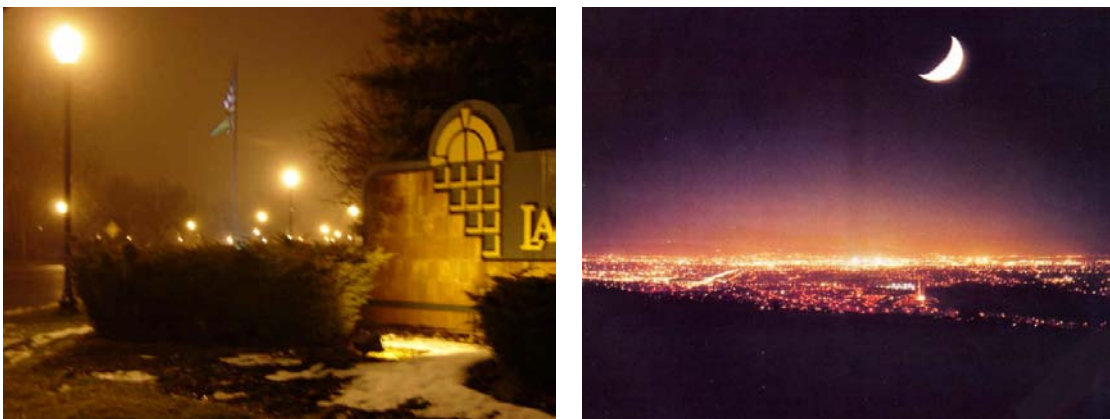


Figure 3.3: Sky glow
Source: www.nightwise.org & www.darksky.org

Light fitting will deliver light where it is needed, but will potentially also give four areas of unwanted, and wasted light in different ways (Mizon, n.d.):

Spill light - falls outside the area where it is needed

Upward light - this is wasted light shining above a light fitting

Upward reflected light - this is unavoidable and dependant on the reflectance of the surfaces below the light fitting

Direct glare - from seeing the bright filament of an unshielded light

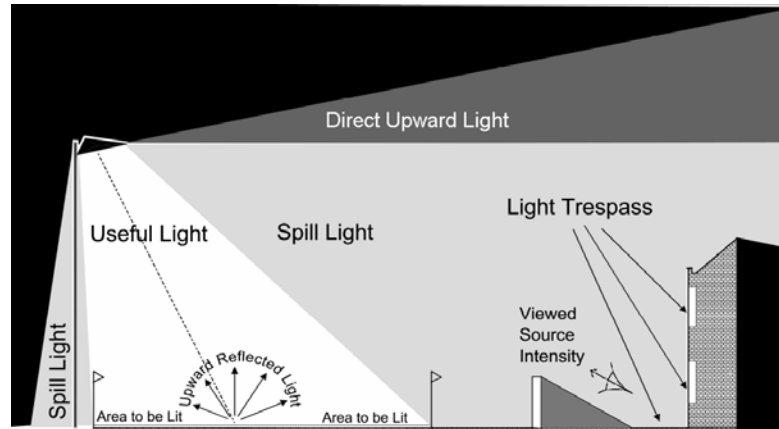


Figure 3.4: Light Pollution (Taken from Guidance Notes for the Reduction of Obtrusive Light Source: ILE (2005), UK. www.ile.org.uk)

To reduce spill light, specific designed lighting equipments should be used to minimise the upward spread of light near to and above the horizontal.

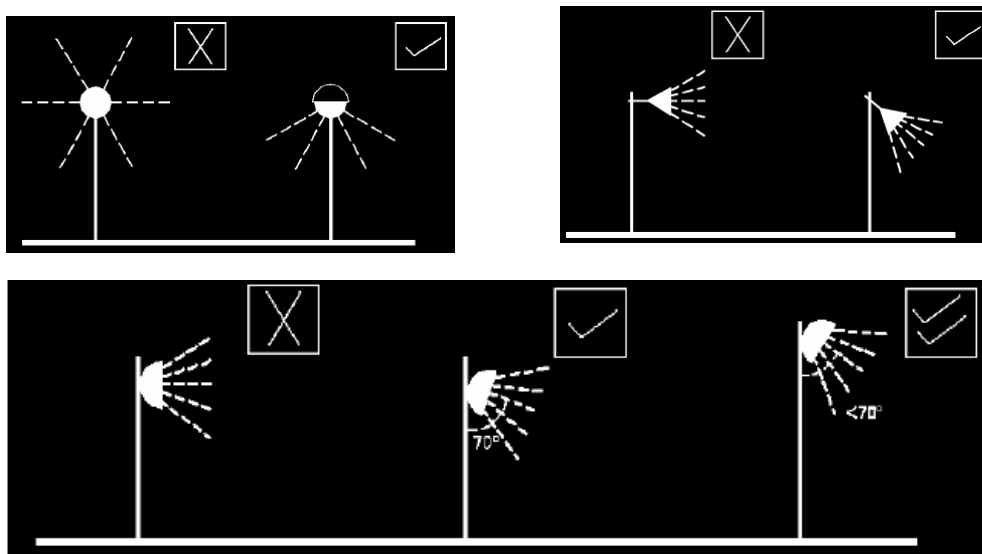


Figure 3.5: Light Pollution (Taken from Guidance Notes for the Reduction of Obtrusive Light Source: ILE (2005), UK. www.ile.org.uk)

v. Safety and Security

Lighting is known as an effective tool to improve the perceptions of safety in urban areas. People feel more comfortable and confident using areas where there is good visibility and when they feel they can be seen or heard by other people (Atlas 2008, NYSERDA 2002, “City of Port Philip” 2004).

One of the purposes of outdoor lighting is promotion of safety at night by providing quick, accurate and comfortable visibility for drivers and pedestrians (US Department of Transportation 2006, Gerken et al. 2003). Pedestrians are the most vulnerable, slowest and most unprotected type of traffic or movement. According to NYSERDA (2002), proper lay out and efficient equipments can make an area appear safer and more secure for people as well as vehicles. Lighting strategy should aim to improve the pedestrians’ experience of the urban areas (“City of Port Philip”, 2004).

There is also the perception that more lights can reduce crime (Clark 2002a, Miyazawa & Miyazawa 1995, Atkins, Husain & Storey, 1991), however NYSERDA (2002) pointed out that direct glare and high light level can reduce the perception of safety by making visibility more difficult and “City of Port Philip” (2004, P.4) added that “the emphasis of safety and security is about good lighting not necessarily more lighting”.

3.2.1.2 Outdoor Lighting Design Principles

Outdoor Lighting Design Principles are discussed under the following headings:

The elements of design standards, human needs, field conditions

i. Design Standards

According to “City of Port Philip” (2004), the lighting standards define the minimum performance parameters and technical requirements for lighting design. Lighting design needs to comply with the technical parameters of relevant standards.

Lighting design standards include technical knowledge in relation to urban designing regulations and also human needs, visual aesthetic, cost, energy standards and operating–maintenance controls.

Design standards may be examined in three steps namely, design concept, equipments characteristics and performance criteria in terms of the urban design quality.

Zissis and Mucklejohn (2007) pointed out that developing relevant standards can play a significant role in economising energy and contributing to sustainable development.

ii. Human Needs

People need outdoor lighting for safety, security and aesthetic purpose. Outdoor lighting should meet every ones’ need in terms of pleasure, safety and productivity.

According to Lang (1994, P.161), “the urban design concern is with the layout of environments that provide safe and secure setting in which people can pursue their lives. Cognitive needs are basic to life and the aesthetic quality of the built and natural environment is an important mechanism in attaining a variety of ends”. He added “good lighting reduces opportunities for miscreant to hide and enables people to scan their environment” (Lange, 1994. P. 254)

Lighting design can give aesthetic character to a place but the aesthetic effects of lighting in both daytime and night time is seldom given the attention it deserves.

Aesthetic consideration include the scale and physical appearance of the equipments such as pole style, colour, material finishing, shape, height and luminaires' type and size and order of the design are determining factors in outdoor light designing.

iii. Field Conditions

The character of urban spaces which have variety of activities should be taken into consideration in outdoor lighting design.

Commercial, residential areas, walkways, public areas, and recreation areas are different in term of light quality, specifications and standards, performance requirements, ease and quality of construction and cost.

3.3 The Effects of Improved Street Lighting on Crimes

There are two known approaches to prevent crimes. One approach contends that the central focus of any crime prevention should be on individuals and their behaviours and tries to change their propensity to commit anti social or criminal acts. The second approach focuses on changing the structure of societies, communities and situations to alter either the risks of criminal victimisation or environmental opportunities for offending” (Miyazawa & Miyazawa, 1995, P.3)

Following the second approach, Clark and Mayhew (1980), Heal and Laycock (1986) (as cited in Atkins, Husain & Storey 1991, P.1) say that “making changes to environmental conditions and operational practices can discourage crime”.

CPTED is a term used to describe a broad range of programs involves “examining the creation and use of space, land use and the position and architecture of buildings including such factors as lighting, access and landscaping...” (Levinson, 2002, P.625) as an aid to reduce crime that can lead to a reduction in fear of crime and an improvement in the quality of life (Crowe, 2000 as cited in Cozens, Thorn & Hillier, 2008).

Miyazawa and Miyazawa (1995) explained that changing the situations and altering the environmental opportunities are known as cornerstone of crime prevention but the approach has clear limitations because of “organised bureaucratic resistance to change and an absence of knowledge about how to organisationally implement risk reduction programs” (P.9).

There is something magical in the widespread belief that improved outdoor lighting at night is known as a means of preventing actual crime and reducing fear of crime (Clark 2002a, Miyazawa & Miyazawa 1995 and Atkins et al., 1991). Explaining the nature of crimes will answer the question why improved outdoor lighting has been suggested as a means of reducing crime. “Crime is a covert activity and to commit a crime, all offenders will assess the risk of being seen when making a decision about committing a crime” (Atkins et al. 1991, P.2). If lighting encourages people to notice suspicious activities, and act as a deterrent by increasing opportunities for surveillance, it may affect on crime rates and fear of crime.

Cohen and Felson (1979 as cited in Painter & Tilley, 1999) argued that lighting may affect on crime rate if it can contribute to increased street usage and presence of more of ‘capable guardianship’ as “one of the essential conditions for a crime to be committed that must converge in space and time” (P.1).

Painter and Farrington (1997) asserted that there is no specific theory to relate street lighting to crime. They reported that situational prevention approaches focus on ‘opportunity reduction’ and ‘increase perceived risk’ by modification of the physical environment, can explain the way street lighting improvements could prevent crime (Painter & Farrington, 1997). They emphasised the role of improved street lighting to strengthen informal social control and community cohesion through more effective street use (Jacobs 1961, Angel 1968, Newman 1972, Bennett & Wright 1984) and

investment in neighbourhood conditions (Taub et al. 1984, Fowler & Mangione 1986, Lavrakas & Kushmuk 1986, Taylor & Gottfredson 1986, Wilson & Kelling 1982) (Painter & Farrington, 1997).

Sampson et al. (1997 as cited in Byrne & Rebovich, 2003, P.82) states that “a low degree of ‘collective efficacy’ or informal social control in a neighbourhood causes high crime rates”. According to Farrington and Welsh (2002, P.3) street lighting is known as a highly visible sign of positive investment and can prevent crime only “if it physically improves the environment and signals to residents that efforts were being made to invest and improve their neighbourhood and it can lead to a positive image of the area, increasing community pride, optimism and cohesion”. Improved lighting may improve community confidence by providing a highly noticeable sign that local authorities are investing in the area and “stimulates a general ‘feel good’ factor” (Farrington & Welsh, 2002, P.4) that may affect to reduce fear of crime. According to Warr (1990 as cited in Miethe & Meier, 1994, P.67) “darkness is a major factor underlying of peoples’ evaluations of dangerous places”.

Farrington and Welsh (2002) explained that when the actual and perceived risks of victimisation lessen, the area will be used by more number of community members and it can lead to increase formal surveillance. There exists a strong evocative potential of lighting and to significant role of lighting to arouse sensation and even feelings in people (Rateau, 2002).

Lighting improved visibility and it can deter offenders by increasing the risks of being recognised or interrupted while committing a crime (Mayhew et al. 1979 as cited in Painter & Farrington, 1999). Farrington and Welsh (2002), added that better lighting will help to show the presence of police and other authority figures more visible to people.

According to Farrington and Welsh (2002), it is also feasible that improved lighting increases opportunities for crime and explained that better lighting may bring more number of potential victims and potential offenders to the same physical space and better visibility may help potential offenders to make a better judgments of their vulnerability and attractiveness and they can easily commit crimes and escape (Farrington & Welsh, 2006). They argue that increased street usage may increase number of unoccupied houses available for burglary. According to Pease (1999a, P.63) “increased illumination may facilitates illegal activities like drug dealing and other problematic forms of street life”.

Clark (2008) adopted some points from the review by Pease (1999a) and discussed on the effectiveness of improved lighting to reducing crime at day time as follows:

“if offenders commit crime in both light and dark time, night time arrest and subsequent imprisonment would reduce both day time and night time crime...improved lighting shows that the police are determined to control the city and as a result potential offenders might no longer see the neighbourhood as affording easy pickings and citizens might be motivated to pass on information about offenders... better lighting can increase community pride and cohesive leading to a greater willingness to intervene in crime and to report it”(Clark, 2008, P.18)

History: According to Farrington and Welsh (2002), Clark (2002b) and Cozens et al. (2005) the interest in the effects of improved street lighting to reduce crimes has been growing since dramatic rise in a number of cities. It started from mid twentieth century. "Berla 1995, Wheeler 1967, Wright et al. 1974, Tyrpak 1975 and Hartley 1974 reported that the initial results were encouraging and such improvements produced substantial reductions in recorded crime" (Cozens et al., 2005, P.334).

Cozens et al. (2005) said that the review of these positive results by Tien et al. (1979) as part of the national evaluation program of Low Enforcement Assistance Agency (LEAA) showed that of the 103 studies, only 15 were considered sufficiently

rigorous for evaluation and it showed that the results were inconclusive and other indicators of crime should be used in addition to recorded crime data. Farrington and Welsh (2002) explained that the evaluation concludes that:

"Each project was considered to be seriously flawed because of such problems as: weak project designs, misuse or complete absence of sound analytic techniques, inadequate measures of street lighting, poor measures of crime (all were based on police records and insufficient application of the impact of lighting on different types of crime)" (Farrington and Welsh, 2002, P.1).

They argued that this evaluation should have stimulated more studies using more adequate designs and alternative measures of crime such as victim surveys, self reported or systematic observation but it was interpreted as to show that lighting had no effects on crime rates and effectively killed the topic in United States.

Farrington and Welsh (2002) reported that very little research was carried out in UK until 1980 but there was a resurgence of interest between 1988 until 1990.

Cozens et al. (2005) states that lighting studies by Painter (1991) in Hammersmith and North West of England showed reductions in crime and disorder. Atkins et al. (1991) said that although Painter's work provided useful and consistent information about short term impacts of improved lighting in small particular areas but long term effects and the benefits of re-lighting programs in wide areas are still unknown.

A review by Ramsay and Newton (1991as cited in Clark, 2002b) did reject Painter's results because of important shortcomings in methodology and analysis. They suggest improved street lighting could only reduce the fear of crime. A Home Office funded study by Atkins et al. (1991) in Wandsworth found no effect on crime but interviews indicated that people in the relit areas did feel safer at night. Cozens et al. (2005) reported on the studies by Herbert and Moore (1991), Davidson and Goodey (1991), Burden and Murphy (1991) and Ditton et al. (1993) and Bainbridge and Painter (1993) produced inconclusive findings. Methodological inadequacies were highlighted

by Cozens et al. (2005) as a reason to raise serious doubts about the validity of many of these exploratory studies.

Moreover, Shaftoe and Osborn (1996 as cited in Clark (2002b) studied lighting improvements in Bristol and found that lighting changes reduced fear of crime and actual crime in high crime locations. Farrington and Welsh (2002) argued that although they managed to extract quantitative information indicating that the changes were effective in reducing night- time and day-time crimes but “the study was found difficult to interpret because street lighting was gradually improved in different places over 28 month” (P.32)

Poyner and Webb (1997 as cited in Clark, 1997) pointed out to the effectiveness of improved lighting to prevent thefts from shoppers at retail places in Birmingham and Coventry in England. In another project by Poyner and Webb in Dover in (1991 as cited in Farrington & Welsh, 2002), improved lighting in parking garages in town centres led to reduction thefts of vehicles but not from vehicles. However, in both projects, lighting improvement was not the only interventions to prevent crimes. Farrington and Welsh (2002) reported on two more experiments by Painter and Farrington in Dudley (1997) and Stoke-on- Trent (1999) and in both studies, crime decreased both in day-time and in night- time.

A survey by UK Home Office (Findings 249) bases on a sample of 82 offenders (Table 3.1) reported on the factors as a deterrent to crime. In this report, the presence of lighting as a deterrent has not been mentioned anywhere but it is possible that improved lighting helps to improved neighbourhood watch.

Table 3.1: Decision-making by house burglars: offenders' perspectives

| Types of deterrent | Percentage |
|--|------------|
| 1 Presence of alarms outside property | 84% |
| 2 Belief that house is occupied | 84% |
| 3 Presence of CCTV/camera nearby property | 82% |
| 4 Apparent strength of doors/window locks | 55% |
| 5 Poster campaigns | 18% |
| 6 Property marking campaigns | 25% |
| 7 Evidence of membership of Neighbourhood Watch or similar | 29% |

Source: (Hearnden & Magill, 2004)

3.3.1 The analytic review on the effects of street lighting on crimes

Pease (1999a, P.50) says that “The relationship between lighting and crime is perhaps unique in the number of reviews published per original study carried out”. The review by Tien et al. in (1979 as cited in Farrington & Welsh, 2002) on 105 US lighting projects in cities and towns, funded by Law Enforcement Assistance Agency (LEAA) concluded the encouraging results that improved lighting can prevent crime were mixed and generally inconclusive. According to Clark (2002a), the report by Tien et al. (1977) presented that there is no statistically significant evidence that lighting can prevent crimes but perhaps lighting uniformity decreased fear of crime.

Clark (2002a) pointed out to the review by Ramsay and Newton (1991) on four reports by Painter about three small-scale increased lighting projects in parts of London and found shortcomings in methodology and analysis. However, they reviewed the literature and concluded that “better street lighting had little if any demonstrated effect on actual crime. Nevertheless, fear of crime did diminish with brighter lighting” (Clark (2002a, P.11).

According to Pease (1999b), in a review by Poyner and Webb (1993) to generate a rating system for crime control measures, they found improved lighting effective as a crime control measures in most of the studies reviewed.

Clark (2002a) reported another review by Sherman, Gottfredson, Mackenzie, Eck, Reuter and Bushway (1997). Eck (1997) summarised the findings and explained that the limited research on lighting continues to use weak designs (typically without control areas) decreased uncertainty about the effects of lighting on crime and asserted to the problematic relationship between lighting and crime when one considers that offenders need lighting to detect potential targets and low-risk situations (Fleming and Burrows, 1986 as cited in Eck, 1997). Lighting is effective in some places, ineffective in others and counterproductive in still other circumstances (Clark, 2002b).

Eck revised his views in 2002 and pointed out to some studies from Britain that removed the lingering doubt about lighting efficiency particularly in public spaces and residential communities (Sherman, Farrington, Welsh & Mackenzie, 2002). A systematic review by Farrington and Welsh (2002) on available studies from UK and US found that improved street lighting led to a significant reduction in crime. This systematic review (which excluded several poorly designed lighting evaluations) found that improved street lighting reduced recorded crime overall by 7% in eight American studies and by 30% in five UK studies, and reductions in recorded crime were also demonstrated during the day. The results from all thirteen studies showed 20% deduction in recorded crimes (See Appendix B). According to Farrington and Welsh (2002), the criteria were:

*“Improvements in street lighting were the main intervention studies;
There was an outcome measure of crime;
Crime levels before and after the interventions were measured;
The studies included a comparable control area
The total number of crimes before interventions shouldn’t be less than 20
in each area” (Farrington and Welsh, 2002,P.9).*

Farrington and Welsh (2002) also reported that financial saving from reduced crimes greatly exceeded the financial cost of improved lighting in two studies from UK in Dudley 1997-2001 and Stoke on Trent 1999.

Marchant (2004) pointed out that although the Farrington and Welsh review appears to be appropriate at first sight but on close examination, the statistical claims and methods are unfounded. He explained that there is a conflict between the evidence and reviewers' interpretation in Bristol, Birmingham and Dudley projects. According to Marchant (2006, P.52), after he examined the work considered that "it was not as rigorous as it needed to be to make such a strong claim" and added that the strong claims made in the review are inconsistent with the data.

Farrington and Welsh (2008) revised the systematic review and adjusted the variances the conclusion was substantially unaffected and explained that UK studies included in the review showed that improved lighting can be effective in reducing crime in some circumstances but added that the optimal circumstances is not clear at present and needs to be established by future evaluation strategies. They asserted that improved street lighting as a feasible, inexpensive and effective method of reducing crime should be considered in any crime reduction program in coordination with other intervention strategies. (P.23).

However, Marchant (2006) said 'after reviewing the revised analysis by Farrington and Welsh (2006), he is still in doubt about the result and more exacting scientific and statistical standards are needed in the area of crime research.'

The review by Clark (2002a, P.) showed "although it is commonly believed that outdoor lighting helps to prevent crime at night but the evidence is equivocal". He reviewed Dudley and Stoke-on-Trent projects as problematic studies in detail. He drew attention to serious shortcomings and said "in both projects the results were larger than in most other studies and much publicity has been given to the results, leading to increased public expenditure on outdoor lighting in UK and elsewhere" (P.17).

Clark (2002a) also criticised the Meta analysis by Farrington and Welsh (2002) and concluded that the result derived for a typical relighting treatment is too large. Moreover, Clark (2003) argued that darkness inhibits crime and that crime is more encouraged than deterred by outdoor lighting although lighting is important for mobility safety or limiting the fear of crime. Clark (2003) pointed out to the growth of artificial sky brightness in the cities and crime in the twentieth century and said crime rates and apprehensive sky growth curves are positively correlated in Australia, Canada, New Zealand and USA. He draws attention to negative effects of lighting on health, safety, quality of life and ecology and said “lighting seems to be regarded as an indicator of progress but governments typically neglect to monitor its growth, let alone control its excesses and adverse effects” (P.130).

The recent reviews by Farrington and Welsh (2002, 2008), Clark (2002a, 2002b) and Marchant (2004, 2006, 2009) are more likely to indicate that the effects of improved lighting on crime is still in doubt. The Meta analysis review by Farrington and Welsh (2002) has been criticised by Clark (2002a, 2002b) and Marchant (2004, 2006) because of some shortcomings in methodology. However, the review could lead to design more explicit studies to test the main theories of the effects of improved street lighting (community pride versus surveillance/deterrence) and to investigate the effects of improved lighting on different types of crime according to characteristics of areas.

Moreover, Farrington and Welsh (2002) points to some other shortcomings in their systematic review. They explained that the systematic review was based on available relevant studies and they asserted that not all studies meet the criteria ideally and most of the studies suffered from lack of detail about how the reviewer conducted the research. They added that the effects of improved lighting on crime may vary according to characteristics of the area, residents and design of the area and it also depends on the

existing design of the lighting, initial crime rate and length of the study (before and after lighting intervention). They also pointed out to American studies that are now rather dated comparing to the results from British studies that are mostly conducted in the 1990s.

The effects of improved lighting are likely to be greater if the existing lighting level is poor (Farrington & Welsh, 2002). From all studies, only four of the eight American evaluations and three of five British Evaluations specified the degree of improvement in the lighting.

Table 3.2 Meta analysis of four American studies + three British studies specify the degree of lighting improvement

| evaluation | Milwaukee (1973/1974) | Atlanta (1974) | Fort Worth (1979) | Portland (1974) | Stoke (1999) | Bristol (1994) | Dudley (1997, 2001) |
|--------------------------------------|--------------------------|-------------------|-------------------------|--------------------|-----------------|----------------------------|---------------------------|
| Location | US | US | US | US | UK | UK | UK |
| Degree of Lighting improvement | 7 times | 4 times | 3 times | 2 times | 5 times | 2 times (approximately) | 2 times |
| Total Result (Meta Analysis) | Effective | Effective | Effective | Not effective | Effective | Effective | Effective |
| | 1.37 | 1.39 | 1.38 | 0.94 | 1.72 | 1.35 | 1.44 |

Note: The odds ratio indicates the change in crimes in the control area divided by the change in crimes in the experimental area; odds ratio greater than 1.0 indicate a desirable effect of improved lighting

Table 3.2 presents the results of a Meta analysis of four American studies and three British studies that specified the degree of lighting improvement in experimental area. The results from Meta analysis of the both American and British evaluations by Farrington and Welsh (2002) can strength the belief that lighting will have more significant effects on crime if the lighting improvement is remarkable.

Farrington and Welsh (2002) suggested to study the effects of improved lighting to prevent different types of crime and explained that there might be varied effects on different types of crime. In the systematic review, the attention was focused principally on a group of crimes considered likely to be affected by environmental influences, however, different data sources (police records, victim records or victim survey) and

lack of information on some types of crime such as vandalism and assault that people don't tend to report to police can bias the results.

In the Meta analysis by Farrington and Welsh, the crimes categorised into two groups namely, property crimes and violent crime.

Table 3.3 and Table 3.4 present the effects of improved lighting on two crime categories (violence and property crimes) from both British and American studies:

Table 3.3: Meta analysis of American street lighting evaluations

| Types of crime | Atlanta | Milwaukee | Portland | Kansas City | Harrisburg | New Orleans | Fort Worth | Indiana police |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Violence | 1.30 | 1.09 | 1.04 | 1.79 | 0.81 | 0.86 | ... | ... |
| Property | 1.47 | 1.03 | 0.83 | 0.88 | 1.14 | 1.07 | ... | ... |
| Total (crime) | 1.39 | 1.37 | 0.94 | 1.24 | 1.02 | 1.01 | 1.38 | 0.75 |
| Result | E | E | N/E | E | N/E | N/E | E | E |
| Data source | Police records | Police records | Police records | Police records | Police records | Police records | Police records | Police records |

Note: E: effective N/E: not effective

The odds ratio indicates the change in crimes in the control area divided by the change of crimes in the experimental area; odds ratios greater than 1.0 indicate a desirable effect of improved lighting

Table 3.4: Meta analysis of British street lighting evaluations

| Types of crime | Dover | Bristol | Birmingham | Dudley | Stoke – on - Tent |
|----------------|----------------|----------------|----------------|---|-------------------|
| Violence | ... | 0.48 | ... | 1.76 | 1.89 |
| Property | 1.14 | 1.57 | 3.82 | 1.33 | 1.59 |
| Total (crime) | 1.14 | 1.35 | 3.82 | 1.44 | 1.72 |
| Result | E | E | E | E | E |
| Data source | Police records | Police records | Police records | Police records/ victim report/self report | Victim survey |

Note: E: effective N/E: not effective

The odds ratio indicates the change in crimes in the control area divided by the change of crimes in the experimental area; odds ratios greater than 1.0 indicate a desirable effect of improved lighting

The results showed that the effects of improved lighting are likely to be different on two crime categories but it should not be denied that the results might be affected because of applying different data sources (from police and from victims), different methods to record crimes (day time crimes and night time crimes) or the effects of other interventions.

Table 3.5 & 3.6 present the effectiveness of improved lighting on specific types of crime where it is available. In the review by Farrington and Welsh (2002), the general city crime rate changes regardless of the effects of improved street lighting on crimes or the effects of other factors on crimes, investigating territorial displacement, diffusion of benefits have been considered by controlling the crimes before and after interventions in 3 different experimental, adjacent and control area.

Table 3.5 from American evaluations showed improved street lighting considered to be effective to prevent robbery, burglary and vehicle theft but it doesn't show any significant effect to prevent assault.

Table 3.5: The effects of improve lighting on different types of crime (American evaluations)

| Types of crime | | Atlanta | Milwaukee | Portland Kansas city | Kansas city | Harrisburg | New Orleans | Fort Worth | Indiana police | |
|---------------------|---|--------------|--|----------------------|-------------|--------------|--------------|--|--|----------|
| Robbery | E | -8.1 | No information available on types of crime | -31.5 | -52.2 | -8.7 | - | No information available on types of crime | No information available on types of crime | |
| | C | +23.6 | | -30.3 | -16.9 | +7.1 | - | | | |
| | A | - | | -36.6 | - | - | - | | | |
| Result | | Eff | | N/Eff | Eff | Eff | Eff | | | - |
| Assault | E | +418.2 | | -11.3 | -40.5 | +9.4 | -18.8 | | | |
| | C | +319.6 | | -5.6 | +3.8 | -24.2 | -30.1 | | | |
| | A | - | | -22.1 | - | - | - | | | |
| Result | | N/Eff | | N/Eff | Eff | N/Eff | N/Eff | | | |
| Burglary | E | -9.8 | | +11.9 | - | +32.9 | -25.8 | | | |
| | C | +32.8 | | -7.3 | - | +46.0 | -28.8 | | | |
| | A | - | | +11.6 | - | - | - | | | |
| Result | | Eff | | N/Eff | - | Eff | Eff | | | |
| Larceny | E | - | - | -39.2 | - | - | | | | |
| | C | - | - | -28.9 | - | - | | | | |
| | A | - | - | - | - | - | | | | |
| Result | | - | - | Eff | - | - | | | | |
| Motor vehicle theft | E | - | - | +3.0 | +2.4 | -29.0 | | | | |
| | C | - | - | -34.1 | +20.0 | -22.6 | | | | |
| | A | - | - | - | - | - | | | | |
| Result | | - | - | N/Eff | Eff | Eff | | | | |

Note: E: Experimental area C: control area A: adjacent area
 Eff: effective N/Eff: not effective

Table 3.6 presents the results from British studies but the crimes considered to be affected by improved street lighting are very different in types and they are from different data sources (police record and victim survey). However, British evaluations showed the positive effects of improved lighting on vehicle crimes, violence and

burglary in some circumstances but more studies need to be designed to investigate the effects of improved lighting according to characteristics of areas on different kinds of crimes.

Table 3.6: The effects of improve lighting on different types of crime (British evaluations)

| Types of crime | | Dover | Bristol | Birmingham | Dudley | Stoke – on - Trent |
|-----------------------------------|---|--------------|--------------|-----------------|-------------|--------------------|
| Burglary | E | - | - | - | -37.7 | -15.1 |
| | C | - | - | - | -13.4 | +0.6 |
| | A | - | - | - | - | -20.3 |
| Result | | | | | Eff | Eff |
| Theft of vehicle | E | -81.6 | - | - | - | - |
| | C | -47.1 | - | - | - | - |
| | A | - | - | - | - | - |
| Result | | Eff | - | - | - | - |
| Theft from vehicle | E | -21.4 | -29.6 | - | - | - |
| | C | -50.0 | +10.8 | - | - | - |
| | A | - | - | - | - | - |
| Result | | N/Eff | Eff | - | - | - |
| Vehicle crime | E | | | | -49.1 | -46.4 |
| | C | | | | -15.7 | -34.7 |
| | A | | | | - | -47.7 |
| Result | | | | Eff | Eff | |
| Dishonestly | E | - | - | - | -7.1 | - |
| | C | - | - | - | +60.0 | - |
| | A | - | - | - | - | - |
| Result | | - | - | Eff | - | |
| Robbery | E | - | +50.8 | - | - | - |
| | C | - | -27.8 | - | - | - |
| | A | - | - | - | - | - |
| Result | | - | N/Eff | - | - | |
| Theft | E | - | - | -78.7 | - | - |
| | C | - | - | -18.5 | - | - |
| | A | - | - | - | - | - |
| Result | | - | - | Eff | - | |
| Vandalism | E | | | | -18.2 | - |
| | C | | | | +10.9 | - |
| | A | | | | - | - |
| Result | | | | Eff | - | |
| Violence / violence self reported | E | | | | -40.8/-39.6 | -68.0 |
| | C | | | | +4.9/-25.6 | -39.2 |
| | A | | | | - | -66.3 |
| Result | | | | Eff/ Eff | Eff | |

Note: E: Experimental area C: control area A: adjacent area
 Eff: effective N/Eff: not effective

It should be noted that comparing and analysing two different experiments under the same condition is a really a difficult task and needs more attention to people's perception of safety and crime. The Meta analysis by Farrington and Welsh (2002) draw

attention to necessity of more studies on the effects of improved lighting on specific types of crime considering the characteristics of the area since the reaction of criminals and residents to any environmental changes may be vary between communities.

3.3.2 The effects of improved lighting on Fear of Crime

According to Ferraro (1995), fear of crime is defined as “an emotional response of dread or anxiety to crime or symbols that a person associates with crime” (P.4) and explain that to produce a fear reaction in humans, a recognition of a situation as possessing at least potential danger, real or imagined is necessary. O’ Gorman (2009) asserted that the definition “incorporates not only an individual’s concerns about crime and the consequences of criminal activity but also their perceptions of risk and the role of environment in eliciting fear.” (P.iv)

According to Tanner and Tiesdell (1997) crime and fear of crime are two separate issues that was realised and became important from early 1980s. Hough and Mayhew (1983 as cited in Tanner & Tiesdell ,1997) pointed out that “ while crime rates were rising , peoples’ fear of crime were rising at a much faster rate” (P.122). Fear of crime is known as one of the social problems (Garland, 2001) that can affect peoples’ quality of life. Lewis and Salem (1988) say that fear of crime generates behaviours that is destructive to community. Schneider and Kitchen (2002) pointed out to crime and fear of crime as key factors directing the choices that citizens make and discussed that these choices affect quality of life.

Brogden and Nijhar (2000) say that people with fear of crime will lose access to chances in betterment of life and they are denied enjoyment of desirable life styles. Kifer (2004) explained that fear of crime may lead people to change their normal routines, avoid from certain areas and people. They may withdraw from the streets and explained that consequently people may ignore to maintain social control that helps to

prevent crimes and disorder. Moore and Trojanowicz (1988) said that fear of crime produces social consequences and causes people feel uncomfortable and fear motivates people to invest time and money in defensive measures to reduce their vulnerability.

Ferraro (1995, P.3) asserted that fear of crime may increase “social integration, migration, restriction of activities, added security costs and avoidance behaviour”. Lee (2007) explained that fear of crime has been identified as being responsible for an even increasing number of social maladies.

Feeling safe is a deterrent to victimisation and most criminals are cowards and prefer to attack weaker persons and particularly those who are afraid (Narisada & Scheruder, 2004). Fear of crime sometimes affects people more than the actual crime itself. Lee (2007) reported that many researchers and policy makers believe that fear of crime is as serious a problem as crime itself and some believe that fear of crime is a more severe problem than crime (Warr 2000, Clements & Kleiman 1976 as cited in Ferraro, 1995).

According to research by University College London (2007), people with strong fear of crime are almost twice as likely to show symptoms of depression. Fear of crime is associated with decreased physical functioning and lower quality of life. Research by the Centre for Regional Economic and Social Research, Sheffield Hallam University (2005), revealed that there is a strong positive relationship between increasing fear of crime and self reported poor health.

It is also believed that fear is natural and can prevent many people from becoming victims of crime. O’ Gorman (2009) pointed out to both positive and negative effects of fear of crime among residents and explained that fear of crime can cause people to engage “ in a range of protective strategies, insurance, communication, participation, information seeking and avoidance behaviours which can impact both positively and

negatively on quality of life” (P.30). Moore and Trojanowicz (1988) explained that although “fear of crime can prompt cautions among residents and reduce criminal opportunities and it also can motivate citizens to shoulder some of the burdens of crime control by buying locks and dogs”, but unreasonable fear becomes a social problem.

There are two models² to explain the causes and consequences of fear of crime and to design programs for fear reduction introduced by Miyazawa and Miyazawa (1995); first model tries to find the causes of fear through actual incidents of crime and second model is based on the relation between fear of crime and social and physical incivilities.

Based on the above two models researches showed that fear of crime is not always linked to real presence of crime in an area. According to John Howard society of Alberta (1999) age, gender, past experiences with crime geography and ethnicity and culture determine the level of fear. There are also other variables such as low income level and low education level to increase fear of crime. O’ Gorman (2009) added that geographical location and socio- economic status also linked to fear of crime. According to Ferraro (1995) and O’ Connell (1999, 2002 as cited in O’ Gorman, 2009), media can play a significant role in shaping perceived risk and fear of crime. Schweitzer, Kim and Mackin R. (1999) pointed out to the physical characteristics of the built environment that might be related to fear of crime and crime effecting the social interactions.

Miyazawa and Miyazawa (1995) introduced the factors known to generate fear of crime. They explained that personal experiences of victimization, indirect victimization (knowing about the victimization of others, media coverage of crime , vulnerability to

² "First is 'victimization/opportunity reduction' model that examines the relation between fear of crime and actual incidents of victimization; this model denies the direct linkage between perception and realities and assumes that the realities of victimization have a basic impact on fear of crime. They explained that this impact amplified through informal community networks and subsequently raise fear of crime among residents. This model emphasized on opportunity reduction programs to lower risk of victimization since the actual incidents of crime are basic generator of fear among residents. Second, 'disorder/social' control model assumes that residents' perception of disorder can generate fear of crime. Social incivilities (such as noisy teenagers, drunks and addicts on the streets) and physical incivilities (graffiti, litter, vacant houses with broken windows) interpreted by residents as signs of community disorganization that leads to higher level of fear... " (Miyazawa & Miyazawa,1995,P.155)

crime (women and aged are more vulnerable to crime), community environments (social and physical deterioration of community produces the residents concern for the community and this concern increases fear of crime) and public attitude to criminal justice systems (if people in a community have confidence in the ability of the criminal justice systems to cope with crime, they will be less fearful of crime).

Wesley Skogan (as cited in Moore & Trojanowicz, 1988, P.3) divided the contributing causes of fear into five broad categories:

- i. *" Actual criminal victimisation*
- ii. *Second hand information about criminal victimisation distributed through social networks*
- iii. *Physical deterioration and social disorder*
- iv. *Characteristics of the built environment*
- v. *Group conflict"*

He explained that "the strongest effects on fear arising from physical deterioration, social disorder and group conflict" and added that "it is hard to detect the effects of the built environment on fear once one has subtracted the effects of other variables" (P.3), however, Rohe and Burby (1988) reported on the importance of the image of the housing in a study of fear of crime in public housing and some studies in UK revealed that the lowest income and deprived regions have the highest level of fear in neighbourhoods (Rohe & Burby, 1988) and Smith and Hill (1991) points that the fear of crime is within characteristics of the neighbourhoods itself not individuals groups. Some research also suggested that people think that other neighbourhoods are more dangerous and crime is usually committed by outsiders. Brantingham et al. (1977) and Merry (1981a) stressed the fear of strangers and unknown in urban neighbourhoods and points to the impact and importance of increased population density on social ties that

lead to isolation and antisocial behaviour. Although these conditions are not necessary crime but rather incivilities that relate to issues in an environment (Grohe, 2006).

Moore and Trojanowicz (1988) point to the findings by Charles Murray (1983) and reported that there is little evidence of separate effect of the built environment on fear and explain that the only exception is evidences indicating that improved lighting can significantly reduce fear of crime.

Lighting is known to have a key role to prevent crime and reduce fear of crime (The Institution of Lighting Engineering, 2005) by making the streets and open areas more visible (Narisada & Scheruder 2004, Fennelly 2004).

Clark (2002b) explains that people tend to fear more in dark or dimly lit places and said that it is universally reported that fear of crime is greater at night than it is by day regardless of what the risks of actual crime are. Coumarelos (2001) points to the effects of situational and contextual factors on fear of crime and reported that people are more likely to feel unsafe at night than during the day. According to Tanner and Tiesdell (1997) people are more fearful after dark and reducing the impact of darkness help people to become less afraid to venture out. He explained that when the lighting levels are diminished, people naturally become more fearful.

Although different factors are known to have impact on fear of crime but lack of light and good visibility may justify why people having a higher level of fear at night.

According to Atlas (2008), although darkness or lack of light is sometimes CPTED strategy but lighting helps people feel safer.

Lighting must signal to potential offenders that they are more likely to be seen and identified the victim, observer or the police (Fisher & Nasar, 1992). Based on an experiment in a college campus to find the relation between site features and fear of

crime found that fear of crime was the highest in places which offered places for criminals to hide and had a restricted view. Lighting may reduce fear by diminishing the number of places where criminals can hide and by increasing the distance over which people can see (Boyce, 2003).

Ferraro (1995, P.25) explained that “fear involves an emotional and sometimes psychological reaction to perceived danger, there exist an inherent difficulty in measuring fear from questionnaire or interview data collection methods Even the best survey measures of fear of crime are not pure reflections of emotional experiences; rather they are expressions of imagined fear”.

Hale (1996) identified four issues central to fear of crime studies:

"First, criminological research focuses on ordinary or street crime, rather than corporate or white-collar crime. Second, researchers have been conceptualized fear as something that is merely present or absent in people. According to Fattah and Sacco (1989), this limits a detailed discussion of the ephemeral, transitional, and situational nature of fear. Third, over reliance on quantitative methods causes fear to be treated as a static and simple process. Fourth, most recent research considers fear of crime to be a social problem, which can damage social and psychological stability."

The possible effect of improved street lighting on fear of crime has been examined in line with the studies on the effect of improved street lighting on crime. The results are mostly based on the interviews before and after interventions.

Research by Hack (1974), Vrij and Winkel (1991), Tien et al. (1976), Fleming and Burrows (1986), Atkins et al. (1991), Ramsay and Newton (1991), Ken Pease (1991), Painter (1994) (as cited in Farrington & Welsh, 2002) report on reducing fear of crime after improvements in street lighting.

3.4 Lighting and vandalism Prevention: Theories

Relevant theories on the effects of lighting to prevent vandalism: The effect of improved lighting to prevent vandalism is based on several studies aimed to save energy and control vandalism conducted in some school campuses.

According to Purvis (2008), there are two basic thoughts regarding lighting a school campus: 'Lighting vs. no lighting' during the evening, after dark and early morning hours. He explained that each strategy has its particular advantages and disadvantages. Purvis (2008) states that people have tendency to avoid and fear areas where is absolute darkness and it might prevent people to enter the unknown. He asserted that total darkness tends to reduce vandalism and graffiti because the offenders cannot see what they are doing or creating. Moreover, the risk of being noticed by others is high if the invader turns on the school lights or uses even a hand held light.

Clark (2003) reported that California Extension Service (n.d.), King (1995) and Wilson (1995) also said that darkness could reduce vandalism because vandals like or need to see the damages they cause.

Frumkin (2006) points to the importance of security lighting to prevent vandalism though he reports that the Marion County, Florida public schools implemented dark campus approach (2000) and it could help the "district to save 46,000\$ per year on energy expenses and reduce the cost of vandalism by more than 50%" (P.26); some other evidences are presented in Table 3.7 by International Dark-Sky Association (IDA) reports on successful 'dark campus' approach.

Table 3.7: The effects of lighting on vandalism prevention

| Location | Source | Year | Energy saving | Vandalism costs |
|--|--------|---------|---|--|
| San Antonio (Texas) | IDA | 1973 | Annual energy savings amounted to hundreds of dollars per school | The annual cost of repairing damage caused by vandalism dropped from \$160,000 to \$41,000 in just a few years |
| 4-J School District in Eugene, Oregon (8 schools) | IDA | 1989 | At one school annual energy savings totalled \$300 | vandalism has virtually disappeared in certain problem schools The district also researched their insurance requirement and found that turning off all the lights, including exit signs, was okay when nobody was in a facility |
| California/ Livermore Joint Unified School District | IDA | 1981-82 | energy savings of about ten percent | a slight decrease in vandalism |
| California /Cupertino Union School District | IDA | 1981-82 | energy savings totalled to \$8,190 during the 1981-82 school year | vandalism dropped 29 percent, |

Source : International Dark Sky Association (IDA) (www.darksky.org)

Clark (2003) asserted that darkness also can inhibit property crime and reports on crime rate after unexpected darkness in some cities³, however, Purvis (2008, P.277) said “if security problem appertains to breaking in or burglary, then lighting is necessary”.

According to Purvis (2008), lighting will also keep potential vandals away from properties because they can be seen easily in the brightness of the light and it can provide legitimate users a sense of security or well being. He also asserted that lighting may attract potential vandals to properties because lighting will help them to observe their targets and they can use additional lighting without being noticed by others. He added that “lighting that is not designed properly or doesn’t illuminate an entire area or create shadows, can generate a situation where intruders can use shadows to hide and observe law enforcement better when they attempt to respond to the situation” (P.278)

³ “Auckland in 1998 for sixteen days, darkness in the towns of Bernardston and Northfield in north-western Massachusetts in early 1990 and some other towns in Massachusetts because of budgetary reasons, imposed darkness in Britain during world war 2 because of security reasons, darkness after midnight in Sussex (claimed by Pearce, 1995), unexpected darkness in 8 states in north eastern parts of USA and Ontario province of Canada in 1965 and new York blackout for 13 hours in 1965 and in 1977”(Clark, 2003).

Weisel (2004) pointed out to the effects of installing, upgrading and maintaining lighting to detect vandals but asserted that additional lighting may attract graffiti in isolated and remote locations.

Anon (1971), Carr and Spring (1993), Daniels (1982), Fey (1986), Irwin (1978), Sharp (1964), Ward (1973) (as cited in Goldstein, 1996) suggested to improve interior and exterior lighting to prevent vandalism and NLB reports on successful improved lighting programs to tackle vandalism (Table 3.8).

Table 3.8: The effects of lighting on vandalism prevention

| <i>Location</i> | <i>Source</i> | <i>Year</i> | <i>Energy saving</i> | <i>Vandalism costs</i> |
|--|---------------|-------------|--|--|
| Bryant College in Smithfield, Rhode Island | NLB | - | 45% less per year to operate and maintenance of the new improved lighting system | The problems almost disappeared. Saving about 1000\$ per year in accident cleanup cost, 3000\$ annually in vandalism avoidance and 10,000\$ annually in fender bender repair cost have |

Source: National Lighting Bureau (NLB) (www.nlb.org)

3.4.1 Knowledge gaps

Although both ‘dark campus’ theory and improved lighting to tackle vandalism shows positive effects but the results are not conclusive, because of:

- Lack of scientific evaluations on the effects of improved outdoor lighting or darkness on vandalism
- Lack of information on the existing lighting level and the lighting level after intervention
- Combination of improved lighting with other crime control measures such as target hardening or formal surveillance

Both theories should be studied in urban environment considering the effects of either low or high level of lighting on people's perception of safety as well as prevention of other types of crime that might be different with school campus experiments. Moreover, the possibility of darkening the urban areas or excessive use of light in the cities to prevent vandalism and graffiti (considering the economical, environmental and social effects of lighting on societies) and the effects of lighting interventions on different age groups and communities with different social and cultural values should come into consideration.

3.5 Tehran: Environmental characteristics

This part points to some aspects of the physical and environmental characteristics of Tehran urban areas. It is to investigate if there is any correlation between urban environmental variables and occurrence of vandalism and graffiti. The focus of this part will be on four environmental variables that can provide opportunities or limitations on vandalism and graffiti occurrences and discuss how these physical features effects on implementation of environmental strategies to combat graffiti and vandalism in urban areas of Tehran as well as the residents' life style and quality of life.

3.5.1 Tehran: General Perspective

Tehran's urban area between Alborz Mountains in the north and Dashte-e Kavir in south is located on a vast mountain slope. Tehran's urban area spans 250 kilometres from east to west and 50 kilometres from north to south. The city is limited by the mountains and consequently, the city has grown towards west and south (Schuppe, 2007). According to Tehran Geographical Information centre [TGIC] (2004), "the city spans over a land area of 18,814 km² of Tehran province". Tehran had a population of 12 million in 2004 and this is the highest concentration of population in Iran and Middle East but it is not disproportionate with respect to the total population of Iran (15.6%)

(Masserat et al., 2005). The population of Tehran is more than the sum of three other major cities of Iran namely Isfahan, Mashad and Tanbriz. This imbalance between Tehran and other large cities of Iran is the result of high political, administrative and economic centralisation. This had made Tehran more developed than other regions in Iran (Masserat et al., 2005).

The city of Tehran ranks among the prominent cities of the world that has a comparatively short, but very fascinating history of turning from a small village into a metropolitan area populated by millions of people. The city of Tehran is divided to 22 districts and 112 sub districts (Nahiyeh). Tehran is a metropolis because it functions as a political and economic capital. It is not however, an international city with political and cultural activities benefiting a country like Iran. As with other metropolises, Tehran is facing more diverse and complex issues than smaller cities. There are problems from concentration and mobility of the population that have transformed the social relations as well as the infrastructure and spatial features of the Tehran metropolis (Masserat et al., 2005). These issues root in improper and fast development of the city without concerted and unified planning⁴ taken over the previous years. Moreover, the newly approved urban planning bylaws that are executed without much consideration are known to cause problems in designing the city.

⁴ "Tehran's comprehensive plan with an agenda to expand a metropolis was propounded in early 1960s. This plan was provided by A. Farmanfarmaiyan and V. Gruen in 1966 and entered the implication phase in 1968. According to this plan, Tehran metropolis would have had the capacity to house 5,500,000 residents within an area of 180km² by 1991. This plan was in favour of motor cars and the priority was to create a highway network for a sprawled city with a low population density. Primary objective of the plan was to relieve problems in the city, which had no zoning regulations to control land use or density. This plan would have decentralised the city by creating 10 new regional centres, each serving 500,000 people. Separated by landscaped open spaces, each community centre would have had its own commercial, employment and industrial complexes. The plan that was adopted later created 22 different city sections. Although this plan was only partially implemented and the city extended southward rather than westward, it is still continues to be a reference for planning and management even today. In the years following the Islamic revolution and then during imposed war of Iraq on Iran, opportunity to review the comprehensive plan was lost. In 1991 in order to find solutions for the new problems of a metropolis, the Iranian company of ATEC reviewed the plan. This review concluded the city only within its boarders and ignored the new suburbs around it but Tehran's municipality did not approve it. In this plan, there were no considerations for disaster management. The ministry of Housing and Urban Development provided technical assistance to the municipality to prepare a set of recommendations and directives that was to serve as the 25-year plan of Tehran. For the first time in 2001, the plan of Tehran metropolis concerning the city and urbanised lands around it was drafted. This plan brought about the idea of creating major and expensive infrastructure to be funded by the government of the province of Tehran" (Masserat et al. 2005, "Tehran, Iran" 2005).

Moreover, the first nucleus of Tehran metropolis is based on old and Iranian - Islamic urban planning patterns, which cannot meet current urban planning requirements. A wide range of land area of metropolis Tehran in south, east, west and central regions include old city structures⁵ (Figure 3.6).

Urban areas with old structures and high congestion and density of population, houses that are in dire need of renovation or rehabilitation, lack of pavement in most streets, unsuitable system of urban sewage and garbage collection and failure in observing requirements of international urban planning standards give the impression of an environment with poor aesthetics and improper maintenance that no one cares about that. According to Fisher, Bell and Baum (1984), in such conditions, vandalism becomes more common. These areas suffer from poor informal control and the buildings are mostly neglected by residents. Although the municipality has made its utmost efforts for encouraging residents of these old-structure regions to renovate and reconstructed the old buildings⁶, however, renovation and reconstruction trend is so slow. Generally, renovation and reconstruction of old structures in central and south parts of Tehran is not satisfactory besides the fact that these old buildings are replacing with low quality buildings in terms of construction materials and construction process.

⁵ There are still buildings made of sun-dried bricks (1.2% of all buildings of Tehran) in old historical centre of the city and the majority of dwelling units in central and south-eastern parts of the city are made of semi- durable materials, i.e. bricks without steel skeleton that constitutes 45% of all the dwelling units in Tehran. This proportion is as high as 80% in some of the south-western quarters. In north and north-western quarters, the majority of buildings have been built with reinforced concrete or metal skeleton since 1981 (Masserat et al. 2005).

⁶ Tehran municipality provided low interest loans to owners for re construction of the old buildings (Tehran municipally website: en.tehran.ir)



Figure 3.6: Old structures in the city with high density of population

3.5.1.1 Tehran: Block Layout

Northern – Southern Side Separation of Lots in City: According to Tehran municipally bylaws, the location of the building on the land should be on northern part of the land and specified portion of the lot (40%) should remain open as yard. If yard is located in front of the building, it is defined as northern lot and if yard is located at the back of the building, it is defined as southern lot (Figure 3.7).

A major disadvantage of southern design is nearness of the buildings to adjacent streets. Consequently, the building facade and windows can easily be targeted by vandals. However, southern lots benefit of higher level of informal surveillance⁷ (Figure 3.8).

⁷ Because of the existence of the windows overlooking the streets

In most of northern lots, the front yard is surrounded by high walls (approximately 3 meter high)⁸. Due to distance of the building with the entrance gate, owner cannot usually monitor the boundary walls. Consequently, the walls face to the street can easily be targeted by vandals and graffiti writers. However, because of the existence of the walls surrounding the building, the building itself is protected from vandals (Figure 3.9).

The high walls surrounding the buildings and inappropriate design and use of materials vulnerable to vandalism can provide opportunities for vandals and graffiti writers (Figure 3.10). Using specific design on boundary walls such as fresco, green walls ... can restrict vandals' activities (Goldstein,1996) (Figure 3.11).

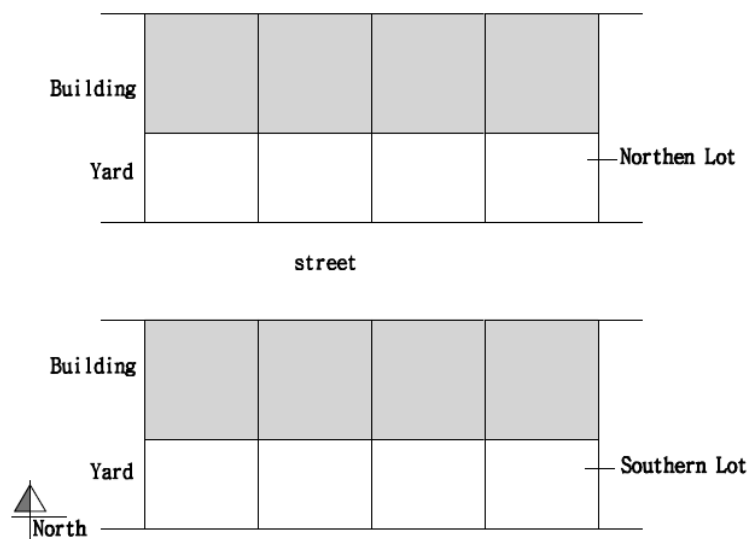


Figure 3.7: Southern and Northern lots in Tehran

⁸ It is to ensure the owners privacy



Figure 3.8: Views of southern lots in Tehran



Figure 3.9: Views of Northern lots in Tehran

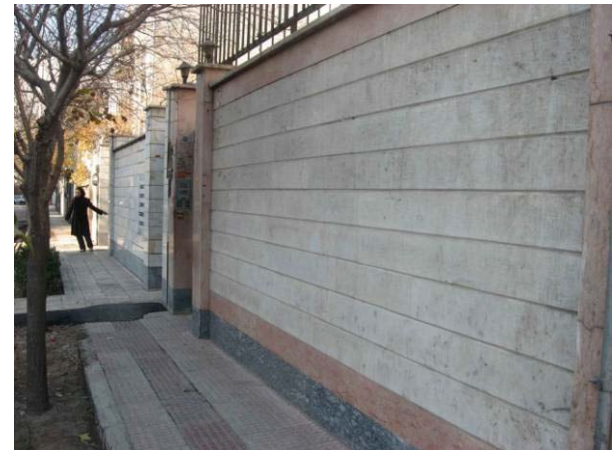


Figure 310: Inappropriate façade design (use of materials vulnerable to vandalism) can give vandals more opportunity to vandalise



Figure 3.11: Appropriate Design of the boundary walls helps to prevent vandalism and graffiti

3.5.1.2 Tehran: Street Design

Streets as one of the most important elements of public realm are fundamental to the form and function of the urban environment. The design of the streets influence on how people live, how they relate to each other and how they experience the environment (Gold Coast City Council, 2009)

One of the urban characteristics of Tehran that is based on old and Iranian - Islamic urban planning patterns is existence of narrow streets and thoroughfares (less than 6 meters) especially in old parts of the city which are not consistent with the needs and desires of its residents.

Difficulties in offering municipal services such as electrical, telecommunications, gas systems and garbage collection systems to residents are known as consequences of inappropriate design of the street ahead of urban planning of metropolis Tehran (Figure 3.12 & 3.13). Moreover, in most of the streets in Tehran, lack of sidewalks has affected the pedestrians' environment and pedestrians are forced to share the streets with motorists. Because of the actual danger to pedestrians, they will not be comfortable to use the streets (Untermann, 1991).



Figure 3.12: Inappropriate Designing of Streets and Thoroughfares



Figure 3.13: Inappropriate Designing of Streets and Thoroughfares

Even though the municipality started widening these narrow streets, however, the buildings are not constructed at the same time. It can create hidden spaces that can give vandals the opportunities to vandalised properties without being seen by others (Figure 3.14&3.15) since the facades of the new and old buildings are not aligned together.

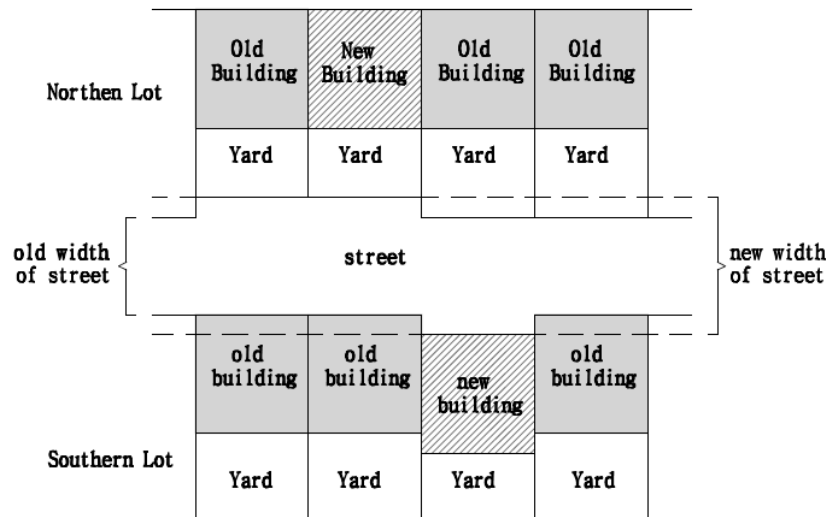


Figure 3.14: Facades vulnerable to vandalism



Figure 3.15: The hidden spaces made during the reconstruction of old buildings can give vandals the opportunity to vandalise without being seen

One of the aspects of the street design in Tehran is the design of the intersection in bevelled form. This design aims to provide a good and early view at intersections to avoid any cars crashes⁹. Based on the author's observation, this part of the properties that can be perceived easily by pedestrians and drivers are vulnerable to vandalism (mostly to commercial graffiti). However in some locations the bevelled form is covered with green plants (Figure 3.16).

⁹ "The view on other traffic approaching the intersection is largely determined by the angle at which crossing streets meet" (European Commission Road Safety. [www. http://ec.europa.e](http://ec.europa.e))



Figure 3.16: Facades vulnerable to vandalism

The large number of vehicles parked on the streets is another issues face in Tehran urban areas especially in congested part of the city. It causes major problems to the people and drivers that can be costly to life and properties. In most parts of urban areas of Tehran, there are not enough indoor parking spaces for residents because of either inappropriate division of the lots or narrow streets. Moreover, lack of enough public parking lots in the city increase the number of the cars parked illegally on the streets and pavements. The excessive number of vehicles parked on the streets can limit traffic flow, emergency services¹⁰ and pedestrians' movement. Apart from that, the vehicles parked on the streets are more susceptible to vandalism (Scott & La Vigne, 2007)



Figure 3.17: Inappropriate and inadequate parking lots in the city

¹⁰“Emergency vehicles did not have ingress or egress due to the number of vehicles parked on the streets”

3.5.1.3 Tehran: Building Design

Unfortunately, Tehran municipally has no control over the public face of the buildings in urban areas of Tehran. Existence of the buildings designed without any relation to their physical context is one of the urban characterises of the city. Poor scale and proportions, boring repetition of elements, stylistic clichés and poor quality materials are founded too often in buildings in different part of the city¹¹. Although Tehran municipally has started strong commitment to control the design and construction of the buildings in recent years, however, the control over the maintenance of the buildings is still a challenge in Tehran urban areas (Figure 3.18).



Figure 3.18: Buildings designed without any consideration to their context

¹¹ “Since the design of an individual project cannot be judged without some reference to its context, the success of individual works will always be linked to the way in which they deal with their setting. This setting effects the building form and layout, facade composition and articulation, how the buildings relate to each other and how they provide privacy and security, sun access and ventilation, what colours and materials are used and how car parking is resolved” (Maher, 2000)

Various Types of Buildings

It is a review on the building types in Tehran, as the building types can cause limitations or opportunities for vandals and graffiti writers to commit crime.

Irrespective of the land use of buildings, the buildings in Tehran can be classified and categorised in some various groups:

a. High-Rise Buildings

The high rise buildings are scattered mainly in north, east and west part of the city which are developing day by day. Shortage of the land and its high cost, concentration of facilities coupled with pleasant climate are considered as the most important reasons behind development and expansion of high-rise buildings in these regions (Figure 3.19).



Figure 3.19: A view of the city – North of Tehran

Most of high rise buildings are the single buildings surrounded by high walls. In such buildings, the interior public spaces (such as hallways, elevators, stairwells, and lobbies) are protected and defended against the presence of outsiders and intruders¹² (Figure 3.20). If there are some high-rise buildings on one site, the open spaces

¹² Since the number of families in such buildings are limited and there exists the possibility of monitoring of all interior public spaces and the entryway.

surrounding the buildings and the corridors to apartments are shared by large number of people. In such building complex, because of High density of population, the intruders are less likely to be recognised as outsiders (Newman, 1996) and a lot of spaces in and around the high-rise complex are not overlooked by residents.



Figure 3.20: High-Rise Monuments in Tehran

b. Single Buildings

The single buildings in Tehran can be seen in the form of detached and row houses:

I. Detached

Detached buildings are mostly seen in northern parts and outskirts of the city especially in northern, eastern and western areas. The detached buildings are free standing buildings usually surrounded with high walls which are so vulnerable to vandalism (Figure 3.21). However, the building itself is protected from vandalism.



Figure 3.21 Detached buildings in Tehran

II. *Row Houses*

Most buildings in metropolis Tehran have been constructed as row houses. The row houses are multi-storey houses located in one area and are at least (if not identical) consistent in architecture, design and appearance to all adjoining buildings (Figure3.22).

In Tehran, the construction of building five stories is allowed but there is no controls on the skyline created by the buildings' facades overlook the streets.

The row houses are divided to northern lot and southern lot. The susceptibility of both designs to vandalism has been discussed earlier in this chapter.



Figure 3.22: Row buildings in Tehran

In multi stories row houses, the stairs and landing are shared by families. The interior public spaces in such buildings are usually neat and well maintained and these areas are usually defined by families as their own and outsiders are not allowed to interior public spaces of the building. However, the building facade (southern lot) of the building or the boundary walls (northern lot) can easily be targeted by vandals.

3.5.1.4 Tehran: Outdoor Lighting

Tehran outdoor lighting system suffers from irresponsible lighting policy resulted by rapid growth of the city. Apart from the huge budget needed to redesigning the outdoor lighting system, to improve lighting system, the city urban areas need major improvement. Resident's participation is also need to help improving the nighttime's atmosphere in Tehran urban areas.

Tehran's night time street environment can be characterised as a visible demonstration of bad outdoor lighting. The majority of Tehran's streetlights are old style poles and fixtures with poor optical control. Although some of the old style poles have been replaced with new cobra head fixtures, however, bad placement of the lighting poles in relation to other roadway elements and inappropriate height of the poles are the common cause of light pollution in Tehran urban areas (Figure 3.23).

One of the problems is the placement of the poles in low width of streets and pavements that causes light trespass to the properties. The problem is worsened in very narrow alleys, although in some alleys the light source is installed on the walls. Inappropriate placement of the old poles is major problems that also affect pedestrians and vehicular traffic (Figure 3.24).



Figure 3.23: Old style poles are seen extensively in old structure of the city



Figure 3.24: Inappropriate placement of lighting poles in narrow streets

Moreover, inappropriate pole height cause either to diffuse the light into the trees or shine almost all of the lights onto the tree canopy tops keep the ground under the trees in deep and dangerous shadow (Figure 3.25).

Glare conditions are a significant part of the Tehran's current lighting problems. Yellow – orange glare, light trespass into buildings and up lighting to the sky is the chief characteristics of the Tehran's degraded night time environment. There is no control from municipality on the types of light fixtures and colour that people use to light the entrances of their houses as well as building facades in residential and business areas of the city¹³.



Figure 3.25: Inappropriate pole height can cause safety problems

Underground utility wires¹⁴ are a key prerequisite to achieving adequate street lighting (Weaver, 1997). Although, underground utility wires implemented in most of newly built urban areas but majority areas in old structure of the city have over headed street wires with street light fixtures attached (Figure 3.26).

¹³ It is based on Informal, conversational interview with 2 experts in Tehran municipally department and electricity department. They were asked if there is any regulations to select the lighting fixtures to lit the buildings' entrance in urban areas of Tehran (Kazemi A. , Safari S., Personal Communication, October 16,17, 2008)

¹⁴ “ The primary advantages of underground utility wires are improve aesthetics and overall improve reliability. Underground utility wires require little tree trimming and much less susceptible to motor vehicle accidents” Marison., Miller , Christie (2005). “Concerns about the reliability of overhead lines, increases in their maintenance and operating costs, and issues of public safety and quality-of-life are leading more and more utilities and municipalities to the realization that converting overhead distribution lines to underground is the best way to provide high-quality service to their customers” (The power to change the face of America, 2009)

Even though undergrounding utility wires has been required for new developments of the city and over-head wiring utility wires can affect the efficiency of the lighting system and aesthetics of the city but there is no effort to expand underground utility system due to the budget needed to underground the overhead wires in old parts of the city.



Figure 3.26: Overhead street wires affect efficiency and aesthetics of the city

3.6 Tehran: Individual Characteristics

Tehran has faced sudden changes of industrialisation due to political, economic and ecological considerations. The tremendous increase in Tehran's population has been due to migration. The proportion of migrants to total population clearly reflects a new demographic and cultural change. Most migrants are men but the sex ratio is just 109 men to 100 women and they are mostly 20 to 40, meaning that Tehran is a favourite destination for the young (Masserat et al. 2005). This portion of population desires to settle in the capital to begin a new and better life. Because of these considerations, different ethnicities and groups from different cultural backgrounds have been attracted

to the city and subcultures are highly influential in socialisation, acculturation, solidarity, and integration of the individuals in the society (Navabakhsh, 2005).

People in Tehran are grappling with rising stress and crime because of population explosion. The high growth of population and poverty in last three decades is known to cause major problems in Iran (Sheykhi, 2007). Traffic, air and sound pollution and the high cost of living are some of the major problems of living in Tehran. As a result, young people have to find alternative ways of employment to make a living and they have less leisure for other activities and resting. Living in Tehran is stressful for its residents and e people suffer from severe depression. They are less patient compared with the people living in other cities of Iran (Hashemi, 2008). The city is divided into four parts: North, South, West and East. "People living in the southern part of the city have lower levels of education. They are younger and poorer. They have higher population densities and have more vulnerable structures in comparison to the social groups living in the central and northern portions of the city. The central districts have the richest cultural heritage. A number of cultural buildings are located in this part of the city and daytime population can be significantly high due to the concentration of public buildings. Higher income groups, higher literary rates and newer structures, characterise the northern districts"("Tehran, Iran Disaster ", 2005).

3.6.1 Tehran: Demography

Inhabitants of the metropolitan area were mostly born elsewhere or are children of those who were not born in the capital. Thus, their identity is unique, new and constantly changing. The real identity of Tehran's citizens and their social- cultural characteristics, especially in new neighbourhoods are neither well understood nor considered. In 2004, Tehran' urban area had a population of 12 million. This is the highest concentration of population in Iran. This proportion has remained almost

constant for the past 40 years. Tehran's urban region, after a period of rapid growth between 1950 and 1970 similar to other metropolises of the world, is witnessing slow growth now (Masserat et al. 2005).

Table 3.9: Annual Rate of Population Growth (%)

| | 1916 | 1926 | 1936 | 1946 | 1956 | 1966 | 1976 | 1986 | 1996 |
|-----------------------|------|------|------|------|------|------|------|------|------|
| Tehran | 3.6 | 3.6 | 4.1 | 2.9 | 4.5 | 5.7 | 5.2 | 2.9 | 1.1 |
| Suburb | 2.6 | 2.3 | 2.9 | 2.3 | 4.8 | 8.1 | 13.1 | 11.9 | 8.7 |
| Metropolis | 3.5 | 3.6 | 4.1 | 2.9 | 4.6 | 5.8 | 5.6 | 3.7 | 2.5 |
| Iran total population | 0.7 | 0.7 | 1.6 | 3.5 | 4.3 | 5.3 | 4.1 | 5.4 | 3.2 |

Source: Masserat et al. (2005)

In Tehran province, the average population density is 5.3 persons per hectare (pph) while in the city of Tehran it is 92 pph and in province without Tehran it is only 1.9 pph. Tehran is a capital with a low average density because it has vast areas, which are inbuilt. Southern quarter of the city has the highest density (average density of 300pph) and northern part of the city has the lowest population density (40 to 90pph). The city centre that previously had a higher population density is now facing a decrease in residential population.

Population: Age Structure

Tehran region as in entire country has a young population. 33.8% of its population is below 15 years of age, but this ratio is lower than the national average (39.4% in 1996) as in the urban areas of the country. In 1996, the average of the population was 21.1 and 27.6 years in Iran and Tehran respectively. The city of Tehran has a relatively older population than other parts of the region (the average of age in Tehran is 27 years old and 30.7% of its population are below 15 years old) (Masserat et al. 2005).

Table 3.10: Population of age group (S)

| Age of population | Tehran | province | Iran |
|-------------------------|--------|----------|------|
| Average of age (year) | 27.6 | 25.0 | 21.1 |
| Youth, 0-14 years (%) | 30.7 | 33.8 | 39.4 |
| Elders, 15-64 years (%) | 64.5 | 62.1 | 56.2 |
| 65 years and more (%) | 4.7 | 4.1 | 4.4 |

Source: Masserat et al. (2005)

Table 3.11 Tehran Population Age structure (2006)

| Age | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85 and above |
|-----------------|-----|--------|---------|---------|---------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------------|
| No. | | 929959 | 1036246 | 1402077 | 1734736 | 1520903 | 1164412 | 1067710 | 912777 | 763828 | 594755 | 411838 | 309411 | 237341 | 196866 | 118695 | 75190 | 35682 |
| Total: 13422366 | | | | | | | | | | | | | | | | | | |

Source: Iran statistical centre (2006)

Gender Ratio

The population of men in the province of Tehran is clearly more than that of women (5.33 million vs. 5.02 million). The reason for such a difference is explained mainly by occupational migration of men to the capital. Many young men in search of jobs have resided in the Tehran (Masserat et al. 2005). The main characteristics of the province's demographic types include:

- Very high ratio of children and the youth
- Very high ratio of adults to children and the youth

3.7 Summary

This chapter was a review on urban physical and environmental characteristics of Tehran and discussed how environmental variables such as lighting design, housing design, block layout and street design in Tehran urban areas can provide opportunities or limitations to occurrences of vandalism and graffiti and how these physical features effects on implementation of environmental strategies to combat graffiti and vandalism in urban areas of Tehran.

The focus of this chapter was on lighting as one of the most important aspects of the built environment that has clearly impact on perception of space by the occupants. Improved outdoor lighting is widely seen and implemented by public as a useful way of preventing crime and lessening its' fear but first, the economical and environmental reasons and the urgent need to control and limit outdoor lighting level in urban areas and second, the assumption that lighting can prevent crime and reduce fear of crime has lead to more investigation on the actual effects of outdoor lighting on crime and fear of crime. The literatures presented in this chapter, disseminate the results from the studies examined the effects of improved street lighting on crime and fear of crime in UK and US.

Several studies and reviews have showed the effectiveness of implementing outdoor lighting interventions to prevent crime. They have explained the theory that lighting can prevent crime and have provided evidence on the cost benefits of the approach. Other studies draw attention to the negative or ineffective impact of improved lighting on crime rate and one study discussed on the effective role of darkness as a crime deterrent. To some extent, the assessment of the recent reviews (by Farrington & Welsh 2002,2008, Clark 2002a, 2002b and Marchant 2004, 2006) are more likely to indicate that the effects of improved lighting on crime is still in doubt.

The review highlights the importance and the need for more studies on the effects of improved lighting on specific types of crime considering the characteristics of the area since the reaction of criminals and residents to any environmental changes may vary between communities. The study on lighting and crime continues with a discussion on vandalism and lighting. A review on available literature highlights the original contribution of this research.

The second part of the chapter, discussed urban design issues faced in Tehran resulting from fast development of the city, concentration and mobility of the population that contributes to incidence of vandalism. The critical review of the problems and limitations in public domain of the City resulted from environmental conditions of the city with respect to high proportion of youth, chaotic urbanisation, and socio-economic condition, highlighted that Tehran has vulnerable urban areas to vandalism and graffiti that pose a threat to stability and development of the country.

Understanding Tehran's social, cultural and urban characteristics is a necessity for this research; through that, a comprehensive study can be performed to relate the research results with Tehran's specific conditions.

Next chapter describes and justifies the data gathering methods used for this dissertation, including the survey instrument, reliability of the surveys.