CAR PARKING PROBLEM IN URBAN AREAS, CAUSES AND SOLUTIONS

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Abstract

Car parking is a major problem in urban areas in both developed and developing countries. Following the rapid incense of car ownership, many cities are suffering from lacking of car parking areas with imbalance between parking supply and demand which can be considered the initial reason for metropolis parking problems. This imbalance is partially due to ineffective land use planning and miscalculations of space requirements during first stages of planning. Shortage of parking space, high parking tariffs, and traffic congestion due to visitors in search for a parking place are only a few examples of everyday parking problems.

The paper examines car parking problem in the city; its different causes and conventional -yet non -successful- approaches. Modern technology has produced a variety of new solutions and techniques in this respect. The paper reviews new planning trends and creative technological solutions which can help alleviate the strain of the problem. Because car parking solutions are not an end in itself, but rather a means of achieving larger community goals in order to improve urban transportation and make cities more livable and efficient, the paper also discusses the environmental impacts which should be taken into considerations for solutions proposed.

Key words: Car parking – Urban planning - Urban Design

1- Research Problem

People prefer to own cars because cars offer an unmatched combination of speed, autonomy, and privacy. But the fact is that there is no private vehicle is perpetually in motion; most private vehicles spend most of their time at rest, either during working hours or over the night. This means that there should be two places for every car in the city to be parked in. The two places should be at the both ends of every trip.

Parking problems in cities and urban areas are becoming increasingly important and have been one of the most discussed topics by both the general public and professionals. The imbalance between parking supply and parking demand has been considered as the main reason for metropolis parking problems. Moreover, the parking system plays a key role in the metropolitan traffic system, and lacking of it shows closed relation with traffic congestion, traffic accident, and environmental pollution. Although efficient parking system can improve urban transportation and city environment besides raising the quality of life for citizens, parking problem is an often-overlooked aspect of urban planning and transportation. Urban planners should seek more efficient and innovative solutions for parking problem on the level of management, planning, and designs.

2- Research Objectives

The paper examines the problem of car parking in cities and urban areas in order to set general principles and guidelines for parking solutions. To achieve the quality of citizens' life the concluded solutions should consider the aspects of planning, management, technology, environment, and aesthetics. The research objectives are:

- Identifying the causes of parking problem and its negative impacts.
- Examining the different conventional - yet non -successful- approaches provided for tackling the problem on both planning and management levels.
- Studying the innovative solutions which use modern technological means, or which consider environmental and aesthetics aspects in both planning design.
- Learning how parking problem should be solved efficiently and comprehensively according to general principles and guidelines.

3- Research Methodology

The content analysis methodology is adopted in this research which based on extensive literature concerned with car parking problem in cities and urban areas. In order to achieve the objective of the paper, collected data has been analyzed and categorized according to types of parking solutions on the level of planning, management, and design. The latter includes solutions that consider mechanical and technological innovations and also the environmental aspects. The conclusion and recommendations of the research have been indicated.

4- Causes of Parking Problems

Parking problem in cities and urban areas means actually that there is a gap between parking demand (number of cars in need for parking spaces) and parking supply (number of parking spaces sufficient to cars in need to park). This gap is due to several reasons:

- Most of old and historical cities, especially the capitals, have been planned with narrow streets where there were no cars but carts moved by horses. Also, population densities of these cities at that time were not so high comparing with the current densities of the same cities and of the same areas. As city streets cannot be changed or altered over time, except for some important reasons and in limited cases, these narrow streets become responsible for accommodating all kinds of vehicles in high densities for moving and parking, a load which exceeds their planned capacities.
- The concentration of activities and facilities which require high rate of cars in the same area such as concentrating commercial facilities with office buildings and governmental institutions in city' CBD, or district centers. (Downtown Cairo is an example of this).
- In new cities and new planned urban areas, there is always a miscalculation of parking demand expected in these areas due to the unexpected elevated rate of car ownership especially among the population of high and middle-income classes. This is due to the failure of mass transit system offered in these new areas to make the people of these classes depend on it in their working or leisure trips.
- Also, in the plans of new cities and new urban areas, the tendency in providing parking spaces depends always on curb-parking and parking areas on street level. There are no lands allocated for parking structures with several floors to absorb the increasing number of cars searching for parking at least in areas with concentrated facilities. For example, in the city of New Cairo and along the Ninetieth Avenue, there is no single land allocated for

a parking structure despite the numerous office buildings and commercial centers stretched along several kilometers.

- In old and existing cities, and as a consequence of invasion and succession phenomenon, changing uses from uses with low rate of cars such as residential to uses with high rate of cars such as commercial or business also contribute to the problem. (Zamalek and Mohandessin in Cairo are examples of it).
- The violation of building codes and zoning regulations - which stipulates, for each area, specific uses of buildings and specific numbers of floors with providing garages in basements. This violation contributes to change all calculations set by planners for providing sufficient parking spaces for cars in these areas.

5- Negative Impacts of Parking Problem

Parking problem distorts urban design. Increasing the supply of off-street parking areas near or beside every building, pushes buildings apart from each other and increases the distances between buildings making driving more necessary and walking more difficult. Also, the aesthetically-continuous pleasing street facades become almost impossible due to the several gaps in these facades between buildings created by parking areas [5]. Curb parking which occurs in rows in front of buildings distorts and alters the way of pedestrians to enter these buildings through their entrances as deigned. Due to the lacking of sufficient areas for parking, open areas such as public squares, public fields, places of social gatherings are, over time and under the pressure of the problem, converted to parking areas.
Parking lots are generally considered the least glamorous and most environmentally harmful type of land use. As a parking solution, surface lots often destroy the sense of enclosure required for some spaces and plazas in the city and allow these enclosures to lose definition. For cost reasons parking lots also rarely implemented with a level of detail that is suitable for a public plaza. For this reason, it is prefer to separate surface lots behind the buildings, or screened by fences, walls, or hedges to mask the presence of these lots.

Curb parking makes several lanes of the road occupied by cars and thus increases the burden on the rest of road lanes, which sometimes become one single lane, leading to the accumulation of cars over the design capacity of roads and causing traffic jamming. Also, to provide more lanes for curb parking without disrupting the flow of traffic especially in narrow streets or in downtown, local authorities tend to create these lanes on the expense of width of pavements making them out of standard and lack some of their functions. The use of these pavements by pedestrians becomes difficult, inconvenient, and unpleasant.

Figure (1): In narrow streets, cars are parked on pavement. Making obstacles is a preventing solution.

Left picture [9], Right picture [Google Earth –street view, by Author]

In many cities drivers at busy times cannot find any place to park their cars in specific areas such as CBD and business centers, either in a parking lot or as a curb parking. In this case, frustrated drivers circle the nearby blocks searching for a place to park their cars. This phenomenon is called cruising. Cruising has an implicated impact on parking problem. The people ,who cruise the streets in a specific area to find places to park their cars, have already arrived but their cars during cruising make the streets overcrowded, consume more fuels, emitting extra pollution, and imposing extra delays on other people using the same streets for just moving. It is to be mentioned that on the other hand, excessive parking lots affect indirectly the natural environment. It is argued that the dark pavement of parking lots is to promote water quality degradation, irritate heat island effects, raise the air temperature, and consume land. Parking lots are generally considered the least glamorous and most environmentally harmful type of land use [10].

Figure (2): Space photo of Mall of Arabia in 6th of October City. A huge unshaded area of asphalt, contributing to urban heat, is allocated for off- street parking lots comparing to the area of the Mall itself. [From Google Earth by Author]

6- Solutions of Parking Problem

Car parking can be provided in three forms; on-street parking (curb parking), off-street parking (parking lot), and parking structures which may be in two types; either as a single or double floors constituting the building basement (if underground) or podium (if above ground), or as an individual structure (multi-story garage). Every form of parking provision has several types in car circulation and arrangement to maximize the number of cars that can be parked in it.

Every parking system in any of the three previous forms, has three key parts; quantity, quality, and management. Conventional parking planning tends to focus primarily on quantity. It assumes that more is always better, and there can never be too much. This type of planning relies primarily on minimum parking requirements and providing abundant parking supply. Parking planning also considers the quality of parking areas such as the convenience and safety of walking from a parking space to destinations, the attractiveness and security of parking facilities, and the environmental requirements of parking areas. Parking management

aims at achieving the best economic performance of parking spaces, especially in parking lots or in curb parking. It focuses on adopting special operating and pricing policies appropriate for each case. The combination of planning and management solutions ensures that parking demand is precisely sized according to development actual needs and its working circumstances, and not according to fixed general standards. It also preserves the financial cost, user's time and convenience, and the green infrastructure needed for the environmental balance [8].

6-1 Planning Solutions

The stage of preparing the parking plan is very important and influential as a part of the master plan of the city. The primary step in planning solutions is calculating the area required for parking for different districts in the city plan according to the government regulations which specify the minimum number of parking spaces that must be provided for every land use. The urban planners estimate the number of spaces needed for a particular project by a formula: so many spaces related to parking/unit related to the facility which may be the user or area unit. The objective of these standards is to ensure that cities have more parking spaces than they would if the matter was left to the free market in order to avoid the implications of the shortage of parking spaces and its impacts on the traffic. But, the unintended consequences of minimum parking regulations are [14]:

- Minimum parking regulations require excess spaces even when parking is free, even at isolated locations with no transit.
- Parking provided for free at most places and its costs are hidden in the prices of goods and services.
- Parking appears free, resulting in more parking demand, more driving, more congestion, and more pollution.
- Citizens must pay for more parking and bigger roads to overcome the resulting congestion.

To prepare the parking plan of a city and in addition to the step of determining the minimum number of spaces required for every land use, the following items within the city should be determined [14]:

- Areas of parking priority and of traffic and parking pressure.
- Traffic density in the main roads, which have traffic jamming due to either overcrowding or secondary street bottlenecks.
- The entrances of the main service areas that suffer from car parking in front of them, which hinders the performance of the service.
- Secondary and narrow streets that are obstructed by traffic due to car parking especially during peak periods and due to cruising.
- Residential areas that are subject to the parking of commercial services vehicles causing noise and overcrowding and causing inconvenience to citizens.
- Areas of special nature that need to be designed for gardens and pedestrian walkways and paths such as archaeological, touristic, and commercial areas.

It is to be noted that city planners should consider all three forms of parking provision in the master plan and choose the best form suitable for the facility or area and for the visual image of the city. City planners tend to concentrate on the provision of parking lots despite that they are generally considered the least glamorous and most environmentally harmful type of land use. City planners also neglect the third form of parking provision, which is individual parking structures, from the master plan. They depend mainly on on-street and off-street

parking with no lands allocated for individual parking structures. This is an attitude that implies postponing the solution of the problem to the future, where there will be a need for this form of parking which requires financial burdens for land acquisition, and a change in the land use of a plot on the expense of the planned land use.

The parking plan of the city center is one of the important plans to be prepared and managed, and also should be reviewed on short-term basis due to many variables associated with the city center. These variables are [14]:

- Future population census.
- Number of car owners.
- The ratio of daily working trips in total trips, especially during peak hours.
- The capacity of the road network that feeds the city center.
- The quality and adequacy of public transit system.
- The efficiency of parking lots.
- The change of the population attraction to the area after development and renewal.

6-2 Management Solutions

Parking management includes various policies and programs that result in more efficient use of parking resources and provides significant economic, social and environmental benefits. Although individual parking management strategies often have modest impacts, their effects are cumulative. A cost-effective, integrated parking management program can often reduce parking requirements by 20-40%, while improving user convenience and helping to achieve other planning objectives [10].

From economical point of view, the financial cost of providing parking is driven by three key factors: the number of required parking spaces, the 'opportunity cost' of the land used for parking instead of being used to house higher value activities, and the cost per parking space. Therefore, the cost of parking is argued to vary considerably depending on the type and location of the development and the type of its parking facilities [8].

The best way to reduce driving is by charging people directly to drive and to vary the price with demand. In this context; parking spaces should be considered real estate either in parking lots or as curb parking. And like all real estate, their location determines their value. A space that provides access to many people, jobs and amenities, such as a parking space in central city, is more valuable than one providing access to fewer people, jobs and amenities, such as a street space in a small town or a city space in the middle of the night. Thus, if parking were priced like most commodities, its price would vary by both time and location. It would cost more in big cities than small towns, more in business districts than neighborhoods, and more at midday than midnight [5].

The provision of more off-street parking spaces will not necessarily eliminate cruising for parking if the price of on-street parking is kept so low that it is always almost fully occupied. If the price of on-street parking is cheaper than off-street, there is always an incentive to cruise for street parking as long as the value of expected cruising time is less than the differential between the on-street and off-street parking prices. It is generally on-street parking that is underpriced, either because no price is charged, or because the meter price is set too low. Owners of off-street parking facilities will presumably not set prices so low that customers are frequently turned away.

Shared parking is a means of managing parking lots that involves the use of one parking facility by more than one land-use activity. The issue is to take the advantage of both different parking demand patterns and different peak times for each use. Shared parking implies that parking spaces are not assigned to a particular use; instead it is operated as a pooled parking resource. An office building and a recreational center can share a parking facility with a capacity less than the total parking spaces when they have two separate parking lots due to the varying peaks of occupancy rate. This strategy can be adopted at various scales; from the scale of a single building to the 'macro' scale of several developments. Shared parking policy has its impact on the land-use strategy set by planners in the master plan of the city.

Table 1 - key-determinants of parking requirements in planning and management contexts [8]

Key Determinants	**Determinants**	**Details**
Demographic	Characteristics of users	People of different ages, social classes, and economic levels tend to have different car ownership rates.
	Car ownership	The higher car ownership rate, the more parking spaces demanded.
Types & characteristics of development	Types & nature of land-use, e.g. length of stay and number of visitors	For Example, a sit-down restaurant would require more parking spaces comparatively with a take-away restaurant with the same number of customers per hour.
	Size of establishment	Larger establishments usually have greater parking demand.
	Mixed land-use	Parking requirements may be reduced when more than one use share the same parking facility, if uses have different peak demand times.
	Density of the district	Each time residential density doubles, auto ownership falls by 32-40%.
	Accessibility of the district (auto or non-auto accessibility)	Increased non-auto accessibility; e.g. walking or biking, will typically result in some reduction in parking demand.
Surroundings	Availability of surrounding parking	Users of cars can use parking lots available on surrounding sites within up to 45 m from the development.
	Availability of transportation choices	Providing adequate transportation options for people decreases parking demand.
Financial issues	Cost of land	The opportunity cost of the land, used for parking instead of being used to house higher value activities, is to affect parking standards.
	Parking pricing	Demand for parking typically decreases with increasing parking price.
Time	Time factor	Depending on the land use, parking

		demand at a site varies by time of day, week, and year. This results in daily, weekly, and seasonal parking profiles, and therefore seasonal parking requirements.

6-3 Innovative Design Solutions

The innovated design solutions for the problem of car parking are mainly associated with the automation of multi-story parking structures. Mechanical car parking systems allow cars to be parked automatically by computer-driven hydraulics in spaces only a few centimeters wider than cars. These systems offer much higher capacity in relation to the needed land but with a capital cost which is restricting take up mostly to city centers and where land values are high. In areas with high housing densities, mechanical parking can be an important tool in delivering more usable public and private spaces. Design options are proliferating from systems that stack two cars vertically on a single plot to those that shift cars horizontally between dozens of spaces without carriageway widths between cars.

Most individual parking structures; either non-automated or automated, have been designed considering only function and cost aspects while neglecting any contextual and aesthetical aspects. Architecturally and urban design wise they can be so innovative, high-tech, beautiful, and can act as a land mark in the urban context of the city.

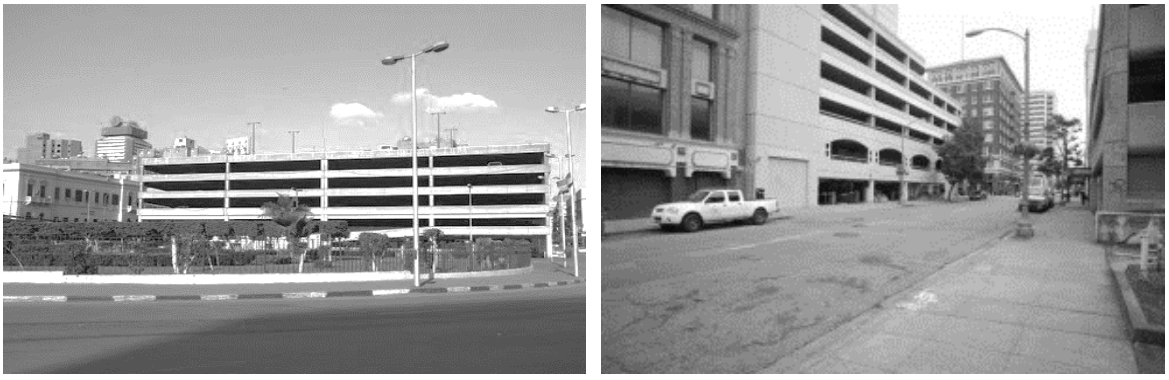

Figure (3): Old form of parking structures; dull and ugly buildings constitute a source of visual pollution in cities. Left, Opera Garage in downtown Cairo [photo by Author]. Right, [9]

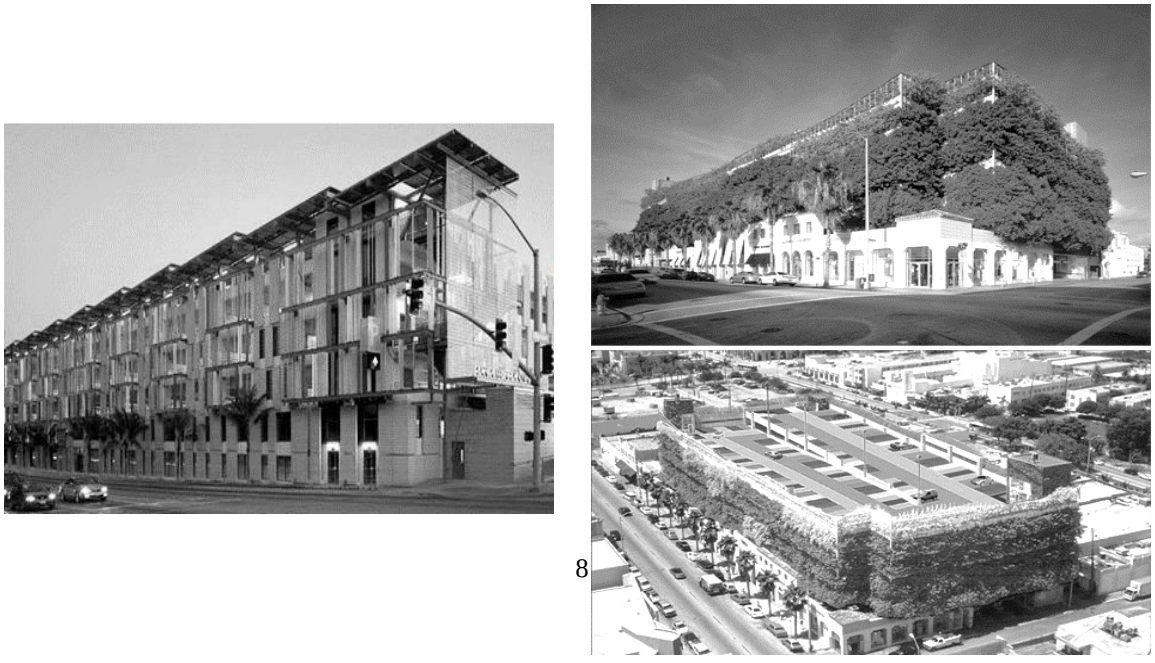

Figure (4): New form of parking structures; pleasant, colorful, and environment- friendly buildings. Above left: Santa Monica Civic Center parking garage, USA. Above Right: Ballet Valet parking garage in Miami, USA. [12]

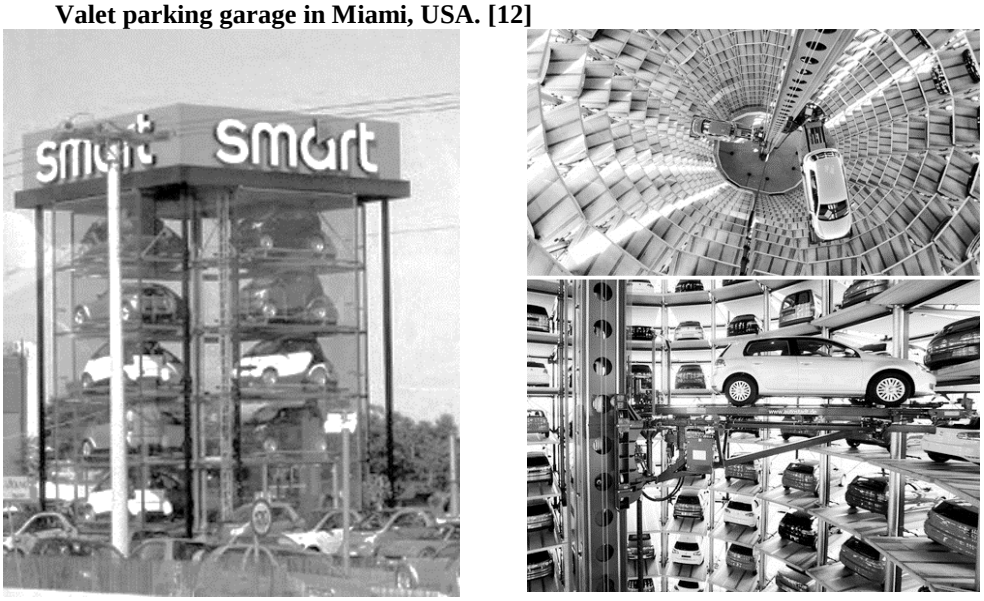

Figure (5): Automated parking structures in different designs; allowing bigger capacity in small areas [12]

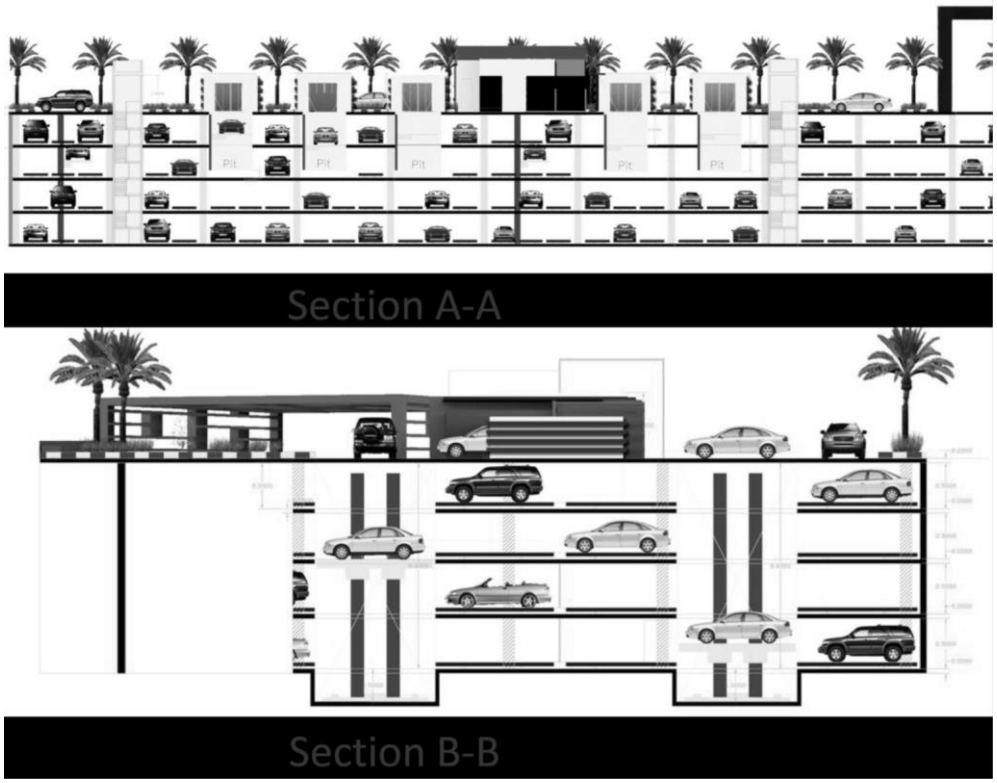

Figure (6): Roxy mechanical garage at Roxy Square –Heliopolis, Cairo. The first mechanical garage in Egypt is under construction [13]

6-4 General Principles for Parking Solutions [6]

1- Understanding the proper role of parking in downtown:
Developing solutions that focus on creating a downtown setting that is compact, walkable, and interesting. This can be achieved by:
- In-fill development with safe, clean sidewalks and curbing.
- Parking accessibility has the potential to set the tone for the rest of the downtown experience for visitors.

2- Strategically locating parking facilities:
- Back to parking behind the main street buildings.
- Clearly mark parking so people can find it through good directional signage and/or way finding system.
- Avoid locating parking facilities in heavy pedestrian corridors.

3- Value the utility of on-street parking:
- Maintain on-street parking as much as possible.
- On-street parallel & angled parking provide perceived advantages of visibility, accessibility and safety.
- Regulate on-street parking to prevent parking nesters (e.g. 2-hours to 90 minutes)

4- Emphasizing Quality Design:
- Parking areas should be generously landscaped and well maintained.
- Landscaping should be designed to include a visual buffer between the parking area and adjacent sidewalk.
- Use visual amenities to help make the transition from driver to pedestrian a positive experience.

5- Making better use of existing spaces:
- Develop a parking educational campaign to inform the public of the whereabouts of typically unused parking spaces.
- Encourage shared parking facilities for users that experience peak parking demands at different times.
- Ways to get the message out include directional signs, publicizing parking locations on websites, brochures, newspapers ads, and through individual downtown businesses to distribute information to employees and customers.

6- Controlling the total volume of downtown parking spaces.
- Establish parking maximums rather than parking Minimums (too much parking discourage people from walking downtown).
- Self-contained parking should be avoided for a traditional downtown because it discourages visitors from passing by other downtown businesses.

7- Planning for parking comprehensively:
Any parking solution should be evaluated for its impact on:
- Traffic patterns and flow.
- Pedestrian experience.
- Density levels.
- Parking coverage rates.
- Activity pattern.
- Aesthetics and historical patterns.
- Sense of place.

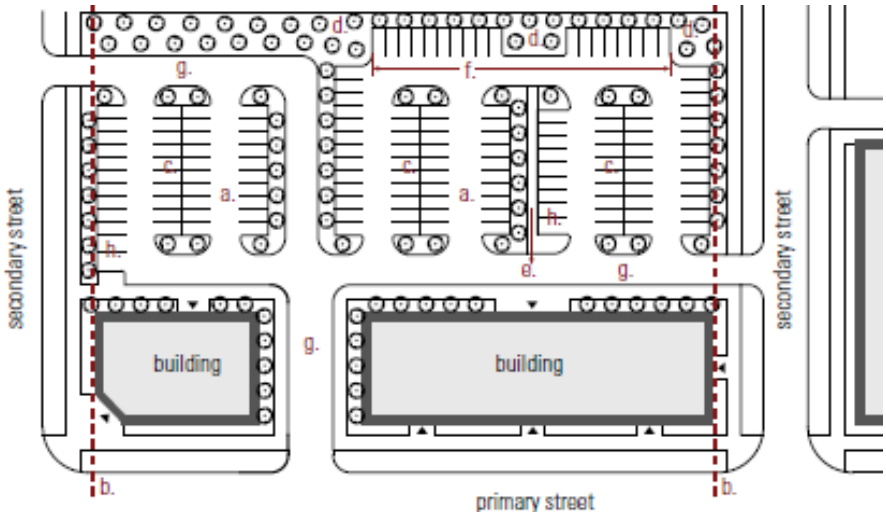

Figure (6): **As off-street parking distorts urban design and is the least glamorous and most environmentally harmful type of land use, it should be behind the buildings on primary street and behind screen of trees or shrubs on secondary streets [7]**

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Figure (7): A ple pathw & lig

- Car parking solutions can be categorized into three main levels; planning, management, and innovative design.
- The allocation and organization of parking areas are essential in the success of meeting the needs of different city districts according to the nature of each district and the facilities which need parking lots.
- Parking facility efficiency can be increased through good management which includes sharing, pricing, parking regulations, and improving enforcement.
- Parking structures can be – with good and attractive architectural designs – unique and attractive buildings which can be used as landmarks in the urban landscape of the city.
- Modern technological solutions such as automated parking structures can help in solving the problem of car parking especially in crowded areas and in high-price lands.

- For better quality of life in cities, parking lots and parking structures should be environment-friendly with well-designed and maintained landscape. They should also enhance safety requirements, visual amenities, and aesthetics values.

8 Recommendations

- City planners and urban designers should consider the need for car parking in their plans to avoid – or at least –alleviate the problem and its implications in traffic congestion and environmental pollution.
- The three forms of parking provision; on-street parking (curb parking), off-street parking (parking lots), and parking structures should be considered in city planning. Panners should choose the best appropriate form for every development or land use.
- Planners and urban designers should enhance the design of the parking facility, improve user convenience and safety, and make the facility environment-friendly.
- Planners should consider "parking structure" as a type of land use in their plans and not just an areas allocated for parking lots.
- The provision and development of efficient mass transit systems will positively affect the strain of parking problem.

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